Green Packaging Design : Jingdezhen ceramic Jiangxi Province, China

Li Ye

A Thesis Submitted in Partial Fulfillment of Requirements for
degree of Doctor of Philosophy in Fine and Applied Arts Research and Creation
June 2024

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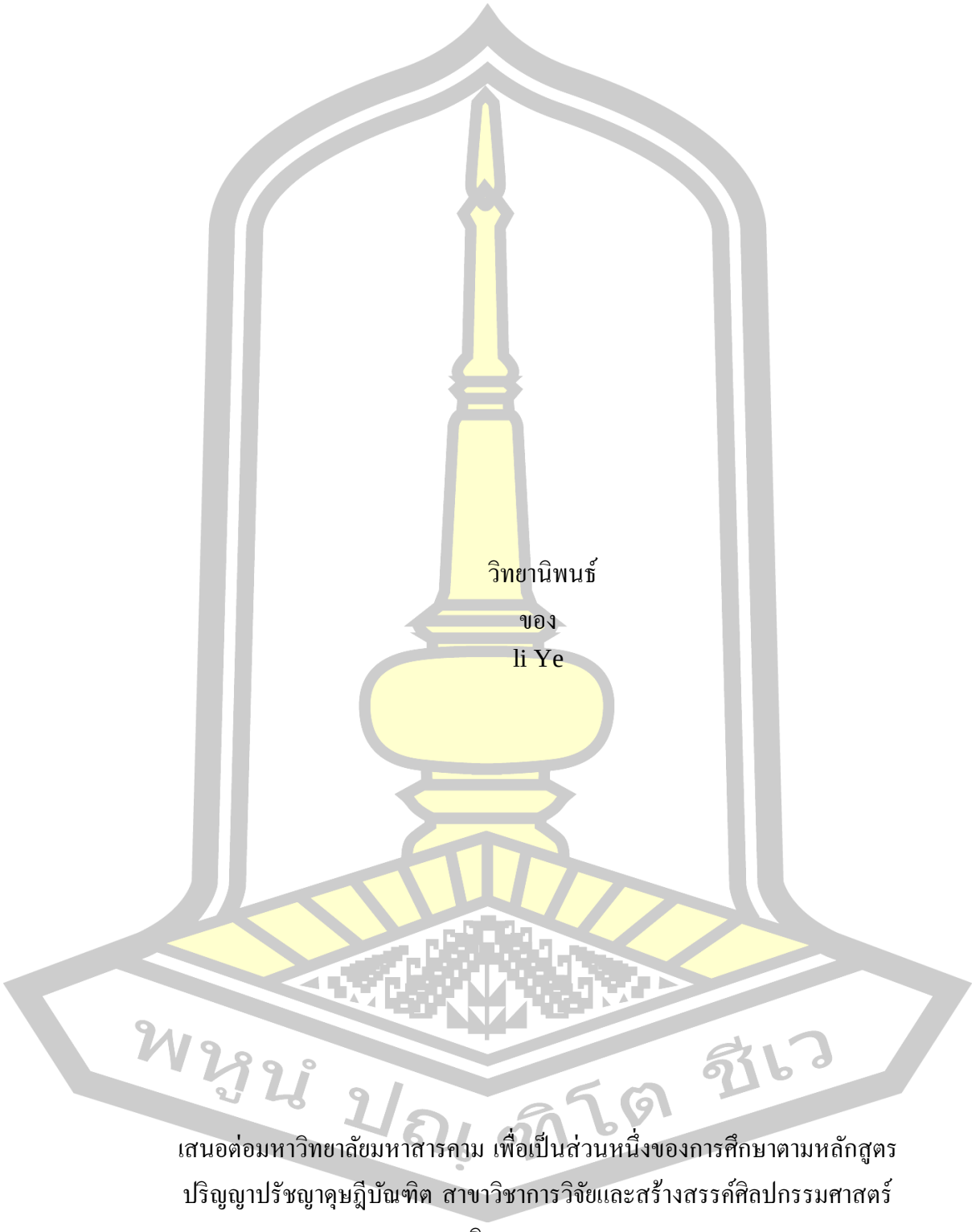

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The examining committee has unanimously approved this Thesis, submitted by Mr. Li Ye , as a partial fulfillment of the requirements for the Doctor of Philosophy Fine and Applied Arts Research and Creation at Mahasarakham University

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ABSTRACT

This paper describes the development of the ceramic industry in Jingdezhen, Jiangxi Province, China, in terms of green packaging design. With the increasing global emphasis on environmental protection, green packaging, as an important strategy for sustainable development, has received more and more attention from enterprises and consumers. This study aims to explore the innovation and application of packaging design in the Jingdezhen ceramic industry in order to reduce the adverse impact on the environment.

In this study, we collected case studies of Jingdezhen ceramic enterprises in green packaging design and analysed the materials, manufacturing processes and packaging forms used. We also interviewed designers and consumers within the companies to understand their perceptions and attitudes towards green packaging.

This study explores the sustainable integration of green packaging and local culture in Jingdezhen ceramic packaging design. In today's context of pursuing sustainable development, green packaging has become a key factor in the transformation of the ceramic industry. Through literature review, design analysis and case studies, this study delves into how green packaging principles can be integrated into Jingdezhen ceramic packaging design and at the same time pass on local culture. It is found that a win-win situation for both environmental protection and culture can be achieved through the selection of biodegradable materials, the re-creation of traditional motifs, and the co-operation with local communities. The results show that Jingdezhen ceramic packaging design from a sustainable perspective can enhance the competitiveness of products, while having a positive impact on cultural heritage and environmental awareness. This study provides a useful reference for the sustainable development of the Jingdezhen ceramics industry, as well as inspiration for the packaging design of other traditional crafts.

However, the application of green packaging in the Jingdezhen ceramics industry still faces some challenges, such as high costs, technical constraints and consumers' habits towards traditional packaging. Therefore, this paper also puts forward some suggestions, including strengthening government support and

encouragement, improving designers' professional skills and awareness, and enhancing communication with consumers, in order to promote the further development of green packaging in the Jingdezhen ceramic industry.

In summary, green packaging is an important path for the sustainable development of Jingdezhen ceramics industry, through continuous innovation and application, can achieve the protection of the environment and the effective use of resources, while enhancing corporate image and market competitiveness. We hope that the research results of this paper can provide certain reference and reference for the green packaging design of Jingdezhen ceramic industry.

Keyword : green packaging, local culture, Jingdezhen ceramics, sustainable development, packaging design

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1.Introduction

In an era where environmental awareness is escalating and the pursuit of sustainability is expanding, industries are compelled to adjust and incorporate eco-friendly practices into their operations. The ceramics industry, emblematic of artisanal skill and historical importance, finds itself at the junction of this transformative shift. As consumer preferences evolve towards products that align with ecological principles and cultural identity, the design of ceramic packaging emerges as a critical juncture where these dual priorities meet.

In an era marked by increasing environmental consciousness and a growing pursuit of sustainability, industries are compelled to evolve and embed eco-friendly practices into their operations. The ceramics industry, renowned for its craftsmanship and historical significance, stands at a pivotal juncture of this transition. As consumer expectations veer towards products that embody ecological values and cultural identity, the design of ceramic packaging emerges as a critical area where these dual considerations intersect.

This research sets out on an explorative journey to examine the intricate relationship between sustainable packaging and local culture within the realm of Jingdezhen’s ceramic packaging design. Adopting a sustainability-focused lens, it seeks to uncover innovative methods that harmonize environmental stewardship with cultural significance. Utilizing a blend of literature review, design analysis, and case studies, the study aims to unveil approaches that effortlessly merge eco-friendly packaging initiatives with the cultural quintessence of Jingdezhen.

This introduction lays the groundwork for a comprehensive exploration of the confluence between eco-friendly packaging, local culture, and sustainability within Jingdezhen's ceramic packaging design domain. Delving into the complex interplay among these facets, the study endeavors to enrich the discourse on sustainable design methodologies and cultural conservation. It seeks to cultivate a nuanced comprehension of crafting packaging solutions that are environmentally responsible while deeply reflective of local identity and values.

The aim of this study is to explore the integration of eco-friendly packaging principles with local cultural elements in Jingdezhen's ceramic packaging design from

a sustainability perspective. This research seeks to fulfill the dual objectives of safeguarding the environment and preserving cultural heritage. By leveraging the principles of green packaging, it investigates the adoption of environmentally sustainable materials, design strategies, and technologies in Jingdezhen's ceramic packaging to minimize ecological footprint and encourage sustainable progress. Additionally, the study delves into the significance of local culture in Jingdezhen ceramics, aiming to understand how to effectively embody and promote these cultural attributes within packaging design, thereby augmenting the regional identity and distinctiveness of the products.

This research focuses on blending eco-friendly packaging with local cultural motifs to create environmentally conscious packaging that preserves traditional cultural meanings, offering innovative pathways for Jingdezhen's ceramic industry's sustainable advancement. It explores methods to bolster the market competitiveness of Jingdezhen's ceramic offerings by harmonizing green packaging initiatives with local cultural elements, thereby appealing to consumers who value environmental sustainability and cultural richness.

In conclusion, this study seeks to thoroughly investigate the fusion of eco-friendly packaging with local culture, aiming to realize sustainability in Jingdezhen’s ceramic packaging design. The goal is to accomplish synergistic outcomes that benefit both environmental conservation and the preservation of cultural heritage.

2.Background

2.1 Importance of research.

By studying the history of Jingdezhen ceramics and the development of ceramic packaging, it is possible to gain an in-depth understanding of local ceramic culture and incorporate it into ceramic packaging design. Drawing inspiration from history, the packaging design is associated with the historical events, characters or periods of local ceramics. You can show the pattern, style or story of historical porcelain on the package such as Figure 1 theme of "Ghost Valley Downhill", depicting the story of Sun Bin's teacher, Ghost Valley. Under the repeated pleas of Su Dai, an envoy of Qi, Gi Guzi agreed to go down the mountain to rescue Sun Bin and Dugu Chen, famous generals of Qi, who were trapped in Yan's formation. Incorporate locally specific traditional ceramic production techniques into the packaging design as in Figure2,

such as specific firing techniques, decoration methods, and so on. This can create a unique sense of craftsmanship on the package. Selecting elements that match the local ceramic ornaments and patterns can give the package design a regional character. These motifs can appear in the edges, background or decoration of the package. Drawing inspiration from the color palette inherent to indigenous ceramics, selecting complementary colors for packaging design can align the package's aesthetic more closely with the ceramics' stylistic color scheme. Incorporate the legends, historical events or cultural stories of local ceramics into the packaging and narrate them through words and images to increase the emotional resonance of the packaging. Apply signs, symbols and patterns related to the local ceramic culture to the packaging design in order to convey deep cultural connotations. When incorporating local ceramic culture, it is important to respect tradition and consider both modern aesthetics and market demand. By cleverly integrating local ceramic culture into packaging design, it can add unique charm and emotional value to the product, while promoting the inheritance and development of local culture.

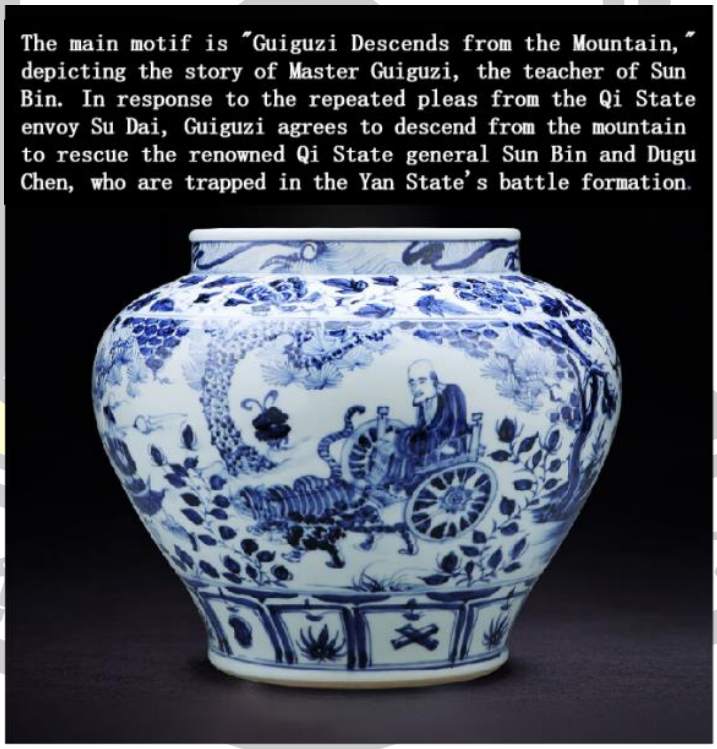


Figure 1Gui Guzi Descends from the Mountain
Source: Photography by Ye Li, 2023

Figure 2 ceramic pattern
Source: Drawn by Ye Li, 2023

The packaging of Jingdezhen ceramics has seen continuous evolution and innovation over the course of history. Transitioning from the earliest rudimentary methods, such as wrapping with grass, to the adoption of paper, bamboo, wood, and various other materials, and progressing to contemporary printing and packaging techniques, the evolution of ceramic packaging has manifested in diverse forms and technologies. Historically, the methods used for ceramic packaging were often intricately linked to the need for transport protection. For instance, during the maritime era, specific packaging techniques were employed to mitigate damage and loss during sea transport, including the use of grass lashing and paper wrapping to secure the porcelain. The selection of packaging methods and materials was deeply intertwined with the cultural, technological, and societal context of each period. It was observed that ceramic packaging also mirrored the characteristics and evolution of local cultures, showcasing the use of traditional bamboo baskets and silk fabrics, for example. Over time, environmental consciousness has grown increasingly significant

in packaging design. Traditional packaging methods were often not sufficiently eco-friendly, prompting modern research and practice to underscore the importance of green packaging as a means to lessen environmental impact.

2.2 History of Jingdezhen ceramics

Jingdezhen porcelain production history is very long, there is information cited in the Qing Dynasty "Fu Liang County Records" records cloud "Xinping smelting pottery, began in the Han Dynasty", that Jingdezhen from the Han Dynasty before the beginning of ceramic production. Jingdezhen ceramics production is more mature period from the Tang Dynasty, when the porcelain products have been very fine, known as "fake jade". According to the qing dynasty "floe liang county" records: "wude four years (621 years), there are people pottery jade, carry porcelain into Guanzhong, known as fake jade, offered to the court, so the edict of zhongchu, etc. and jade into the imperial". (Cao Guoqing,Xiao Fang.1988) can be seen, in the Tang Dynasty period, Jingdezhen ceramic craft has high technical attainments, but really in the quality and scale towards prosperity from the Song Dynasty. From the beginning of the Song Dynasty, Jingdezhen became an important production base for porcelain, Song Zhenzong will also give their own year "Jingde" to this porcelain production area, and regulations in the bottom of the porcelain products must be written on the bottom of the four words "Jingde Nianzhi" as the bottom of the paragraph, and from then on Jingdezhen will be associated with the Chinese porcelain. Porcelain linked together. Song Dynasty is the glorious period of Jingdezhen ceramic production, the national porcelain production is very prosperous, the production of celadon and white porcelain with high artistic taste and historical value, but also Jingdezhen as China's important and well-known porcelain origin of the history of the starting point; at the same time, in the celadon and white porcelain production techniques based on the shadow of celadon porcelain is the biggest highlights of the Song Dynasty porcelain, which is the innovation of the celadon and white porcelain varieties, the success of the firing age in the middle of the Northern Song Dynasty, the Southern Song Dynasty had a large-scale production, the production of the porcelain, and the production of the porcelain. It was successfully fired in the middle of the Northern Song Dynasty, and was produced on a large scale in the Southern Song Dynasty, which had a profound influence on later generations. (Gao Fei. 2020)The color of porcelain

produced in the Yuan Dynasty in Jingdezhen were mainly blue and red glaze, but the "Yuan blue and white" is the most famous. Yuan dynasty blue and white porcelain ware is mainly in the form of large pieces, including large porcelain plate, large porcelain jar, large gourd vase, large vase, high-footed bowls, etc., these blue and white ceramic objects have a great impact on the later generations, its survival or unearthed blue and white porcelain is extremely valuable, individual varieties can be used to describe the degree of value of the "value of the city" to describe the degree of its preciousness during the Ming and Qing dynasties, Jingdezhen ceramic production was more perfect, became the imperial court palace of the court, and became the most popular ceramics. The Ming and Qing dynasties, Jingdezhen ceramics production is more perfect, become an important production base for the imperial court porcelain. Ming dynasty is since ancient times Jingdezhen porcelain production presents the beginning of the event stage, Porcelain technology and the diversity of porcelain types advanced significantly beyond those of earlier dynasties, with a wide array of specialties produced for the court. The establishment of the Jingdezhen Imperial Kiln Factory during the Ming Dynasty marked a pivotal moment, specializing in the creation of porcelain for imperial use. Ming dynasty Yongle, Xuande blue and white porcelain, Chenghua doucai porcelain, Jiajing, Wanli five colored porcelain is porcelain in the top quality. Zheng He in the Ming dynasty had a large number of Jingdezhen porcelain sold overseas, which at that time and after the influence of Jingdezhen porcelain is very big. Jingdezhen porcelain in the Qing Dynasty can be said to be the peak of the development of ancient Chinese ceramics. (Zhu, Lekeng. 2012) During the Qing Dynasty, the imperial court had a special pottery inspector dedicated to porcelain production in Jingdezhen, and the establishment of the pottery inspector system in Jingdezhen made Jingdezhen porcelain almost reach the peak of the realm of excellence. To the Republic of China period, due to the prolonged war, social instability, Jingdezhen ceramic production is seriously hampered, but ceramic technology and production management is still in the difficult to move forward. Although social instability, but in the ceramics sector still emerged some excellent ceramic talent, such as in Jingdezhen is very famous Zhushan eight friends. But in general, the whole ceramics industry is ultimately subject to the factors of war and atrophy. (Li Na. 2013) After the founding of the country to complete the state-run

Jingdezhen Jianguo Porcelain Company's preparations and start ceramic products production, and the original ceramic enterprises to carry out socialist transformation, to achieve the co-operation and public-private partnership. Through understanding the history of Jingdezhen ceramics, summed up the representative works of ceramics in

Era	Description
Han Dynasty and earlier	Origins of ceramic production in Jingdezhen, with early methods like wrapping with grass.
Tang Dynasty	Ceramic production becomes more mature; porcelain is so refined it's likened to 'false jade'.
Song Dynasty	Golden age of Jingdezhen ceramics; introduction of 'Made in the Jingde Year' inscription; famed for celadon and white porcelain.
Yuan Dynasty	'Yuan blue and white' porcelain becomes iconic; characterized by large pieces and influential designs.
Ming Dynasty	Establishment of the Jingdezhen Imperial Kiln Factory; innovations in blue and white, doucai, and wucai porcelains.
Qing Dynasty	Peak of ancient Chinese ceramic art; imperial inspectors oversee production, ensuring unparalleled quality.
Republic of China	Ceramic production declines due to prolonged warfare and social instability, yet notable talents emerge.
People's Republic of China	State-operated Jianguo Porcelain Company established; focus on socialist transformation and production of ceramic products.

various periods as in Figure 3, laying the foundation for the subsequent integration of local culture into ceramic packaging design.

Figure 3 Jingdezhen Ceramics History Table

Source: Drawn by Ye Li, 2023

2.3 Jingdezhen ceramic packaging development history

Jingdezhen ceramic packaging for the real beginning of the time, many records are slightly illustrated. According to the Yuan Jiang Qi "Tao Jiliao" recorded above inside the "pieces" refers to the height, size and capacity of ceramic products, representing the modern Jingdezhen porcelain packaging overall number of words. "With" is on behalf of the formal formation of ceramic packaging tools, so can be found in the literature from the beginning of the Yuan Dynasty, Jingdezhen ceramic packaging has begun to form independently. (Tang, Wenli. 2012)The book "Island Yi Zhi Liao"

roughly records that the ceramic jars contained water, rice, pickles and cereals. Due to the transport at that time the road is very far, the cabin itself is very limited storage space, in order to make the maximum use of commodity storage packaging and design, the transport of ceramic porcelain jars as packaging and being packaged dual-use. Later in 1720 the Essex shipment of Chinese porcelain, ceramic packaging is generally about six hundred pieces per package, weighing about 500 pounds. The profit of ceramic goods is low, but with other foreign trade goods together with the ship is easy to keep the balance of the ship, including the bottom of the ship with ceramics, ceramics and then loaded with tea on top, the top with silk. (Wang, Dayuan. 1981)This is a relatively early and relatively detailed record of the transport process of ceramic packaging, although these ceramic packaging is very simple but these ceramic packaging methods have been used for a long time. Wanli years of the Ming Dynasty, in the history of the detailed records of the "purchase of ceramics, the first ceramic objects into the sand and a little soybean wheat, overlapping dozens of firmly tied into one, placed in the wetlands and then sprinkled with water towards the top, so that the bean sprouts sprouting, entangled in the glue, and then thrown to the ground without breaking before they are to be on the car." This is the earliest detailed record of the ceramic transport method, the use of this method effectively reduces the sea ship transport process brought about by the bumps to the ceramic damage caused by the loss, of course, using this method of packaging costs are usually dozens of times more than ordinary packaging, so this ceramic packaging is quite firm to the present archaeological team members from the sea inside the ceramics recovered from the shore are very intact and no defects. Jingdezhen in the Qing Dynasty Qianlong time in the types of ceramics are roughly divided into coarse ware, fine porcelain. These two types of porcelain can be roughly understood as ceramic varieties of superior porcelain and inferior porcelain. According to the document "Tao said", it is mentioned that the output of paper-making in Jiangxi Province during the Qing Dynasty ranked the first in China, and the raw materials can be roughly divided into haggard paper, cotton paper and bamboo paper, and then there are two types of coarse paper and fine paper in terms of quality. (Zhu Diem. 1984) Most of the coarse paper was used for packaging or making paper for firecrackers, paper media and meditation paper. Also, the coarse paper of this period could be used to wrap the better ceramics,

and then the paper-wrapped ceramics were put into wooden barrels. At that time the more medium ceramics are wrapped with grass finished into a wooden barrel, and then the more inferior ceramics are used at that time the cheaper common diamond grass wrapped ceramics and its external was changed to use bamboo scissors bundled. Ceramics according to its varieties of the division of ceramics let also let the ceramic packaging is also divided into levels of separate treatment.

Jingdezhen in the Qing Dynasty, but also special ceramics in the molding of objects after the separate "Tsuka ware" and "round ware" two large categories, such as bowls, plates, dishes and other flat ware collectively referred to as the round ware. Such as jars, bottles, pots, candlesticks and rainbows and other three-dimensional ware collectively known as the Tsuka ware. Literature "Jingdezhen ceramics history" inside a very detailed record, the early Qing Dynasty ceramics transport mainly choose water transport, ceramics are mainly loaded with wooden barrels because the barrels are strong pressure resistance, large capacity and very strong, is the transport of larger pieces of ceramics is very ideal container. Republic of China when Jingdezhen because of the impact of the political environment at the time, the ceramic industry packaging is still the continuation of the Qing Dynasty before the ceramic packaging process, and not much innovation and improvement. "Republic of China seventeen years, the town has a total of diamond grass line total of more than 140 households, the total number of workers for 2000 people. At that time Jingdezhen ceramic packaging materials are divided into three categories, straw packaging, wood cypress packaging and bamboo basket and bamboo package "Jingdezhen ceramics historical manuscript. (Sanlian bookstore) the use of straw to pack ceramics is the cheapest and most practical ceramic packaging methods in Jingdezhen for thousands of years. At that time the terminology of the ceramic packaging industry like to call the diamond grass packaging, the use of diamond grass packaging operation is the straw according to the size of different ratios, to be used in different categories of rows of ceramics regular packing and bundling. Then use bamboo scissors to tie up the ceramics, and then in order to make the packaged bundled ceramics are not easily dispersed, and then the final third step of the knot grass, the three processes packaged bundled tied up after the ceramics, no matter how to swing will not be easily damaged. Jingdezhen local language to describe is to play grass knot, rolling grass dragon, tie grass gimlet,

this is nearly a thousand years Jingdezhen ceramics is the most traditional and the most ancient packaging methods. Bamboo baskets and wood cypress was also the most traditional Jingdezhen used to sell ceramic tools, is the use of cut wood and bamboo as the most basic raw materials for the processing of handmade, its biggest advantage is not perishable candles, will not rust and strong resistance to pressure, artificial processing costs are very low. According to "Jingdezhen ceramics history" inside a very detailed record of the Jingdezhen ceramics with baskets to carry out the packaging trade records. At the beginning of liberation Jingdezhen ceramic packaging industry with the development of the ceramic industry together into a vigorous new period. In just a few years, Jingdezhen city opened hundreds of large and small factories, including ceramics production services for the emergence of the packaging plant, but also to improve the people's cultural needs of paper mills, printing houses. A large number of hand-made services for the rise and growth of the processing industry, Jingdezhen ceramics packaging industry has laid a solid foundation. Under the guidance of the municipal government, major ceramic companies and citywide ceramic enterprises have collaborated extensively to promote ceramic products through carton packaging, brocade box packaging, and color box packaging, marking the initial standardization of Jingdezhen's ceramic packaging standards and design. In China's traditional gift industry, boxed presentations have consistently been the preferred choice for gift packaging In recent years, Jingdezhen medium and high-end ceramics packaging in the choice of packaging is the most common brocade box, brocade box processing material is the use of cardboard to packaging moulding the outer packaging material decorative use of silk cotton cloth to carry out the second packaging, brocade box is the use of the interior of the Poly flannel, bubble wrap, pearl cotton and sponge and other materials. 21st century the beginning of the Jingdezhen medium and high-end ceramics packaging has been a substantial increase in the trend of the use of a variety of Artificial leather and other gemstones, jade and other jewellery. Very wasteful use of these external packaging to enhance the value of ceramics own goods, the phenomenon of such elaborate ceramic packaging does not comment on the good or bad, but these methods are businessmen in order to promote ceramic products in a way. Through the study of Jingdezhen ceramic packaging historical development, get the millennium ceramic packaging changes in a column

table shown in Figure 4. Through the table can clearly understand the history of Jingdezhen ceramic packaging development.

千年陶瓷包装变迁一览表
List of Millennium Ceramic Packaging Changes

包装方法 Method of packing / 年代 Era	豆麦发芽 Soy wheat Germination	木桶 Wooden barrel	木框（箱） Wooden frame	绳索 Rope	篓筐 Basket	稻草 Straw	木箱 Wooden box	瓦楞纸箱 Corrugated carton	锦盒 brocade box	彩印纸箱 Color printing	礼品包装 Gift package	托盘式集中化包装 Tray centralized
唐代 Tang Dynasty												
宋代 Song Dynasty												
元代 Yuan Dynasty												
明代 Ming Dynasty												
清代 Qing Dynasty												
民国 Republican period												
1949-1959 年												
1960-1969 年												
1570-1979 年												
1980-1989 年												
1990-1999 年												
2000-2014 年												
2014-2023 年												

Figure 4 List of Millennium Ceramic Packaging Changes
Source: Drawn by Ye Li, 2023

2.4 Green ceramic packaging design concept

Various resource and environmental problems triggered by rapid economic development have forced people to start reflecting on the relationship between human beings and nature, which has led to the concept of eco-design. Green design concept, also known as eco-design concept, designers should use non-toxic and harmless natural or recycled materials in the choice of materials to reduce the harm to human health after the industrial revolution. In terms of science and technology, low energy consumption construction techniques and mechanical equipment should be used. Green design refers to the consideration of environmental, social and economic sustainability in the design and manufacture of products in order to reduce negative impacts on the environment, achieve efficient use of resources and minimise damage to the ecosystem. Green design can be realised in the following ways, firstly environmentally friendly, designers have to think carefully about the consumption of natural resources and energy in each step of the design process. From the pre-design stage, designers should consider the types of materials to be used in the design process, and think about how to reasonably recycle and reuse them. Energy-saving and emission reduction technologies should be adopted in the design and manufacture

of products, such as the use of low-carbon materials, the reduction of energy consumption, and the use of renewable energy. The second point of energy-saving, the design should make full use of natural resources, use natural resources to replace most of the artificial equipment, reduce the waste and consumption of energy. At the same time, energy-saving and emission reduction machinery and equipment can be used to ensure that energy saving is maximised. The third point of aesthetics, more use of natural materials for design, close to the original appearance of the form, so as to achieve a naturalised sense of beauty. In addition to some natural materials can show this artistry, there are some synthetic materials and technological materials can also give people a natural feeling. The fourth point of innovation, modern design to break the original design thinking, for new materials, forms, green design refers to the product design and manufacturing process, consider the environmental, social and economic sustainability, in order to reduce the negative impact on the environment, to achieve the effective use of resources and minimise the damage to the ecosystem. Divergent and open-minded thinking patterns are required for equipment selection and so on. Designers should adhere to the design concept of keeping abreast of the times, and have a mindset of continuous curiosity and exploration for new things. Thus, the industry development of packaging design is more diverse and diversified. The fifth point of inclusiveness, the green design concept can be applied to different industry sectors and subject areas. In the design of green design concepts, in addition to the creative beauty contained in itself, also shows the design of the times and ecological, so that the presentation of the design is more rich and vivid, in line with the aesthetic needs of modern people. The sixth point of comfort, in order to be used reasonably, to provide people with the greatest sense of comfort and satisfaction. In addition to consider the general needs of people's lives and psychological needs, but also to take care of special populations, such as children, the elderly, the disabled and other vulnerable groups. Let the special people can also feel the green design concept for people's lives to bring health and comfort. Seventh point of science and technology, new science and technology is to support the green design concept of the power of long-term development, the use of energy-saving technology and equipment in the design can greatly reduce energy consumption. Through some computer technology, network technology, etc. can also design a remotecontrol system,

convenient for people to remote control equipment to reduce energy consumption. In terms of material innovation technology, new materials can be used to replace or optimise the existing materials to enrich the types of environmentally friendly decorative materials (Sun Yujia. 2022)

2.5 The necessity of packaging research of Jingdezhen ceramics

Currently, ceramic enterprises in Jingdezhen largely lack commercial brand awareness, failing to unify the ceramic products with corporate branding through their packaging. The Jingdezhen ceramic market predominantly features products identified by category rather than by brand, with most companies opting to use the names of ceramic types as their brand names. For instance, to align with consumer perceptions of blue and white porcelain, many products are named after this category or its place of origin, such as Jingdezhen, without displaying the company's name or information on the packaging. This not only obscures the corporate brand image in the eyes of consumers but also hinders the establishment of a distinct corporate brand identity.

The inherent uniqueness of ceramic products, resulting from the use of different materials, firing techniques, and manufacturers, contributes to a market filled with ceramics of varying quality. However, ordinary consumers may perceive all these products as representative of Jingdezhen ceramics, effectively erasing any brand distinction. This scenario has led to a situation where ceramic packaging is often generically designed, serving multiple products without specific branding, material, or quality level indicators. Such uniformity in packaging fails to differentiate the products, leaving basic identification and brand distinction by the wayside. (Lin, Xingqun. 2009)

These packaging approaches not only fail to fulfill their role in branding publicity but also significantly impede the development and promotion of the enterprises' own brands. Currently, the ceramic packaging gift boxes on the Jingdezhen market predominantly feature dull and old-fashioned colors, mainly in shades of blue and dark yellow. Additionally, some packaging designs overly rely on gold and silver, resulting in a flashy appearance that lacks creativity, with poor utilization of color combinations and graphic layouts. These designs fail to showcase the unique

characteristics of the ceramic products, leading to a prevalence of outdated and rigid packaging designs in Jingdezhen's ceramic market.

Moreover, the majority of ceramic product packaging disconnects entirely from the porcelain's inherent meaning and cultural spirit, opting for a one-dimensional, mundane approach. Rather than authentically representing ceramic culture, these designs often resort to fragmented cultural symbols, such as the overuse of traditional motifs handed down from ancestors, with dragon and phoenix patterns being particularly overrepresented. The perpetuation of traditional motifs should not be equated with mere replication. Jingdezhen's rich porcelain culture cannot be solely encapsulated by dragons and phoenixes, nor can it be honored through the mere application of opulent imperial palace patterns. The valuable traditional culture bequeathed by our forebears deserves to be reinterpreted with new meanings and forms, showcasing its vitality anew. It should inspire modern individuals to embrace discovery and innovation, imbuing traditional culture with a new allure. Traditional culture ought to evolve into a style, becoming a distinctive trend.

The lack of creativity in Jingdezhen’s ceramic packaging market is epitomized by widespread plagiarism and imitation, merely catering to current consumer tastes rather than focusing on the ceramics' inherent characteristics. Packaging should not only match the shape of the porcelain but also harmonize with its colors and graphics. The prevailing approach leaves consumers with a vague or even misleading impression of the products.

Through research and analysis of the current ceramic packaging design in Jingdezhen, it's evident that there's a notable lack of design consciousness, absence of brand awareness, and a disconnect between tradition and innovation, leading to ineffective communication of product and corporate culture to consumers. This study delves into the reasons behind the ceramic packaging market's stagnation and offers a fresh perspective on Jingdezhen's ceramic packaging sector, based on market research and relevant data collection. The investigation covers aspects such as packaging materials, sales packaging, and transport packaging, evaluating the pros and cons of various materials and transportation methods. It emphasizes the significance of eco-friendly packaging for the ceramics industry, aiming to identify optimal packaging design solutions.

The analysis offers insights into the critical role of color, graphics, and text in ceramic packaging, outlining design principles, methods, and strategies. It also examines how the integration of traditional culture with packaging design materials can imbue packaging with cultural depth, thereby resonating with the essence of ceramic culture. Furthermore, the study discusses the impact of packaging on the development of Jingdezhen's ceramics, the corporate culture, and brand value, highlighting the role of packaging in promoting ceramic culture. By incorporating contemporary cultural elements into traditional cultural heritage, the goal is to invigorate ceramic packaging with modern artistic aesthetics, thereby revitalizing Jingdezhen's ceramics market Designing ceramic packaging that reflects Jingdezhen's local cultural traits, promotes ceramic manufacturers, and incorporates innovative, eco-friendly ideas holds significant value and importance. This approach not only aims to enhance the market's dynamics but also to uphold and propagate the rich ceramic culture of Jingdezhen.

3. Purpose of Research/Objective Research Objective

3.1 Study the historical development of Jingdezhen ceramic culture and ceramic packaging, focusing on the relationship between ceramic culture and Jingdezhen ceramic packaging.

3.2 Study Jingdezhen ceramic packaging, analyze local cultural concepts, ceramic market behavior analysis, and green packaging to design Jingdezhen ceramic packaging.

3.3 Design ceramic packaging from the perspective of packaging design, and promote the development of Jingdezhen ceramics through packaging.

4.Research question

4.1 What is the historical development of Jingdezhen ceramic culture and ceramic packaging?

4.2 How to study Jingdezhen’s local cultural concepts and ceramic market behavior analysis? How to carry out green packaging and Jingdezhen ceramic packaging design?

4.3 How to design ceramic packaging from the perspective of promoting the development of Jingdezhen ceramics?

5. Terminology

Green packaging design refers to the principle of fully considering environmental protection and resource conservation throughout the packaging design and production process. This approach employs eco-friendly materials, technologies, and methods to minimize the negative impact on the environment. This design philosophy not only focuses on the practicality and aesthetics of packaging but also emphasizes the environmental performance of the packaging throughout its entire lifecycle. This includes the selection of materials, the production process, usage, and the final recycling or disposal methods. The goal of green packaging design is to achieve sustainable development of packaging.

Eco-friendly packaging refers to packaging solutions conceived from eco-design principles that encompass both economic and environmental considerations. The core concept involves integrating these considerations into every stage of the product design process, including the planning, design, manufacturing, usage, and disposal phases.

Ceramic means an is the general name of pottery and porcelain, and is also a kind of arts and crafts in China. As far back as the Neolithic Age, China had painted pottery and black pottery in a rough and simple style. Pottery and porcelain are different in texture and nature. Pottery, is made of high viscosity, strong plasticity of clay as the main raw material, opaque, there are small pores and weak water absorption, the sound of turbid. Porcelain is made of clay, feldspar and quartz. It is translucent, non-absorbent and resistant to corrosion. The fetal material is hard and compact, and the knocking sound is brittle. Chinese traditional ceramic arts and crafts are famous in the world for their high quality, beautiful shape and high artistic value.

National culture refers to the unique and significant cultural heritage that the Chinese nation has developed over its long history, which holds special importance for the nation's continuity and the country's survival. Historically, various concepts and spiritual elements within the national culture have played a crucial role in reinforcing and perpetuating the feudal state order, a practice that has faced significant criticism in modern times. However, the philosophical insights, moral values, and artistic perspectives at the core of this culture are irreplaceable in nurturing the exceptional spiritual qualities of the nation.

Jingdezhen means an world famous porcelain capital with a long history of porcelain making. It is a prefecture-level city in the northeast of Jiangxi Province. From the Yuan Dynasty to the Ming and Qing dynasties, the emperors sent officials to Jingdezhen to supervise the production of court porcelain, set up porcelain bureaus and royal kilns, and the ceramic industry was very prosperous.

Brand image means an refers to the personality characteristics of an enterprise or one of its brands in the market and in the hearts of the public. It reflects the evaluation and cognition of the public, especially consumers, on the brand. The brand image is inseparable from the brand. The image is the characteristic of the brand and reflects the strength and essence of the brand. Brand image includes product name, packaging, graphic advertising design and so on. Image is the foundation of brand so the enterprise must attach great importance to shaping brand image. Brand image is a collection of all the associations consumers have for the brand, which reflects the image of the brand in consumers' memory. The formation of brand association is the result of both marketing activities and non-marketing activities. Consumers' associations with brands can be obtained through both enterprise-controlled channels and non-enterprise-controlled channels.

Green design means an that in the whole life cycle of a product, the impact on resources and the environment should be fully considered. In addition to giving full consideration to the function, quality, development cycle and cost of the product, various related factors should be optimized to minimize the overall negative impact of the product and its manufacturing process on the environment and make the indicators of the product meet the requirements of green environmental protection. The basic idea is to incorporate environmental factors and measures to prevent pollution into product design at the design stage, take environmental performance as the design goal and starting point, and strive to minimize the impact of products on the environment.

Sustainable development represents one of the fundamental tenets of the Scientific Development concept Theories and strategies concerning the coordinated development of nature, science and technology, economy and society. It first appeared in the International Union for Conservation of Nature's World Natural Resources Conservation Program in 1980: "It is necessary to study the fundamental relationships

among nature, society, ecology, economy and the process of utilizing natural resources in order to ensure global sustainable development."

Artistic value means an Artistic value mainly refers to the cultural value, aesthetic value and artistic means embodied by works of art. The more typical the nationality, regionalism and personality reflected by the artwork, the higher the artistic value.

6. Scope of Research

6.1 Areas of research

The focus of this study is to apply theories and methodologies from fine arts and design to investigate the integration of green packaging principles and local culture into Jingdezhen ceramic packaging design within the framework of sustainable development. This aims to achieve the dual goals of environmental preservation and cultural heritage continuity. Through green packaging principles, the study explores the application of eco-friendly materials, design approaches, and technologies in Jingdezhen ceramic packaging design to minimize environmental impact and foster sustainable growth. It delves into the significance of local culture in Jingdezhen ceramics, examining ways to embody and enhance these cultural aspects in packaging design, thereby augmenting the regional distinctiveness and uniqueness of the products. The research seeks to merge green packaging with local culture to create environmentally friendly packaging that maintains traditional cultural nuances, offering innovative strategies for the sustainable progress of the Jingdezhen ceramics sector. Additionally, it looks at how the fusion of green packaging and local culture can boost the market competitiveness of Jingdezhen ceramic products, appealing to consumers who value environmental consciousness and cultural depth. In summary, this research aims to thoroughly investigate the harmonization of green packaging and local culture to realize sustainable Jingdezhen ceramic packaging design, striving for synergistic achievements in environmental conservation and cultural preservation.

Main study area: Jingdezhen City is nestled in the northeastern region of Jiangxi Province, spanning a land area of 5,256 square kilometers and lying in proximity to Anhui Province. Positioned at the transitional zone between the remnants of Huangshan and Huaiyu Mountains and the Poyang Lake plain, its topography features

a basin-like form, being higher at the edges and lower in the center. The tallest peak, Wugu Tip, rises 1,618 meters above sea level. The area is interlaced with rivers; notably, the Changjiang River, the second longest river in the area stretching 210 kilometers, traverses the city from north to south. Meanwhile, the longest river, Le'an River, extends 240 kilometers and flows into Poyang Lake to the north. Jingdezhen boasts a subtropical monsoon climate, abundant natural resources, and an exemplary ecological environment, with a forest coverage rate of 67.85 percent.

Specific places where information was collected.

Jingdezhen Museum: Understanding the Development of Jingdezhen History and Culture

Jingdezhen Ceramic Museum: to understand the historical development of Jingdezhen ceramics, study ceramic patterns, color, patterns; for the back to do ceramic packaging design accumulation of materials.

Museum of Ceramic Packaging in Jingdezhen: To understand the development and evolution of ceramic transport and ceramic packaging, and to master the technology of ceramic packaging to prevent breakage, so as to facilitate the use of future design.

Jingdezhen ceramic city: research ceramic market packaging, analysed the current Jingdezhen ceramic packaging problems.

Jingdezhen ceramic factory: research ceramic manufacturers ceramic packaging, understand the needs of manufacturers and the current problems.

6.2 Duration of the study

Completion of thesis and design of the work: March 2021 to December 2023

6.3 Other scope

Time for historical research on Jingdezhen ceramics: from the Han Dynasty to modern times

Time for historical research on ceramic packaging in Jingdezhen: from the Yuan Dynasty to modern times

Era of Research on the History of Jingdezhen Ceramics: From the Han Dynasty to Modern Times

Research on the history of ceramic packaging in Jingdezhen: from the Yuan Dynasty to modern timess

7. Research Methodology

7.1 Research subjects (people who investigate research subjects)

According to the research need to understand the history of ceramics in Jingdezhen, these three experts in ceramic history were targeted and selected as information providers: 1. Chen Yuqian, male, professor and doctoral supervisor of Jingdezhen Ceramics Institute; 2. Zhao Gang, male, director of Jingdezhen Ceramics Museum, expert in ceramic history; 3. Shao Hong, female, deputy director of Jingdezhen Ceramics Museum, expert in cultural relics preservation, and research on ancient ceramics.

According to the research need to understand the history of packaging in Jingdezhen, these two ceramic packaging experts were targeted to be chosen as information providers: 1. Zhao Shuitao, male, curator of the Jingdezhen Packaging Museum, chairman of the board of directors of Jingdezhen Chuntao Packaging Co. 2. Zhang Ting, female, deputy curator of the Jingdezhen Packaging Museum, guest professor of the Jiangxi Academy of Art and Design.

According to the research need to understand the Jingdezhen ceramic market, targeted selection of the ceramic market industry representative of the founder of the enterprise to serve as an information provider: 1. Zou Jun, male, founder of Chunfeng Xiangyu brand, one of the three major kilns in Jingdezhen; 2. Ruan Dinh Rong, male, founder of Xiaoya brand, one of the three major kilns in Jingdezhen; 3. Duan Zhenmin, male, founder of the JiuDuanYao brand, one of the three major kilns in Jingdezhen.

7.2 Research tools

The research on the packaging design of Jingdezhen ceramics primarily employs the following methodologies:

First, the survey method involves fieldwork, mapping, measurement, and the collection of other relevant data. This method aims to gather a variety of materials on specific aspects of the subject matter comprehensively or semi-comprehensively. By formulating a plan, this approach enables the analysis and synthesis of collected data to draw certain conclusions.

Second, the observation method utilizes audio and visual recording tools, such as cameras and camcorders. This approach allows researchers to use their senses and auxiliary tools to directly observe the subject of study, thereby acquiring information. Scientific observation is characterized by being purposeful, planned, systematic, and repeatable.

Third, the questionnaire method, a fundamental research technique in psychology, collects information through a set of questions designed to measure human behavior and attitudes. This method is deployed to gain insights into respondents' perspectives and experiences.

Fourth, the interview method involves face-to-face conversations between the interviewer and interviewees to understand their psychology and behavior. Depending on the research question, purpose, or target audience, the interview can take various forms. Interviews can be categorized into structured and unstructured types based on the standardization level of the interview process. This method is highly versatile, offering a straightforward and narrative way to collect information on various aspects of the study, including job analysis.

Together, these methods provide a robust framework for exploring the integration of traditional and modern elements in the packaging design of Jingdezhen ceramics, aiming to enhance both aesthetic appeal and cultural significance.

7.3 Information gathering

Through a structured investigation, this study analyzes ceramic packaging cases that represent Jingdezhen ceramics, utilizing these examples as references to enhance the research's reliability. The research involved studying and analyzing books and journal articles related to packaging design, visual packaging design of ceramics, and corporate branding. Additionally, online resources were sought to gather relevant information.

Observational methods were applied to explore the packaging design of Jingdezhen ceramics and compare it with the packaging of other products. This approach aimed to summarize the methods employed in Jingdezhen ceramic packaging design, thereby providing a more substantial theoretical foundation.

The deployment of questionnaires was bifurcated into two distinct categories: the first targeted individuals associated with the ceramic and ceramic packaging

industries, while the second was aimed at consumers of ceramic products. The objective was to collate market data from these questionnaires to formulate a comprehensive summary of ceramic packaging trends.

Field visits were conducted primarily through interviews at key locations such as the Jingdezhen Ceramic Museum, ceramic packaging museums, ceramic production areas, and ceramic enterprises. These interviews aimed to delve into the packaging market of Jingdezhen ceramics, collecting and recording valuable information. The culmination of this research involved gathering, integrating, and analyzing the collected data to derive insightful conclusions.

7.4Analysing the data obtained

By conducting questionnaire surveys with ceramic art masters, manufacturers, packaging designers, and others involved in the production field, data on the current demand for packaging was collected. Additionally, questionnaires targeted at ceramic buyers were used to gather information on consumer preferences regarding ceramic packaging. This dual approach allows for the design of packaging that better meets the preferences of both ceramic producers and consumers.

Historical and cultural materials were collected through consultations with ceramic historians, and the curator of the Jingdezhen Ceramic Museum provided summaries of the ceramic patterns, color schemes, and characteristic designs of each dynasty. Understanding the historical development of Jingdezhen ceramics enriches the foundation for future ceramic packaging design, offering insights into traditional patterns, colors, and styles.

The curator of the Jingdezhen Packaging Museum conducted numerous interviews to gather information on the evolution of Jingdezhen ceramic packaging. These interviews provided insights into the history of ceramic transport and packaging techniques, including methods to prevent breakage, which will be invaluable for future design initiatives.

Field visits to the top three of the ten famous kilns in the Jingdezhen market were conducted to observe and record relevant market data. By analyzing current market packaging trends, issues with existing Jingdezhen ceramic packaging were identified, offering a clearer understanding of the current market dynamics and packaging needs of manufacturers.

7.5 Introduction to the study

Full research paper: presented in a descriptive-analytical writing style with pictures and diagrams.

Research articles: international research articles, Scopus or ISI level.

Designing a set of products

8.**Literature Review**

Limei Xiong (2021: 7-36) Application of Computer Virtual Technology in Ceramic Packaging Design At present, with the continuous development of at present, with the continuous development of science and technology, computer virtual technology has become one of the indispensable components in ceramic packaging design. virtual technologies play an important role in the process of ceramic packaging design, effectively improving the efficiency and quality of ceramic packaging design, and the significance of ceramic packaging design. packaging design, and the significance of its in-depth research is self-evident. Based on this, this paper discusses the application of computer virtual technology in ceramic packaging design. Firstly, it briefly discusses the related contents of ceramic packaging design and its basic design principles. Firstly, it briefly discusses the related contents of ceramic packaging design and its basic design principles. Then, taking the actual product design as an example, it discusses in detail how the commonly used Rhinoceros and V-ray for rhinoceros can be effectively applied in ceramic packaging design, can be effectively applied in ceramic packaging design and their final results, with a view to providing reference for similar work in the future.

Konlin Shen and Maharbiz Michel M (2021: 26-77) Ceramic packaging in neural implants The lifetime of neural implants is strongly dependent on packaging due to the aqueous and The lifetime of neural implants is strongly dependent on packaging due to the aqueous and biochemically aggressive nature of the body. over the last decade, there has been a drive towards neuro modulatory implants which are wireless and over the last decade, there has been a drive towards neuro modulatory implants which are wireless and approaching millimeter-scales with increasing electrode count. A so-far unrealized goal for these new types of devices is an in-vivo lifetime comparable to a sizable fraction of the lifetime of a device. Achieving an in-vivo

lifespan for new medical devices that spans a significant portion of a healthy patient's lifetime (>10-20 years) remains an elusive goal. Traditionally, approved medical implants have encapsulated components within metal casings, such as titanium, incorporating brazed ceramic inserts for electrode feedthroughs. The compatibility of this conventional methodology with the objectives of miniaturization, augmented channel counts, and wireless communication remains uncertain.

Ceramics have been pivotal in traditional medical implants owing to their exceptional dielectric properties, corrosion resistance, biocompatibility, and durability. Despite these advantages, ceramics are less frequently used as housing materials due to their inherent brittleness and the challenges they pose in fabricating complex geometries. However, advancements in thin-film technology present new avenues for the application of ceramics. Borrowing techniques predominantly from the semiconductor industry, thin films can be deposited and intricately patterned, offering adjustable conductivities during the manufacturing process to yield both conductors and insulators. This innovation facilitates the creation of flexible substrates, paving the way for the development of compact and reliable neural implants.

This discussion focuses on the application of ceramic materials in medical device packaging and explores the potential of ceramic thin-film micromachining and processing techniques. By leveraging these advanced technologies, there is an opportunity to overcome existing limitations and achieve breakthroughs in the fabrication of miniaturized, reliable neural implants.

Junxiong Li (2020: 10-53) Research on the application of Monet's painting style in ceramic packaging design This paper aims to study the painting style This paper aims to study the painting style and characteristics of Claude Monet, the pioneer of Impressionism, and explore its innovative application in ceramic packaging design. As an important part of the design field, packaging design can not only stimulate the development of ceramic packaging, but also enhance the quality of packaging. This paper aims to study the painting style and characteristics of Claude Monet, the pioneer of Impressionism, and explore its innovative application in ceramic packaging design. The author delves into the philosophy that design is both inspired by and influential to life, investigating the practicality of integrating Monet's painting style into ceramic

packaging design. This exploration covers various facets, including elements of impressionism, emotional demands, and visual aesthetics, aiming to foster positive developments in product packaging design within the contemporary context.

T.L. Tsang and D. Perrin (2019: 73) A Polyimide Removal Process for Die Sealed in Ceramic Package A new dry/wet process was developed for removing polyimide from die that had undergone a package lid seal temperature of 325°C in ceramic packages A characteristic translucent, glasslike residual A characteristic translucent, glasslike residual film that remained after the dry etch was consistently removed by wet etching cycles: This removal technique has resulted in very clean die surface This removal technique has resulted in very clean die surface reproducibly without degrading the die's electrical functionality. The study also examined the impact of polyimide cure temperature and die physical parameters on the dry/wet to process technique. It was discovered that this method could effectively remove polyimide subjected to temperatures exceeding the lid seal temperature utilized in ceramic packaging processes. For smaller dies with thinner polyimide layers, achieving comparable outcomes is possible by employing lower RIE (Reactive Ion Etching) power and slightly simplifying the process steps. Additionally, for comparative purposes, a purely wet removal process employing fuming nitric acid was investigated.

SunLi Feng (2021:43) New course reform construction of ceramic packaging in western universities under the background of innovation and entrepreneurship. With the development of social market economy and the country's emphasis on innovation and entrepreneurship education, innovation and entrepreneurship curriculum construction has gradually become a hot topic of higher education reform. With the development of social market economy and the country's emphasis on innovation and entrepreneurship education, innovation and entrepreneurship curriculum construction has gradually become a hot topic of higher education reform. At present, the construction of entrepreneurship and innovation curriculum system in universities is not perfect. This paper takes the course of ceramic packaging as an example, through the investigation and analysis of art design entrepreneurship education in western universities, puts forward the policy of ceramic packaging This paper takes the course of ceramic packaging as an example, through the investigation and analysis of art

design entrepreneurship education in western universities, puts forward the policy of ceramic packaging innovation and entrepreneurship education reform, so as to provide teaching reference for art design entrepreneurship education reform.

Ji Zihan and Junbin Ruan (2020:19-32) Research on the safety of ceramic packaging based on literature analysis According to the data statistics of the existing literature and the comparison of the impact of various ceramic utensils on human body, it is considered that the safety of the packaging of real According to the data statistics of the existing literature and the comparison of the impact of various ceramic utensils on human body, it is considered that the safety of the packaging of real porcelain ware is guaranteed. However, a small part of imitation porcelain ware will precipitate heavy metal elements in the process of storing or placing food, which will have adverse effects. However, a small part of imitation porcelain will precipitate heavy metal elements in the process of storing or placing food, which will have adverse effects on human body. The influence of 3D printing technology on ceramic manufacturing is analyzed, and it is not suitable for general use to manufacture ceramic products. The impact of 3D printing technology on ceramic manufacturing is analyzed, revealing that, due to technical limitations and cost-effectiveness issues, utilizing 3D printing technology for the general production of ceramic utensils is not advisable.

Xiao LI and Zhanhua Don (2019:44) Study on the migration of Lead and Cadmium from ceramic packaging materials to liquor Objective To study the effects of temperature, alcohol content and time on the migration of heavy metals pb and CD from ceramic packaging materials to liquor, and to analyze their Objective To study the effects of temperature, alcohol content and time on the migration of heavy metals pb and CD from ceramic packaging materials to liquor, and to analyze their migration kinetics. Methods The surface of ceramic products was soaked with 38% and 53% alcohol liquor solution for a certain time at 20℃ and 40℃ under dark conditions. The surface of ceramic products was soaked with 38% and 53% alcohol solution for a certain time at 20℃ and 40℃ under dark conditions. Lead and cadmium were extracted from the surface of ceramic products and determined by inductively coupled plasma emission spectrometer after microwave digestion. Results With the increase of temperature, the migration of pb and CD to liquor also increased, and the migration

rate was directly proportional to temperature. As the temperature rises, the migration of lead (Pb) and cadmium (Cd) into the beverage also increases, with the migration rate being directly proportional to the temperature. Migration kinetics analysis reveals that the amount of heavy metal migration of Pb and Cd correlates linearly with the square root of time. In conclusion, the transfer of heavy metals from ceramic packaging materials to beverages also escalates with temperature, and this migration rate is directly proportional to it. The diffusion of heavy metals from ceramic packaging to beverages is a process controlled by the rate of diffusion, which is based on ion exchange.

Zhexiao Ying ; HaiHao Xi (2014:15)Comparison Study of Multi-Layer and Folding Liners of Corrugated Cartons - Domestic Ceramic Packaging Corrugated board is a kind of important material for packaging liner. According to packages of ceramic wine suits and single ceramic bowl, we designed folding liners and multi-layer According to packages of ceramic wine suits and single ceramic bowl, we designed folding liners and multi-layer liners using corrugated boards. Experiments are taken out to compare mechanical properties of different liner structures. Optimal corrugated liner configurations are summarized, taking into account the quantity of corrugated boards, their mechanical properties, ease of manufacturing, and user convenience.

Hu Fei (2014:9-45) On the application of corrugated paper in ceramic packaging -- take the packaging design of "bowl in China tableware" as an example. the face of the market Lin Lang dazzling packaging materials, a beautiful tableware packaging design will attract people's attention, let a person shine Packaging design is not only practical, easy to transport, good protection, but also has environmental advantages. There are many kinds of packaging styles, and the pursuit of Packaging design is not only practical, easy to transport, good protection, but also has environmental advantages. There are many kinds of packaging styles, and the pursuit of increasingly perfect functionality and visual beauty of tableware packaging design has put forward more There are many kinds of packaging styles, and the pursuit of increasingly perfect functionality and visual beauty of tableware packaging design has put forward more requirements and challenges for tableware packaging design. However, with the booming development of packaging industry, the increase of packaging waste, the

recycling and disposal of some materials, has caused great pollution and waste of natural resources to the society. Corrugated material itself has a low price, easy automatic processing recyclable, has good buffering performance, no pollution to the environment, so become the preferred into the 21st century, corrugated packaging materials in modern packaging design is the most widely used, however, with the development of corrugated packaging, it is not easy to find the right material for green packaging. Into the 21st century, corrugated packaging materials in modern packaging design is the most widely used, however, with the development of corrugated packaging, there are also some problems, such as in order to pursue more economic benefits of enterprises, increase the added value of goods and excessive packaging phenomenon. Corrugated packaging structure, lack of creativity; Designers lack accurate positioning of corrugated packaging market. Corrugated packaging structure, lack of creativity; Designers lack accurate positioning of corrugated packaging market. Therefore, as a designer, when choosing corrugated paper as packaging material, the first thing to understand marketing Therefore, as a designer, when choosing corrugated paper as packaging material, the first thing to understand marketing strategy, accurate grasp of consumer psychology, in order to better market positioning, combined with new materials, new technology, new process design.

Yue Chen. Huan Song. (2014:86) Kinetic Migration of Chemical Elements from Ceramic Packaging into Simulated Foods and Mature Vinegar This study developed a method for the This study developed a method for simultaneous determination of 19 chemical elements (Al, V, Cr, Mn, Co, Cu, Ga, As, Rb, Y, Zr, Cd, Te, Ce, Pr, Nd, Sm, Er and Pb) in simulated foods [4%, 6% and 8% (w/v) aqueous solution]. (w/v) aqueous acetic acid] by microwave-assisted digestion and inductively coupled plasma mass spectrometry. We examined the migration of these chemical elements from ceramic packaging to the foodstuffs. We examined the migration of these chemical elements from ceramic packaging into the simulated foods and into two types of mature vinegar. The simulated foods showed matrix effects, compared with stock solution solvents. We examined the migration of these chemical elements from ceramic packaging into the simulated foods and into two types of mature vinegar. The migration of chemical elements from ceramic packaging into simulated foods was affected by migration time, temperature and acidity of the simulated food. The

migration of chemical elements from ceramic packaging into simulated foods was affected by migration time, temperature and acidity of the simulated food. Chemical elements exhibited varying migration behaviors in both black and white mature vinegar, with the extent of migration differing based on the inner surface of the ceramic packaging. This variation underscores the complexity of chemical interactions within different vinegar types and packaging materials. Copyright 2012 John Wiley & Sons, Ltd.

Li Song. Chuanbin Zeng ; Jiajun Luo; Jiejun (2013:61-84)The abnormal electrostatic discharge of a no-connect metal cover in a ceramic packaging device The human body model (HBM) stress of a no- The human body model (HBM) stress of a no-connect metal cover is tested to obtain the characteristics of abnormal electrostatic discharge, including current waveforms and peak current under The human body model (HBM) stress of a no- connect metal cover is tested to obtain the characteristics of abnormal electrostatic discharge, including current waveforms and peak current under varied stress voltage and device failure voltage. Then, failure mechanism analysis and model simulation are performed to prove that the transient peak current caused by a sparkover of low arc impedance will result in the devices' premature damage when the potential difference between the no-connect metal cover and the chip exceeds the threshold voltage of sparkover.

Rulin Zhang (2019:51) Study on the design and modern application of ceramic packaging for export during the Period of 13 hang from the mid-18th century to from the mid-18th century to the early 19th century, the 13th Bank of Guangzhou was the only trading port for western countries to trade with China. From the mid-18th century to the early 19th century, the 13th Bank of Guangzhou was the only trading port for western countries to trade with China. Export ceramic packaging in shisanhang period refers to the packaging of all ceramic materials shipped to western countries through Guangzhou shisanhang period. export ceramic packaging in shisanhang period refers to the packaging of all ceramic materials shipped to western countries through Guangzhou shisanhang during the qing Dynasty's "one trade" period (1685-1842). These export ceramic packaging in the large category belongs to a kind of export ceramics, but different from the general export ceramics, it not only has the aesthetic value of export ceramic art, collection and historical research, but

also has the practical value of convenient storage and It not only has the aesthetic value of export ceramic art, collection and historical research, but also has the practical value of convenient storage and transportation of packaging, protection of products, beautification of content and so on.

Qi Xia; Lehui Yuan (2018:84) On "material beauty and craftsmanship" and Jingdezhen ceramic packaging design. "Material beauty and craftsmanship" is not only an important aesthetic criterion of Chinese design, but also contains the philosophy of design aesthetics. Similarly, Jingdezhen ceramic packaging design aesthetic changes and forms of expression are also deeply influenced by it. Combining with the style of Jingdezhen ceramic packaging, this paper probes into the attachment relationship between Jingdezhen ceramic packaging and Jingdezhen ceramic packaging. Combining with the style of Jingdezhen ceramic packaging, this paper probes into the attachment relationship between the suitability, application and aesthetic trend of packaging material technology and " material beauty and craftsmanship", and sorts out its design origin and aesthetic orientation.

YunDie Wang (2017:16) Application of ceramic pillow pattern in the design of ceramic flower pack Packaging is not only the carrier of product information, but also the carrier of traditional culture. With the development of traditional culture in China, the characteristics of Cizhou porcelain pillow are constantly studied and discovered. With the development of traditional culture in China, the characteristics of Cizhou porcelain pillow are constantly studied and discovered. In particular, the study of the patterns of porcelain pillows. closely related to modern packaging design, whether in shape, color, or in the pattern of composition and formal beauty. Although there are abundant Although there are abundant researches on the patterns of porcelain pillow, there are few concrete applications of the patterns in modern society. This topic through the packaging of the carrier, the porcelain pillow pattern is closely related to modern packaging design. of the carrier, the porcelain pillow pattern in the packaging for reproduction or redesign, which is an effective way to inherit the characteristics of While enhancing the cultural connotation of the product, it also improves the market competitiveness of the product.

Hui Wang (2017:28) Exploring the Use of Recycled Textiles in Ceramic Product Packaging: A Case Study of Jinyun Pottery House's Packaging Design. The

commercial frenzy, technological advancements, and the distortion of consumption concepts and production methods have eroded our inherent respect for nature. As commerce evolves, the ethical and moral foundations of design increasingly drift from their original course in this situation, green design emerges at the historic moment, which is full of idealism and a strong sense of social responsibility. Although there is still a long way to go to achieve green design, it is sure to start a fire. It is not only the responsibility of designers, but also the responsibility of the public. Although there is still a long way go to achieve green design, it is sure to start a fire. A large number of discarded clothes that people eliminate every year still have the value of use and the value and significance of regenerative design. Resource regeneration design can not only prolong the service life of waste products, achieve the purpose of resource recycling, reduce the waste of resources, alleviate environmental pollution. What is more important is to change consumers' existing waste products, and to improve the quality of life of the consumers. more important is to change consumers' existing attitudes towards waste clothing. We will guide consumers to develop green and healthy lifestyles and consumption habits. We will guide consumers to develop green and healthy lifestyles and consumption habits.

Wenjing Liang (2015: 65) Application of bionic concept in ceramic packaging design Bionic design concept is an important way of thinking in the field of Bionic design concept is an important way of thinking in the field of ceramic design. Bionic design is the meeting point between human production activities and nature. Bionic design is a design process from complexity to simplicity, from concrete form to abstract form, which reflects the comprehensive ability of ceramic designers in the field of ceramic design. Bionic design is a design process from complexity to simplicity, from concrete form to abstract form, which reflects the comprehensive ability of designers to observe and refine. This paper analyzes the concept of bionic design, the main This paper analyzes the concept of bionic design, the main characteristics, the function and shape of bionic design and the significance and influence of bionic design. It reflects that the bionic design of daily -use ceramics not only skillfully expresses the effect and displays the beauty of nature, but also produces the emotional resonance between human and nature. It reflects that the bionic design of daily -use ceramics not only skillfully expresses the effect and

displays the beauty of nature, but also produces the emotional resonance between human and nature.

JianYing Hao (2012: 115-136) The phenomenon of "unity" of contemporary ceramic packaging and its countermeasures. China has a long history of ceramic packaging, in the long-term ceramic trade activities, accumulated a wealth of packaging experience and technology. However, with the diversification of contemporary ceramics category and the diversified functions China has a long history of ceramic packaging, in the long-term ceramic trade activities, accumulated a wealth of packaging experience and technology. However, with the diversification of contemporary ceramics category and the diversified functions of transportation, display, sales and promotion of packaging, the basic protection function is far from enough, and the "unity" phenomenon of contemporary ceramics packaging has seriously affected the image recognition and cultural the "unity" phenomenon of contemporary ceramics packaging has seriously affected the image recognition and cultural competitiveness of products.

Wang J (2020: 12-28) Study on the packing characteristics of a special "J" shape ceramic packed pebble bed based on discrete element The packing structures of a special "J" - cylinder-tours shape ceramic packed pebble beds, which might be used in the breeding zone of future fusion blanket and the other applications were numerically studied by the Discrete Element Method. contact force and force chain distribution and the effect of the pebble diameter on the global packing factor have been investigated. Meanwhile, the analyses of radial and axial force chain distribution have been investigated. The contact force and force chain distribution and the effect of the pebble diameter on the global packing factor have been investigated Meanwhile, the analyses of radial and axial local packing factor distribution features and coordination number distribution were performed. the global packing factor increased with decreasing pebble diameter and the cylindrical part of the packed pebble bed had a slightly higher global packing factor than the torus part. The results showed that the global packing factor increased with decreasing pebble diameter and the cylindrical part of the packed pebble bed had a slightly higher global packing factor than the torus part. After briefly increasing, the contact force consistently decreased, and the distribution of force chains displayed a marked distinction between two sections of

the packed pebble bed. Oscillatory behavior was observed in both the radial and axial local packing factors, with notable differences between the two sections. Additionally, the distribution of coordination numbers was analyzed to explore the contact status within the packed pebble bed. The findings from these investigations contribute to a deeper understanding of the packing structure dynamics within the pebble bed.

Yang Xue (2019:13-30) Research on the present situation and development of Jingdezhen ceramic packaging in this paper, the concept of Jingdezhen in this paper, the concept of Jingdezhen ceramic packaging is analyzed, and the concept of ceramic packaging, the evolution of ceramic packaging and the concrete contents of ceramic packaging are elaborated in three parts. In this paper, the concept of Jingdezhen ceramic packaging is analyzed, and the concept of ceramic packaging, the evolution of ceramic packaging and the concrete contents of ceramic packaging are elaborated in three parts. Then analyze the status quo and existing problems of Jingdezhen ceramic packaging, including the status quo of Jingdezhen ceramic packaging industry, the serious lack of local culture, ceramic packaging design lack of creativity and lack of brand awareness four aspects. Finally, the development prospect of Jingdezhen ceramic packaging is analyzed, including the integration of ceramic packaging and culture, the innovation of ceramic packaging design concept and the development of ceramic packaging industry. Finally, the development prospect of Jingdezhen ceramic packaging is analyzed, including the integration of ceramic packaging and culture, the innovation of ceramic packaging design concept and the effective promotion of ceramic packaging brand. development by more concerned people.

Yuan Wen (2019:52) In contemporary society, packaging design plays a crucial role across various sectors, serving essentially as a means to enhance the aesthetic appeal of products. An integral aspect of this design realm involves conveying brand image and emotional values through packaging, a challenge that designers are continually navigating. This study focuses on the packaging design of Chengcheng Yaotou kiln porcelain, emphasizing three main areas of design innovation Firstly, a distinctive challenge faced by Yaotou kiln porcelain packaging is its lack of unique branding elements. Establishing a recognizable brand symbol for Yaotou kiln is a primary objective of this research, aiming to distinguish its identity in the market

Secondly, Yaotou kiln porcelain embodies the essence of folk culture and traditional allure, reflecting a profound sense of pride. Incorporating these elements into the packaging design is crucial to authentically represent its cultural and artistic heritage.Addressing these challenges not only involves crafting a visual identity for Yaotou kiln porcelain but also encapsulating its rich cultural significance and traditional charm within the packaging design. This approach seeks to elevate the brand's market presence and connect emotionally with its audience.

YuShan Zhang (2018:72) Product design of edible ceramic packaging container based on Kansei Engineering The concept of Kansei engineering and Kano model is applied to improve the design of ceramic packaging containers for food products to better meet the needs of users. Through sampling method, case the concept of Kansei engineering and Kano model is applied to improve the design of ceramic packaging containers for food products to better meet the needs of users. Through sampling method, case analysis method and questionnaire method, the main factors affecting consumer satisfaction of edible ceramic packaging container products were obtained, including appearance factors and performance factors. The appearance factor has become more priority in product design and development, and we should try to find the appearance factor that should be included between the words associated with sensibility and design elements. The comprehensive form of ceramic products should complement each other with functions and be flexible and integrated. The results show that the products of ceramic The results show that the products of ceramic packaging containers should have parabolic design elements, artificial surface decoration, glaze, texture and block/closed color, etc. The results show that the products of ceramic packaging containers should have the same design elements as those of ceramic packaging containers.

QingLian Duan (2018:15-46) The application of Chengde regional culture in the packaging of Rice wine -- Taking the design of Rice wine ceramic packaging container as an example with the increasing weight of yellow rice wine in the domestic market, the existing packaging form of simplification and old- With the increasing weight of yellow rice wine in the domestic market, the existing packaging form of simplification and old- fashioned sense can no longer keep pace with the market demand. Chengde has a long history and culture, and is one of the first batch

of national historical and cultural cities. Based on the design concept of Chengde regional culture, the design of packaging container is carried out in combination with the brand of This study delves into the design of ceramic packaging containers for "Misuer" yellow rice wine, highlighting the significance of branding and the allure of packaging design within the commercial context of yellow rice wine. By examining the material, shape, color characteristics, and the inherent rhythm, volume, texture, and spatial dynamics of ceramic packaging containers, the research aims to craft designs that resonate with the "Misuer" brand identity.

Furthermore, the study explores the evolution and development of ceramic packaging containers, specifically focusing on enhancing the appeal of yellow rice wine packaging. This exploration includes analyzing the progression of rice wine culture and its design implications for various alcoholic beverages such as white wine, sake, and wine containers. The goal is to develop packaging that is not only culturally appropriate but also complements China’s extensive history of rice wine culture.

Drawing on information from the Chengde Historical Culture Research Centre, the research sifts through the annals of Chengde's history, uncovering the regional culture encapsulated in ancient architecture, customs, religion, and the profound cultural depths of the Qing Dynasty. By extracting effective elements from Chengde's rich regional culture, the study seeks to harmonize the functionality and aesthetics of rice wine ceramic packaging container design, thereby showcasing the unique regional culture of Chengde.

Xu Zhen (2018:35-42) Development of mass transfer coefficient correlation for a ceramic foam packing humidifier at elevated pressure The cooling The cooling tower model is simple but has necessary precision for the packing design and outlet conditions forecast of the humidifier, especially under the pressure The cooling tower model is simple but has necessary precision for the packing design and outlet conditions forecast of the humidifier, especially under the pressure and temperature level of micro humid air turbine. This research focuses on developing a mass transfer correlation of the novel ceramic foam packing, which has the potential to be used in humidification. The heat and mass transfer properties of the packing are investigated with the mass transfer the heat and mass transfer properties of the packing are investigated with the mass transfer coefficients calculated from 105 groups of

experimental data, and the effects of pressure, water/air mass flow ratio, inlet water temperature and inlet air enthalpy are analyzed. It is shown that the mass transfer coefficient increases with the increase of water/air mass flow ratio, but decreases with the increase of inlet water temperature and inlet air enthalpy. It is shown that the mass transfer coefficient increases with the increase of water/air mass flow ratio, but decreases with the increase of inlet water temperature and inlet air enthalpy. The effect of pressure on heat and mass transfer is related with air mass flow. group correlation of mass transfer coefficient is developed and evaluated. It is shown that the deviations between the predicted and experimental values are estimated within ±12% for It is shown that the deviations between the predicted and experimental values are estimated within ±12% for 75% experimental conditions. The developed correlation can be used to predict the packing height and the water/air outlet conditions of the ceramic foam packing humidifier.

YangYang Li (2018:64-82) Determination of heavy metal speciation in ceramic packaging of liquor by BCR extraction BCR extraction method, total BCR extraction method, microwave digestion method and acetic acid extraction method were used to study the dissolution amount and morphology distribution of Pb, Cd, Zn, Ni and Co in ceramic packaging of liquor. The results showed that the sum of heavy metal speciation by BCR extraction method was 84.90% ~ 109.38% of the total heavy metal content in microwave digestion, total microwave digestion method and acetic acid extraction method. metal content in microwave digestion, and the contents were in the order of Zn>Ni>Pb>Co>Cd. Bcr-based extraction of heavy metals has the highest risk of dissolution of Zn and Ni, moderate risk of dissolution of Pb and Co, and almost no risk of dissolution of Cd. In BCR extraction form, the sum of the weak acid extraction state and the reducing rate of dissolution of Cd were the same as that of Zn and Ni. In BCR extraction form, the sum of the weak acid extraction state and reducible state is 79.55% ~ 411.75% of the heavy metal extraction amount of 24 h with 4% acetic acid. analysis shows that the weak acid extraction state has more significant correlation with the volume fraction of 4% acetic acid soaking solution. the correlation analysis of the extractable form of BCR, it was suggested that ceramic packaging materials may increase the risk of heavy metal Based on the correlation analysis of the extractable form of BCR, it was suggested that ceramic packaging materials may

increase the risk of heavy metal dissolution in liquor containing acid, reducing and Oxidizing substances for a long time. analyze the dissolution characteristics of heavy metals in liquor ceramic packaging, and provide a scientific basis for discussing the risk of heavy metals dissolution on liquor quality and human health. metals dissolution on liquor quality and human health.

JianJie Chen (2018:37-43) Taking Plum vase and Jade Pot Spring vase as an example to study the value of song and Yuan ceramic packaging this paper analyses the practicability and aesthetic feeling of plum vase and Jade pot Spring vase. Based on the double evidence method and imagology, this paper compares Based on the double evidence method and imagology, this paper compares historical documents with cultural relics and images from the commercial culture and Confucianism of song Dynasty. The ancient Chinese concept of cherishing resources and making the best use of them is a very important part of this work. The ancient Chinese concept of cherishing resources and making the best use of things had a profound influence on the creation of the Song and Yuan dynasties, and finally formed plum bottle and Jade Pot spring bottle. The ancient Chinese concept of cherishing resources and making the best use of things had a profound influence on the creation of the Song and Yuan dynasties, and finally formed plum bottle and Jade Pot spring bottle. From packaging to practical wine vessels, and then to furnishings, the function and beauty are unified.

Chen Dan (2019:31-57) Research on the design and packaging of Xiangjie brand pictographic ceramic tea Set China is the hometown of tea culture and has a China is the hometown of tea culture and has a long history in the development of human society. As its bearer, tea ware plays an important role in history and modern life, with profound cultural deposits and high aesthetic value. With the differentiation of aesthetic needs in modern society, pictographic design has gradually become the first choice for artistic designers to pursue individuality. With the differentiation of aesthetic needs in modern society, pictographic design has gradually become the first choice for artistic designers to pursue individuality. they seek creative inspiration from plants and animals in nature, common objects in life, and even microorganisms to design products with pictographic meaning, achieve new breakthroughs, achieve the purpose of using nature, and enhance the This topic with "phase boundary" brand ceramic tea set shape and packing design as the research direction, based on the

research object and the background of research and analysis, is to design products with pictographic meaning, achieve new breakthroughs, achieve the purpose of using nature, and enhance the realm of living art. This topic with "phase boundary" brand ceramic tea set shape and packing design as the research direction, based on the research object and the background of research and analysis, a deep understanding of the concept of pictographic design, technique of expression, as well as in the application of modern ceramic tea set design, the natural plants, animals and characters in the form of dynamic mining and refining, to find the most the natural plants, animals and characters in the form of dynamic mining and refining, to find the most appropriate form of the topic, designed with" The "pictographic" theme of the ceramic tea set, through the traditional ceramic tea set single modeling The "pictographic" theme of the ceramic tea set, through the traditional ceramic tea set single modeling and machine processing stiff sense, better highlight the artistic life articles. In the research of packaging design, the paper breaks through the traditional space waste mode of four-square gift boxes, takes low-carbon green design as the goal, and depicts its shape and appearance with the object image of "Shaikh six methods" as the design concept in traditional Chinese aesthetics. The object ceramic tea set is designed to be different from each the object ceramic tea set is designed to be different from each other and to be natural.

Ramkumar Ramkrishnan (2013:21-39) Experimental study of cooling tower performance using ceramic tile packing. Deterioration of the packing material is a major problem in cooling towers. in this experimental study ceramic tiles were used as a packing material. the packing material is a long life burnt the packing material is a long life burnt clay, which is normally used as a roofing material. It prevents a common problem of the cooling tower resulting from corrosion and water quality of the tower. It prevents a common problem of the cooling tower resulting from corrosion and water quality of the tower. In this study, we investigate the use of three different types of ceramic packings and evaluate their heat and mass transfer coefficients. A simple comparison of packing Behavior is performed with all three types of packing materials. The experimental study was conducted in a forced draft cooling tower. The variations in many variables, which affect the tower efficiency, are described.

Hu Jing (2012:83-95) Elegance, Taste and taste -- Application of ceramic packaging design with the continuous improvement of people's living with the continuous improvement of people's living standards, the product structure of the ceramic market is changing, requiring products to be updated to meet the needs of the modern market, and modern packaging is the best bridge between producers and consumers. With the continuous improvement of people's living standards, the product structure of the ceramic market is changing, requiring products to be updated to meet the needs of the modern market, and modern packaging is the best bridge between producers and consumers. application characteristics and significance of ceramic decoration in modern packaging from the perspective of ceramic packaging design. Obviously, pottery and porcelain adornment changed to the needs of the modern market, and modern packaging is the best bridge between producers and consumers. pottery and porcelain adornment changed with nature, human nature, grade changes the adornment effect that shows its qualitative material is unique.

LinWei Meng (2011:5) The study investigates the impact of soaking time on the release of hazardous substances from ceramic packaging containers. These containers, featuring a single glaze, were found to contain seven harmful elements: lead, cadmium, chromium, nickel, cobalt, antimony, and zinc. A 4% (volume fraction) acetic acid solution was chosen as the soaking medium, and the dissolution of these heavy metals over varying soaking durations was quantified using an Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES). The research focused on examining the relationship between the immersion time and the quantity of heavy metal migration.

Findings indicate that the amount of harmful heavy metals leached from ceramic packaging containers escalates with prolonged soaking time. Furthermore, the presence of coexisting elements was found to influence each other's dissolution, significantly impacting the measured elements' release based on the concentration of these coexisting elements.

JianYing Hao (2010:51-64) Exploring the Aesthetic Attributes of Traditional Ceramic Packaging Containers: Originating from human endeavor and daily necessities, ceramic packaging is a testament to the creativity born from labor. In the current era of industrialization, marked by the swift progress of the global packaging

economy, ceramic packaging materials continue to play a pivotal role in modern packaging solutions. Their enduring presence in everyday life is attributed to their distinct advantages. Despite being an integral part of human societal evolution, systematic research on this category of ceramic packaging remains scarce in China, which is a significant oversight.

Liu Sheng (2009:14-36) A Novel Ceramic Packaging Technique Using Selective Induction Heating. A novel ceramic packaging technology by using selective induction heating is presented. Some aspects of this packaging process, including local temperature distribution, hermeticity, tensile strength, and fracture analysis, were tested and evaluated. Some aspects of this packaging process, including local temperature distribution, hermeticity, tensile strength, and fracture analysis, were tested and evaluated. For high-frequency (f=350kHz) induction heating, the temperature of cover edges near solder-loop For high-frequency (f=350kHz) induction heating, the temperature of cover edges near solder-loop reached up to 320°C in several seconds, hermetic seal of the ceramic package can be promised because of solder reflowing, while the temperature of the ceramic bottom was only about 100°C, so thermal-sensitive devices and integrated circuits inside the ceramic package can be protected from high-temperature damage. Temperature variations and distributions were assessed using an infrared imager, showing strong agreement with simulation outcomes. Ultimately, a range of tensile strength from 4.0 MPa to 13.0 MPa was attained. The fracture interfaces were meticulously examined and analyzed, taking into consideration the induction time and packaging pressure.

JiaLong Xu (2009:64-69) Research on safety limit standard of toxic and harmful substances in ceramic food packaging materials at home and abroad. The safety limit standards of toxic and harmful substances in food contact ceramic packaging materials in China, Europe and America are discussed. It is pointed out that chemical residues in ceramic packaging materials usually migrate into food, resulting in food contamination and threatening consumers' health. It is pointed out that chemical residues in ceramic packaging materials usually migrate into food, resulting in food contamination and threatening consumers' health. The toxic and harmful substances in the ceramic packaging materials stipulated in the standard are discussed in detail. The toxic and harmful substances in the ceramic packaging materials stipulated in the

standard are discussed in detail. Finally, according to the differences in the safety limits of toxic and harmful substances in food contact ceramic packaging materials among countries in the world, some suggestions are put forward.

Tang Wen (2013:5-24) Study on re-design of daily ceramic packaging since ancient times, China has been known as the quintessence of ceramics all over the Since ancient times, China has been known as the quintessence of ceramics all over the world. China is a big ceramic producer, producing a large number of ceramics every year for export and domestic sales, of which daily ceramics account for However, China is not a ceramic power, which is caused by a variety of reasons, and packaging is a direct factor of these reasons. Due to various reasons, daily ceramic packaging has been the most popular form of ceramics in the world. However, China is not a ceramic power, which is caused by a variety of reasons, and packaging is a direct factor of these reasons. Therefore, the re-design of daily ceramic packaging has become an important topic for the sustainable development of ceramic industry and ceramic culture. Therefore, the re-design of daily ceramic packaging has become an important topic for the sustainable development of ceramic industry and ceramic culture. According to the current situation, it Summarize the reasons for the low status of the packaging market, and proposes that the redesign of packaging is the direct means to change the status quo. According to the current situation, it Summarize the reasons for the low status of the packaging market, and proposes that the redesign of packaging is the direct means to change the status quo. The redesign of packaging is not only from the reform of the status quo, but also should take into account the social status of daily-use ceramics, so the article for the reasons of packaging redesign from emotion, culture, science and technology, economic analysis of four With the idea of packaging design again, should be based on the perspective of long-term development of daily-use ceramics, discusses the people-centered, thus puts forward the design of ceramic packaging and "secret" design concept, namely the humanities concern as the core, the green lifestyle as the guide, and carry on the design of ceramic packaging. lifestyle as the guide, and carry on the concrete elaboration, and then the design concept of ceramic packaging design under the guidance of strategic discussions. Ultimately, this study delves into how the redesign of everyday ceramic packaging extends to the cultural creative industry, traditional ceramic culture, and corporate

branding. The proposal for packaging redesign is based on a thorough analysis of the current state of ceramic packaging design.

Ma Ling (2018:63-84) This study focuses on the structural safety design of packaging for "Yazhou Pottery" from Pingtang, Guizhou Province, a folk craft distinguished by its unique regional characteristics. Utilizing local glaze techniques, Yazhou Pottery exhibits unique artistic features like "opening slices" and "kiln transformation." At a time when traditional folk arts are garnering increased attention, the packaging design of Yazhou Pottery—a symbol of Guizhou's traditional pottery craftsmanship—faces critical scrutiny. Key issues identified include rudimentary packaging content, an outdated single-structure form, limited portability, and a design that fails to adequately protect product safety or enhance value, posing security risks during transport and sale.

This research aims to address these concerns through a comprehensive study that includes literature review, field research, visual analysis, and comparative studies, integrating ecological perspectives with a focus on packaging structure and dynamics. The goal is to move beyond traditional packaging forms and establish a new paradigm for secure and logical packaging structures.

The research is organized into several layers: initially gathering data on the historical development and artistic traits of Yazhou Pottery, followed by market research to identify existing packaging issues. It then reviews theories related to the safety of ceramic packaging structures, examining external factors like safety vulnerabilities in the distribution environment and comparing the safety of domestic and international ceramic packaging structures. Finally, by aligning with the artistic and cultural essence of Yazhou Pottery, the study proposes safety-oriented packaging solutions, focusing on materials and structural design to mitigate risks effectively.

Fan ChaoQun (2017:64-87) Analysis and Practice of reduction design of ceramic tableware packaging -- take "Porcelain Art Workshop" as an example.

At present, most of the domestic ceramic tableware packaging still has packaging defects and function loss, excessive packaging but not beautiful, resulting in a single shape and structure of packaging, packaging consumables too much, cannot effectively ensure the quality of products, resulting in At present, most of the

domestic ceramic tableware packaging still has packaging defects and function loss, excessive packaging but not beautiful, resulting in a single shape and structure of packaging, packaging consumables too much, cannot effectively ensure the quality of products, resulting in high damage rate of ceramic tableware, resulting in a great waste of environmental resources. Under the call of green packaging concept, the study of reduction design of ceramic tableware packaging is a major challenge. Under the call of green packaging concept, the study of reduction design of ceramic tableware packaging is imminent. Based on the ceramic tableware packaging as design object, through the collection and analysis of the relevant literature, and the research on the ceramic tableware packaging design at home and abroad, reveals the deficiency of traditional ceramic tableware packaging, at the same time, actively explore and sum up the packaging reduction design of effective method and the right At the same time, actively explore and sum up the packaging reduction design of effective method and the right way, form design creation theory, method and technical route. Based on the analysis and research of the reduction design, in order to ensure the function of the packaging design as the starting point. of the packaging design as the starting point, combined with the ecological environment, the actual needs of manufacturers and consumers, in the selection of packaging materials to pay attention to environmental protection, the use of non-toxic, easily degradable biodegradable materials and environmental protection recycled paper; Packaging structure requires scientific rationalization, through the analysis of the characteristics of The packaging design adopts a simple style, simplify the packaging production process, reduce the waste discharge in the packaging production process. The packaging design adopts a simple style, simplify the packaging production process, reduce the waste discharge in the packaging production process; Strengthen the research of packaging function and realize the extensibility of packaging function. Under the premise of guaranteeing the basic performance of the ceramic tableware packaging, it aims to effectively achieve the Under the premise of guaranteeing the basic performance of the ceramic tableware packaging, it aims to effectively achieve the reduction of the ceramic tableware, effectively solve the defects existing in the current ceramic tableware packaging.

HuiRu Li (2016:45-67) This study examines the current state of daily ceramic packaging design in Jingdezhen, a city renowned as the porcelain capital of China and

a pivotal contributor to the ceramic industry. The term "CHINA" not only denotes porcelain in Chinese but also serves as the English translation for China, underscoring the profound impact of ceramic culture on Chinese heritage. Jingdezhen's immeasurable contributions have shaped the evolution and diversification of ceramic culture, necessitating the judicious utilization and integration of existing resources to foster the ceramic industry's growth through cultural innovation.

Daily ceramic packaging design, infused with Jingdezhen's distinctive ceramic culture, plays a crucial role in promoting and evolving this cultural heritage. However, the current market reveals a chaotic visual landscape in daily ceramic packaging, characterized by uniformity, outdated techniques, and a lack of brand consciousness, which significantly hinders the progress of daily ceramics. Analysis of current documentation reveals that most ceramic packaging designs in Jingdezhen either emphasize cultural and artistic traits or lean towards simplistic artistic approaches. While studies such as "the evolution of Jingdezhen ceramics packaging theory" and "international trade perspectives on Jingdezhen ceramics art packaging" exist, there is a noticeable gap in research from a branding development perspective, especially concerning Jingdezhen ceramic packaging's emotional and humanistic dimensions under new circumstances.

Reflecting on the trajectory of art design development, it's evident that the rapid advancement of modern design is challenging traditional art design principles. To remain relevant, design practices must evolve, breaking free from outdated conventions to meet the modern pursuit of more scientific and humanized visual experiences.

9. **Concept, Theory and Conceptual framework**

The main concepts of this paper are green packaging design and Jingdezhen local ceramic culture. The design needs to take traditional culture as the core of the design. In the process of designing and researching ceramic packaging, it is an unchangeable core point in the whole packaging design process to carry out modern deduction of ceramic traditional culture by studying Jingdezhen ceramic history and packaging history. Local traditional patterns can best reflect the national characteristics and the characteristics of ceramic packaging. can best reflect the national characteristics and the cultural heritage of this region, and they are the carriers of transforming an

abstract concept into a concrete materialized form and communication. One of the main design elements of ceramic packaging is pattern, which has a simple and clear One of the main design elements of ceramic packaging is pattern, which has a simple and clear expression effect and strong appeal, and also occupies a very important position in the fierce competition of modern ceramic products.

The main purpose of green packaging is to protect environmental resources, which is harmless to the natural environment and human health, easy to recycle or degrade, and can effectively promote the sustainable development of packaging. The main purpose of green packaging is to protect environmental resources, which is harmless to the natural environment and human health, easy to recycle or degrade, and can effectively promote the sustainable development of packaging. Simplification of packaging, recycling of packaging materials, degradation of garbage generated by packaging and safety of packaging materials are the main meanings of green packaging. Under the premise of this development, ceramic packaging design also needs to be developed to meet the needs of the environment. Under the premise of this development, ceramic packaging design also needs to involve the inheritance and development of culture, the sustainable development of enterprise Under the premise of this development, ceramic packaging design also needs to involve the inheritance and development of culture, the sustainable development of enterprise economy and the sustainable development of environment, so it is imperative to redesign ceramic packaging.

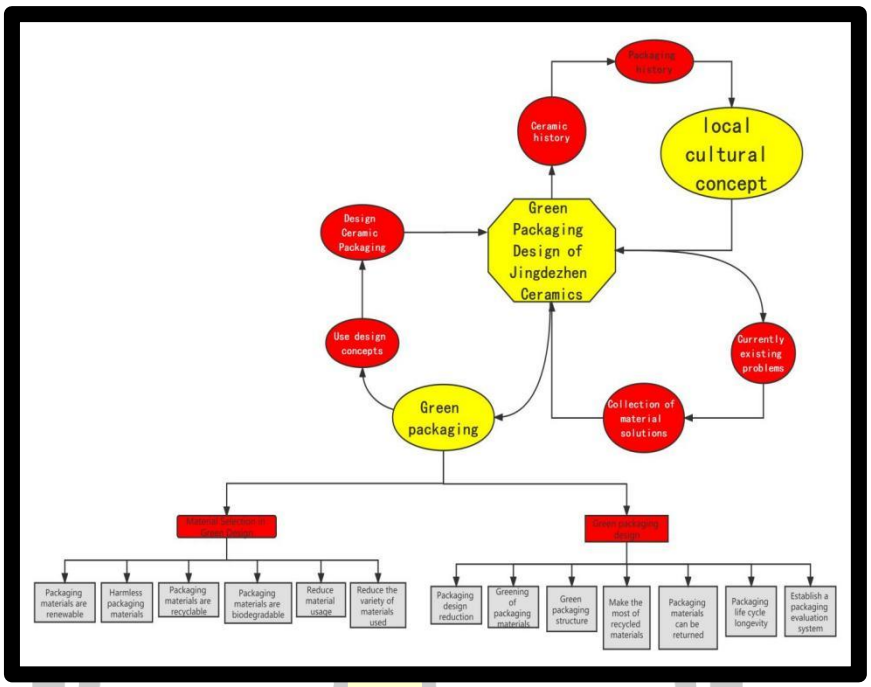


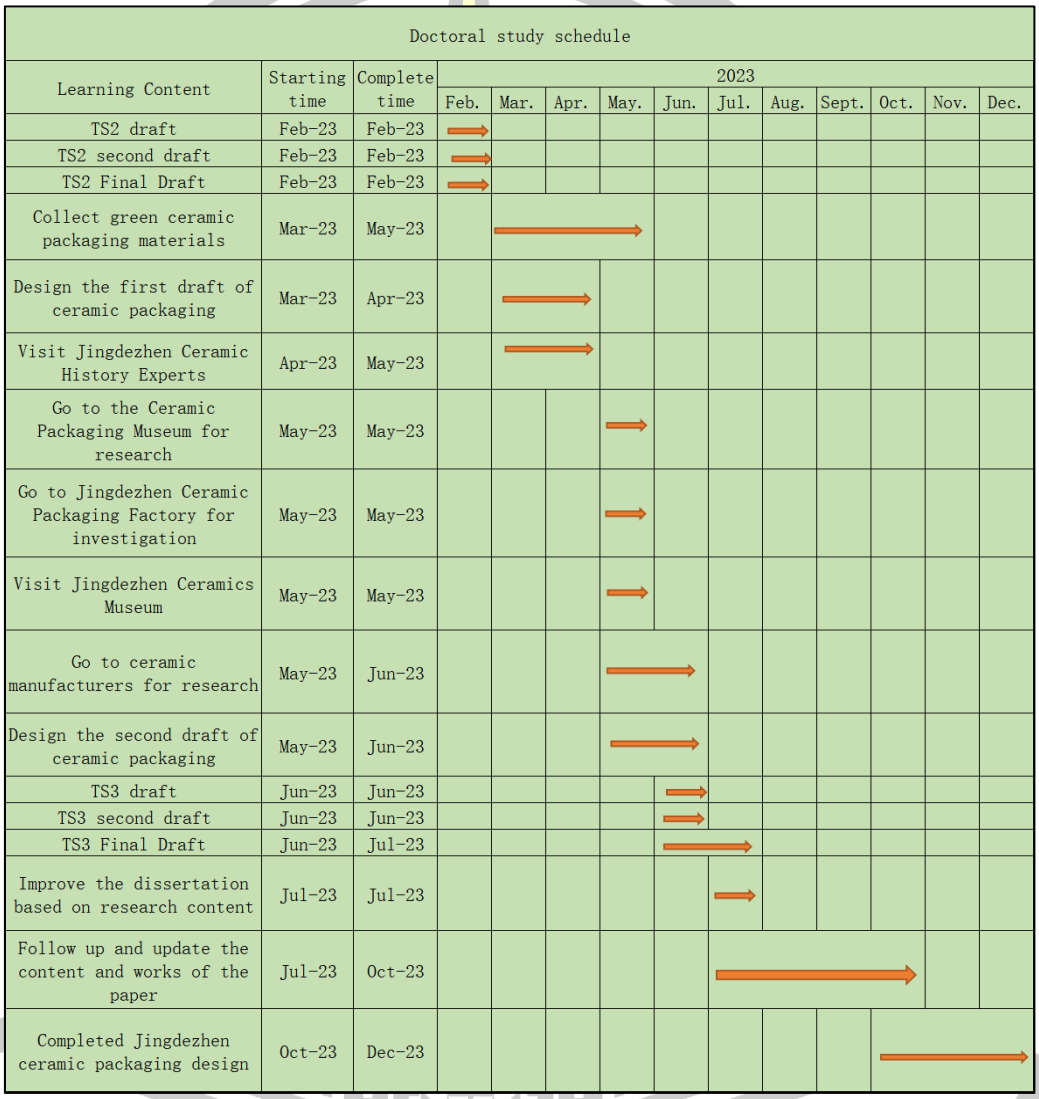
Figure 5 Framework.
Source: Drawn by Ye Li ,2023

This paper focuses on the concept of green packaging design and Jingdezhen local ceramic culture, the design needs to be traditional culture as the core of the design, in the process of ceramic packaging design research, through the study of the history of Jingdezhen ceramics and packaging history, the traditional ceramic culture of modern interpretation is the whole process of packaging design cannot be changed in the core point. Local traditional patterns can best reflect the national characteristics and cultural heritage of the region, is to convert an abstract concept into a concrete physical form and the carrier of the communication process. Ceramic packaging is one of the main design elements is the pattern, the pattern has a simple and clear expression of the effect as well as their own strong infectious force, in the fierce competition of modern ceramic products is also occupies a very important position.

Green packaging its main purpose is to protect environmental resources, the natural environment and human health will not produce harm, easy to recycle or degradable, can effectively promote the sustainable development of packaging. Packaging simplification, packaging materials can be recycled, packaging waste generated by the biodegradable, packaging materials, such as safety is the main meaning of green packaging under the premise of the development of ceramic packaging design also needs to be involved in the development of the heritage of

culture, the sustainable development of the enterprise's economic development and sustainable development of the environment, so the redesign of ceramic packaging is imperative.

10.**Research Plan**



Doctoral study schedule													
Learning Content	Starting time	Complete time	2023										
			Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
TS2 draft	Feb-23	Feb-23	→										
TS2 second draft	Feb-23	Feb-23	→										
TS2 Final Draft	Feb-23	Feb-23	→										
Collect green ceramic packaging materials	Mar-23	May-23		→	→	→							
Design the first draft of ceramic packaging	Mar-23	Apr-23		→	→								
Visit Jingdezhen Ceramic History Experts	Apr-23	May-23			→	→							
Go to the Ceramic Packaging Museum for research	May-23	May-23				→							
Go to Jingdezhen Ceramic Packaging Factory for investigation	May-23	May-23				→							
Visit Jingdezhen Ceramics Museum	May-23	May-23				→							
Go to ceramic manufacturers for research	May-23	Jun-23				→	→						
Design the second draft of ceramic packaging	May-23	Jun-23				→	→						
TS3 draft	Jun-23	Jun-23					→						
TS3 second draft	Jun-23	Jun-23					→						
TS3 Final Draft	Jun-23	Jul-23					→	→					
Improve the dissertation based on research content	Jul-23	Jul-23						→					
Follow up and update the content and works of the paper	Jul-23	Oct-23						→	→	→	→		
Completed Jingdezhen ceramic packaging design	Oct-23	Dec-23									→	→	→

Figure 6Research plan

Source: Drawn by Ye Li ,2023

11.**Framing of the full text**

Chapter I. Introduction

Chapter 2 Jingdezhen ceramic packaging research

Chapter 3 analyses green ceramic packaging design

Chapter 4 Integration of Native Culture and Ceramic Packaging.

Chapter 5 Jingdezhen traditional culture of green ceramic packaging innovation design

Chapter 6: Summary and conclusions

12.**Benefits of the study**

Designing packaging for Jingdezhen ceramics involves a deep dive into the culture and history of ceramic packaging. By leveraging traditional cultural elements flexibly within the design, and incorporating modern scientific advancements and design concepts, this approach breathes new life into the exquisite local culture, making ceramic packaging more distinctive, inheritable, and contemporary. This strategy ensures that the ceramics possess more personality and uniqueness. Native traditional motifs are particularly effective in reflecting national characteristics and the cultural legacy of a region, transforming abstract concepts into tangible forms that facilitate communication. Patterns, as one of the main design elements in ceramic packaging, play a crucial role due to their ability to convey messages simply and powerfully, thus holding a significant place in the competitive modern ceramic market.

The study spans three aspects: the materials used in ceramic packaging, sales packaging, and transport packaging. It analyzes various packaging materials and transportation methods, highlighting the benefits and drawbacks of each, and underscores the importance of green packaging solutions for ceramics and businesses. The current diversity of ceramic packaging materials includes plastics, wood, paper, and more, with plastic and wood being prevalent yet least aligned with green development goals. Hence, the transition towards more recyclable and biodegradable materials is advocated to promote green packaging practices.

Jingdezhen ceramic packaging design not only has the potential to revamp a company's brand image but also to enhance brand value. This research offers insights into selecting optimal solutions for ceramic packaging design, analyzing the impact of color, graphics, and text on packaging, and discussing design principles, methodologies, and strategies. It explores how traditional culture can be intertwined with packaging design materials to create more culturally rich packaging that resonates with ceramic culture. By focusing on ceramic packaging design, the aim is to boost corporate and brand value promotion, further the spread of ceramic culture, and consequently stimulate the economic growth of the ceramic mark

Chapter II

Jingdezhen ceramic packaging research

1.History and origin of Jingdezhen ceramics

1.1 History and Culture of Jingdezhen Ceramics

China holds the distinction of being the world's earliest country to invent porcelain, with the appearance of primitive porcelain as early as the Shang Dynasty, exemplified in Figure 7. This early form of porcelain represents a transitional product from pottery to porcelain, marking a significant advancement in China's ancient porcelain technology. Over the ages, from the Zhou Dynasty through the Spring and Autumn and Warring States periods, as well as the Qin and Western Han Dynasties, kiln workers' continuous development and improvements in porcelain production techniques—such as advancements in raw material processing, molding tool innovations, refinement of the clay body, enhancements in kiln structure, temperature control, and methods of preparing the body and glaze—led to the significant evolution of primitive porcelain. By the late Eastern Han Dynasty, these developments culminated in a new chapter in the history of Chinese ceramic production, laying the groundwork for unprecedented growth in the porcelain industry during the Three Kingdoms, the Two Jin, and the Northern and Southern Dynasties. During the Han Dynasty, the introduction and widespread use of low-temperature lead glazes for pottery set the stage for the later development of a variety of low-temperature glazes in different hues.

Figure 7Primitive pottery

Photo credit: Taken by the author at Jingdezhen Ceramic Museum

The Jingdezhen porcelain industry boasts a rich history, encapsulated in the phrase "two thousand years of smelting history, one thousand years of history as an official kiln, and six hundred years as an imperial kiln." This legacy has endowed the small town, nestled in the south of the Yangtze River, with exquisite porcelain technology, a comprehensive porcelain system, and a profound ceramic culture. Through generations, Jingdezhen has managed to continuously innovate while preserving its heritage, earning a global reputation as a porcelain capital. Ceramics form the cornerstone of Jingdezhen's identity. Over millennia, it has assimilated the finest practices and National quintessence from renowned kilns nationwide. The origins of Jingdezhen's ceramics trace back to the Eastern Han Dynasty, marking over two millennia of history. The "Jingdezhen Pottery Records" note, "(Jingdezhen's) land and water are conducive to ceramics, fostering a tradition among the locals." It goes on to say, "Since the Chen dynasty, Jingdezhen's pottery has been world-renowned." Describing the kilns, it mentions, "Early Tang ware, characterized by its white clay loam, resulted in slightly thin bodies and vibrant glazes, crafted by the skilled hands of Jingdezhen's artisans." "Yi Zhi" states: "During the Tang Dynasty's Wude era, Jingdezhen became famous for its 'faux jade' porcelain, which was transported to Guanzhong and presented as tributes to the imperial court, catapulting Changnan town's porcelain to worldwide fame." This indicates that by the early Tang Dynasty, Jingdezhen's porcelain industry had already achieved significant acclaim, as illustrated in Figure 8.

Figure 8History of ceramic development
Photo credit: Taken by the author at Jingdezhen Ceramic Museum

"The Jingdezhen Pottery Records" document that the Chu region of Changsha had a type of pottery known as the Liling soil bowl, which was of a coarse quality with a thick body and a glaze color that ranged from yellowish-brown to slightly black. The center of the bowl and the foot were often unglazed, reminiscent of the rough pottery produced in Changnan during the Han Dynasty. At that time, Jingdezhen's pottery was still considered a crude product, primarily for local and nearby markets, and was not meant for export.

During the Eastern Jin Dynasty, a significant figure named Zhao Emotional emerged. Utilizing his understanding and mastery of Yue kiln porcelain production techniques from Zhejiang, he executed a series of major reforms in Jingdezhen, transforming aspects like glaze preparation, molding, and firing. His contributions to the development of Jingdezhen's ceramics were pivotal, earning him the honorific title "Master of Porcelain Production" and leading to the establishment of a temple in his name within the town.

By the first year of the Southern Dynasty's Chen Zhide era (583 AD), the porcelain industry in Jingdezhen had made considerable strides. Historical records cite that since the Chen dynasty, Jingdezhen's porcelain had become renowned worldwide. In the Tang Dynasty, Jingdezhen's ceramic production saw great advancement, and the market for these goods expanded southward, northward, and southwestward. Archaeological findings indicate that Tang porcelain was exported primarily through two routes: one overland via the ancient Silk Road from Xi'an through Xinjiang to the Middle East, and the other by sea from Guangzhou around Malaysia, through the Indian Ocean to the Persian Gulf and Mediterranean countries.

Ancient records are silent on the Jingdezhen porcelain industry during the Five Dynasties. However, investigations of ancient kiln sites from the 1950s and 1980s suggest that the industry had begun to take shape, with 18 kiln sites producing a variety of porcelain during this period.

Following the southward migration of the Song court, numerous master craftsmen from prominent northern kilns migrated to Jingdezhen, bringing advanced porcelain technology that significantly enriched the local ceramic industry. Porcelain technology during the Song Dynasty improved markedly, as evidenced by the emergence of blue and white porcelain, a defining characteristic of the era. This type

of porcelain, which became prevalent in the mid-Song period, represented a monumental leap in China's porcelain industry—from transparent glaze to a transparent body, and from soft to hard porcelain.

By this time, Jingdezhen porcelain, in terms of texture, shape, glaze, and production, had entered a golden age, a period the West deemed "the era of porcelain success." The term "shadow green" is commonly used for "blue and white porcelain," with some referring to it as "hidden green." In the Ming Dynasty, Song Yingxing's "Tian Gong Kai Wu" referred to shadow green as "plain jade bone." Since the Song Dynasty, Jingdezhen's porcelain has been distributed "throughout the nine provinces, reaching foreign shores," with the "Ceramic Road" by sea becoming a vital conduit for East-West cultural exchanges, in tandem with the terrestrial "Silk Road," and earning historical fame. During this period, Jingdezhen's porcelain industry experienced rapid development as shown in Figure 9.

Figure 9Song Dynasty Ceramics
Photo credit: Taken by the author at Jingdezhen Ceramic Museum

During the Yuan Dynasty, Jingdezhen porcelain witnessed significant advancement, as depicted in Figure 10. An event of considerable importance occurred between the mid-12th century of the Southern Song Dynasty and the 13th century of the Yuan Dynasty, which altered Jingdezhen's destiny: the people of this ancient town

began to use kaolin as a raw material for the porcelain body, subsequently inventing a binary formula for porcelain material production. This innovation mitigated the crisis of raw material scarcity, dramatically increased the rate of finished products, and enhanced the whiteness of the porcelain, heralding a new age of high-temperature, hard porcelain.

The maturity of blue and white porcelain during this period signaled the advent of the era of Chinese colored porcelain. The successful firing of blue and white, underglaze red, eggshell white glaze, and colored glaze porcelains, combined with the use of kaolin, propelled the Jingdezhen porcelain industry into a golden era. In the Yuan Dynasty, the government established the "Fuliang Porcelain Bureau" in Jingdezhen. The town was home not only to the government-operated "Jufu" kiln but also saw the number of kilns grow to over 300. Yuan Dynasty blue and white porcelain holds a significant place in the annals of porcelain production.

Underglaze red, or glaze red, was a major innovation by Jingdezhen's porcelain artisans during the Yuan period. The emergence of blue and underglaze red marked the end of China's long-standing reliance on monochromatic glazes, transitioning porcelain decoration into a new era of underglaze color and forming distinctive Chinese porcelain characteristics.

Figure 10Yuan dynasty ceramics
Photo credit: Taken by the author at Jingdezhen Ceramic Museum

During the Ming Dynasty, Jingdezhen ascended to become the national hub for porcelain production, as illustrated in Figure 11, establishing itself as a world-renowned metropolis in the porcelain industry. The craftsmanship of blue and white porcelain peaked during this era, alongside significant achievements in overglaze polychrome painting, the Chenghua-style Doucai, and various colored glazes. In the second year of the Ming Hongwu era (1369), the imperial court established the "Imperial Kiln Factory" in Jingdezhen. At that time, the town hosted 58 official kilns and hundreds of private kilns, producing a spectacle of "white smoke covering the sky by day, and red flames illuminating the heavens by night."

After the mid-Ming Dynasty, Jingdezhen became the focal point for kilns worldwide, with the town bustling with "servants and workers... numbering no less than hundreds of thousands each day." Jingdezhen, along with Hankou Town, Foshan Town, and Zhu Xianzhen, rose to prominence as one of China’s four great towns.

During the Qing Dynasty, especially throughout the reigns of the Kangxi, Yongzheng, and Qianlong emperors, Jingdezhen's porcelain production skills soared to unprecedented heights. This period saw the creation of Kangxi blue and white, Wucai (later known as Gucai), and the three Monochrome glazes, influenced by court enamels. Additionally, new varieties such as Yongzheng pastels and Lang kiln red emerged, becoming highly valued glazes.

At that time, Jingdezhen had a population exceeding 100,000. The porcelain industry flourished with throngs of merchants, and the town was described as a place where "the wonder of blossoming porcelain captivated all directions, with half of the twenty-mile-long street occupied by kiln families." However, by the late Qianlong era, the porcelain industry in Jingdezhen began to decline. In the early Jiaqing period, the production variety and quantity at the imperial kiln factory dwindled significantly compared to the Qianlong period. Following the Opium Wars, Jingdezhen’s porcelain industry suffered severe setbacks.

Figure 11Ming Dynasty Ceramics
Photo credit: Taken by the author at Jingdezhen Ceramic Museum

At the end of the Qing Dynasty and the onset of the Civil War, Jingdezhen saw the emergence of "Anhua light red color" porcelain, an imitation of the light red landscape painting style of Yuan Dynasty painter Huang Gongwang. This unique low-temperature colored porcelain was a breath of fresh air in the pottery scene and swiftly gained popularity in Jingdezhen's ceramic industry. Pioneering this new wave were representative artists from Anhui Province's Yi County and Chengmen, as well as Jin Pinqing, a painter from the Imperial Kiln Factory, and the renowned Wang Shaowei, famed for his "light-red color" works. These artists championed new ceramic painting techniques and forms of decoration. Their efforts to replicate the light red landscape painting style of the Yuan Dynasty on porcelain later developed into a popular school of literati painting that endured into the early years of the Republic of China.

During the early Republic of China, Jingdezhen's fine art porcelain began to make its presence felt on the global stage, participating in international exhibitions and competitions, as shown in Figure 12.

Figure 12Qing Dynasty Ceramics
Photo credit: Taken by the author at Jingdezhen Ceramic Museum

In 1912, Jingdezhen's "Porcelain Tower" was awarded the Gold Medal at the Italian International Exposition. Following that, in 1914, Xu Baisheng's "Porcelain Carved Dragon Boat" along with Pan Runyu's creations clinched the Gold Medal at the Chicago International Exposition and garnered the winner's prize. In 1915, a trio of masterpieces from Jingdezhen, including Wang Dafan's "Fortune and Longevity" pastel porcelain panels, Wang Yuting's "Ink Colored Landscape" porcelain panels, and the "Yan Deyi ceramics" number ebony glaze vase, received Gold Medals at the Panama-Pacific Exposition held in San Francisco, USA.

In 1932, Zeng Longsheng's "Sun Yat-sen Porcelain Statue" (a porcelain sculpture) was also awarded the Gold Medal at the Panama International Exposition. It's notable that during the Republic of China era, ceramic paintings began reflecting social events, including themes of war. This period also saw the emergence of a new literati school of art in porcelain, injecting fresh vitality into the Jingdezhen porcelain industry. In 1918, the governor of Fuyang County, Xu Zhongting, convened well-known ceramic artists and porcelain masters to establish the Jingdezhen Porcelain Art Research Society. The main focus of this society was to drive innovation in ceramic art, including porcelain design and colored glaze ceramics, as well as restoration and innovation.

After the dissolution of the Porcelain Art Research Society, in 1928, led by Wang Qi, a new ceramic artists association, the Yue Circle, was established, featuring the renowned "Eight Friends of Zhushan," as depicted in Figure 13. Each artist had a distinct style and contributed to the fusion of ceramic painting with fine art. They continued to develop new techniques for painting on porcelain, carrying forward and advancing the traditional Jingdezhen techniques of colored porcelain painting. Alongside the "Eight Friends of Zhushan," other prominent figures included blue and white artist Wang Bu, pastel porcelain landscape artists Zhang Zhitang and Wang Dacang, figures and ladies painter Fang Yunfeng, fish and algae themed artist Zhang Peixuan, bird and flower specialist Yu Hanqing, Cheng Yunong, master of porcelain carving Zeng Longsheng, and a host of others who traveled between Changnan and Jingdezhen, as well as those who operated 'red shops' in Nanchang (shops specializing

in painting on white porcelain). These pastel porcelain artists included Liu Xiren, Zou Wenhou, Tu Juting, Wan Yunyan, Liu Zhongqing, Liang Tuisi, and more.

Figure 13The Eight Friends of Mount Pearl
Photo credit: Taken by the author at Jingdezhen Ceramic Museum

During the Republic of China, despite the turmoil of the times, Jingdezhen's ceramic vocational education emerged and continued to advance without ceasing. Thanks to the efforts of numerous pioneers in ceramic vocational education, Jingdezhen consistently cultivated ceramic specialists who actively engaged in ceramic innovation and the application of modern ceramic technologies, marking a significant endeavor in China's modern vocational education. To rejuvenate the porcelain industry in Jingdezhen, many distinguished societal figures and visionaries advocated for porcelain enhancement through a series of reform initiatives. Efforts included attempts to establish new porcelain factories (companies), innovations in porcelain technology, and the founding of ceramics vocational education. Both the government of the Republic of China and civilian forces contributed significantly during this period. While inheriting traditional porcelain technology, Jingdezhen also underwent substantial changes in production methods, molding technology, firing techniques, and decorative processes.

After the establishment of the People's Republic of China, the Jingdezhen porcelain industry transitioned from decentralized production to a more intensive model, from handmade to mechanized techniques, and from wood-fired, coal-fired, and oil-fired

kilns to gas kilns, experiencing a period of flourishing progress. The "Ten Porcelain Factories" referred to the large-scale porcelain factories established under the planned economy. In April 1950, the state-owned Jianguo Porcelain Company was founded on the basis of the confiscated Jiangxi Porcelain Company, becoming the earliest state-run ceramic enterprise in the city. By July 1958, to expand the scale of ceramic enterprises and increase the degree of the nationalized economy, Jingdezhen merged 10 public-private porcelain factories, 9 porcelain production cooperatives, and some painting cooperatives according to various factors such as location and product. This merger resulted in 9 large-scale enterprises, namely the Art Porcelain Factory, Xinping Porcelain Factory (later renamed the People's Porcelain Factory), Red Flag Porcelain Factory, Huadian Porcelain Factory, Dongfeng Porcelain Factory, Architectural Porcelain Factory, Red Star Porcelain Factory, Arts & Crafts Porcelain Factory (later renamed the Sculpture Porcelain Factory), and the Cosmos Porcelain Factory, alongside the existing Jianguo Porcelain Factory, collectively known as the "Ten Porcelain Factories". At the time, these factories employed approximately 38,000 workers.

Subsequent adjustments and expansions introduced new enterprises such as Jing Xing Porcelain Factory, Bright Porcelain Factory, Xinhua Porcelain Factory, Red Porcelain Factory, Aurora Porcelain Factory, Xinfeng Porcelain Factory, for the People's Porcelain Factory, Huafeng Porcelain Factory, among others. With the establishment of the "Ten Porcelain Factories," Jingdezhen’s porcelain production surged, with the firing process evolving from manual to mechanical and transitioning from wood, coal, and oil kilns to gas kilns, continuing the legacy of the porcelain industry.

By 1995, major porcelain factories began restructuring, a process largely completed by 2009. Yet, people still tend to collectively refer to the large-scale porcelain factories prior to restructuring as the "Ten Porcelain Factories," a testament to their lasting impact on the identity of Jingdezhen’s porcelain industry.

1.2 Cultural heritage

Jingdezhen, an ancient cultural town with a history of more than 1700 years of township, born of porcelain, famous for porcelain, and prospered by porcelain, is the historical witness of Jiangxi "Millennium Porcelain Capital" and a business card of

Chinese ceramic culture. In its long history of development, through the porcelain sold to the world, not only brought a generous economic income, so that the people rich, creating a "craftsmen to the eight, ware into the world to go," the prosperity of the scene. At the same time, also greatly promote the cultural exchanges between China and the West, porcelain in English "CHINA" has become the abbreviation of China and Jingdezhen porcelain culture is not unrelated to the dissemination of foreign. To a certain extent, the history of the development of Jingdezhen ceramic culture is a history of the development of China's pre-industrial civilization, Jingdezhen ceramics are known as "white gold" by the western society and renowned around the world.（Zheng Yunyun, Li Yanfen2021).In August 2019, the National Development and Reform Commission and the Ministry of Culture and Tourism issued the "Jingdezhen National Ceramic Culture Heritage and Innovation Pilot Area Implementation Plan", which clearly states: "Jingdezhen porcelain is an important cultural symbol for the world to know China and China to the world, as well as an important carrier for the inheritance of Chinese culture." It also calls for "strengthening the ceramic culture of China" and "strengthening the ceramic culture of China", and requires "strengthening the ceramic culture of China". And requirements "to strengthen the ceramic culture protection heritage innovation" "to promote the innovative development of ceramic culture industry". In the development of Jingdezhen ceramic culture, we must dig deep into the development of Jingdezhen ceramic culture of the historical process, explore the Jingdezhen ceramic culture of modern inheritance of feasible paths, which is of great significance for the protection of good inheritance of good use of Jingdezhen excellent ceramic culture.

Jingdezhen ceramic culture is China's outstanding traditional culture, "treasure", in the modernity of the vision, its inheritance, development is the history of Jingdezhen's heavy responsibility. In fact, "Jingdezhen national ceramic culture inheritance and innovation pilot area implementation program me" implementation, fundamentally speaking, is to achieve the modern inheritance of Jingdezhen ceramic culture. In this regard, Jingdezhen must grasp the opportunity to meet the challenge, starting from the soft power of culture, explore Jingdezhen ceramic culture diversified inheritance of the living model, in order to achieve the modern transformation and innovative development of Jingdezhen ceramic culture.

Today's era, is the "Internet +" era, such as big data, cloud computing, Internet of things, blockchain and other information technology to obtain unprecedented development, in this context, the use of information technology to disseminate the Jingdezhen ceramic culture is the topic of modern heritage of Jingdezhen ceramic culture. In this regard, to deeply excavate the connotation of Jingdezhen ceramic culture, with culture as the root, with porcelain as the axis, with history as the line, will be associated with the historical evolution of Jingdezhen ceramic culture in the development of technological technology, cultural celebrities, emperors, ruins and other sites of the integration of in-depth excavation, Jingdezhen ceramic culture stories to speak deep, speak through, speak alive, and made into a short video web page, etc., the use of the financial media for wide dissemination, so that the culture of Jingdezhen with the help of information technology means to achieve the development of information technology. Jingdezhen culture with the help of information technology means to achieve the maximum range of dissemination, highlighting its cultural charm. To establish Jingdezhen ceramic culture celebrity museum, the development of Jingdezhen ceramic culture is inseparable from many skilled craftsmen, including Jingdezhen porcelain master Zhao Dexue (Eastern Jin Dynasty), Huo Zhongchu (Tang Dynasty), Tang Ying (Qing Dynasty), "Eight Friends of Zhushan" (Republic of China) and so on, through the excavation of Jingdezhen ceramic celebrities of historical information and historical contribution, and through the jittery voice, Weibo, Weibo, public website and so on, to make Jingdezhen culture achieve the maximum range of dissemination by means of information technology, highlighting its cultural charm. By digging Jingdezhen ceramic Celebrities historical information and historical contribution, and through the jittery voice, micro letter public number, microblogging, website and other ways to carry out a full range of promotion, tell the story of Jingdezhen ceramic culture development of the celebrities, so that the historical and cultural resources into economic and social development resources, help Jingdezhen ceramic culture dissemination. To vigorously develop ceramic creative industries, "porcelain" as the elements, to porcelain, porcelain road, porcelain business as the theme, create and develop a number of Jingdezhen ceramic culture closely related to cultural and creative products, including the creation of "ancient kiln impression" cultural scenic spots, filming and culture of Jingdezhen

Highly relevant film and television works, etc., to form a three-dimensional, diversified cultural and creative industries, expanding the strategic ideas of cultural marketing.

Jingdezhen ceramic culture dissemination, in the final analysis, is a kind of artefact culture of Chinese expression. In the modern inheritance and dissemination of Jingdezhen ceramic culture, it is necessary to take the artefact culture as the core and realise diversified development in accordance with the requirements of the development of the times. To face modernisation and globalisation, perceive modern people's life style, cultural demands, the style of the times, etc., combined with the needs of the times for cultural innovation of artefacts, to create artistic masterpieces with a rich content of the times, for example: combined with the needs of the airport development, innovation and development of the production of "art ceramic carpet" with the texture of the traditional fibre carpet and ceramic physical texture. ", not only highlights the practical value of ceramics, but also enhances the cultural added value of ceramics, so that Jingdezhen ceramics more and more highlight the value of Chinese symbols. To combine large sports events, traditional cultural elements, folk customs, etc., these elements into the Jingdezhen ceramic culture and art creation, so that the Jingdezhen ceramic culture with the Chinese spirit, the depth of Chinese culture, with Chinese style, for example: the Olympic Games, the Asian Games, etc. held as an opportunity to create in the creation of embedded in the Chinese elements, to create works of art echoing the spirit of sports, will greatly enhance the attractiveness of ceramic culture （ Zhang Huilin, Li Haidong， 2020）. The attractiveness of ceramic culture will be greatly enhanced （ Zhang Huilin, Li Haidong， 2020）. To strengthen synergistic cooperation, the formation of artifacts cultural centre, adhere to the principle of multi-head cooperation, integration of government agencies, ceramic culture research institutes, colleges and universities, ceramic culture civic organisations, market players, etc., to play a prominent role in the modern inheritance of ceramic culture of Jingdezhen of different strengths, around the how to create artistic masterpieces, how to innovate the craft, how to regulate the development of the market, how to encourage the development of the originality of the artwork and other topics. Theme, in human, material and financial resources to

support, support, in order to stimulate the original passion of different subjects, to achieve the prosperity of Jingdezhen ceramic culture.

The thousand-year-old porcelain capital Jingdezhen is the world's ancient porcelain industry masterpiece. Ceramic culture has a long history, in its long-term development process, leaving a large number of sites and remains, these sites and remains have become witnesses to the development of ceramic culture in Jingdezhen, but also the valuable heritage of the modern inheritance of ceramic culture in Jingdezhen. In this regard, it is necessary to do a good job in the protection of ruins and remains, in the protection and development of its due historical value. First of all, to speed up the application for the world intangible cultural heritage, Jingdezhen ceramics have hundreds of years of history of official kilns, and left a large number of civilian kiln sites, including the Imperial kiln factory site, Lok Ma Bridge kiln site, Hutian kiln site, Le Ping South kiln site of ancient porcelain kilns, kaolin mine site, Dongbu dock, etc., which are the precious resources of the Jingdezhen ceramics culture, with a unique historical heritage in the process of the application for the heritage, we must highlight the protection and development of the sites and remains. Relics of the protection and development, the heritage as Jingdezhen ceramic culture modern heritage of outstanding work to grasp, so that Jingdezhen this living "ceramic history and culture textbook" better real show (Li Songjie, Wu Qi,2019)Secondly, the construction of Jingdezhen Museum of Ceramic History, a museum is a cultural history, Jingdezhen to build a Chinese ceramic culture museum city, a large number of ceramic products with historical significance and historical connotations in the museum to focus on display. At the same time, explore Jingdezhen ceramic culture protection of new models, such as: the construction of ancient ceramic gene bank in Jingdezhen, will be unearthed over the generations of imperial kiln gene specimens for collection, the construction of open shared database, and the use of modern information technology, digital display, to create a world-renowned ceramic digital museum, for the protection of culture, research, development, imitation, escort.

Technological innovation is the first productive force, in the modern inheritance of Jingdezhen ceramic culture, we must take the material technology innovation as the lead, through technological innovation to develop ceramic products with technological value-added, to continuously enhance the economic and social benefits,

only in this way can we better realise the ceramic culture dissemination and inheritance. In this regard, we must adhere to the focus of new ceramic materials research, the use of colleges and universities, research institutes and other advantages of the construction of a number of advanced ceramic materials Institute, Institute of New Energy Materials and Devices, etc., to strengthen the magnetic ceramics, high-tough ceramics and semiconductor ceramics materials, such as R & D efforts, and transformed into a reality of the production capacity to achieve the scientific and technological research and development to the scale of the benefits of the transformation, and constantly enhance the influence of Jingdezhen ceramic technology innovation. At the same time, we should take the new glaze and artistic design techniques as an entry point, the traditional ceramic craft techniques and modern ceramic production process, not only to inherit the seventy-two crafts of Jingdezhen ceramics production, but also research and development of new production processes, and adhere to the depth of the fusion of artistic design, process optimisation and cultural innovation, to tell a good story of China, highlighting the cultural charms, and constantly improve the quality of Jingdezhen ceramics and the added value. value-added, so that the ancient Jingdezhen ceramic culture glows in the modern vision.

In short, Jingdezhen is China's "millennium porcelain capital", in the history of the development of Chinese ceramic culture has a pivotal position. In the long history of Jingdezhen ceramic culture development, emergence of a large number of bright cultural masterpieces and technology, from the ancient "burnt pottery" to the Han and Tang dynasties "white porcelain" and then to the Song and Yuan period of the "shadow celadon porcelain from the ancient "burnt pottery" to "white porcelain" in the Han and Tang Dynasties, to "shadow blue porcelain" in the Song and Yuan Dynasties, to "blue and white porcelain". Into the new China, Jingdezhen ceramics and re-take up the revival of ceramics of the historical mission, emerged in the glaze, comprehensive color, modern pottery, modern blue and white, glaze in the color of modern ceramics rich in new technology, new materials, for the development of Chinese ceramics injected a strong impetus. Jingdezhen ceramics, as an important part of the excellent traditional Chinese culture, must adhere to the principle of modernity transformation and innovative development, develop, make good use of, and develop

Jingdezhen's millennium porcelain culture, so that it can be inherited and developed under the vision of modernity.

2. **Packaging of Jingdezhen Ceramics**

2.1 The concept of ceramic packaging

Ceramic artistry boasts an extensive and vibrant history, stretching back to antiquity and unfurling a tapestry of diverse content and styles through the ages. The evolution of ceramics, both functionally and technologically, is intimately linked with the advancements in ceramic production methods. This evolution has progressed from rudimentary hand molding to the use of the potter's wheel, transitioning from slow-turning to fast-spinning techniques.

Early evidence suggests that initial ceramic creation was driven by practical needs, with artisans handcrafting simple, small objects. As techniques evolved, the coil building method, which involved layering ropes of clay, enabled the crafting of larger vessels like jars and bottles, significantly broadening the range of ceramics as packaging containers. The advent of the slow and fast potter's wheel further propelled the development of ancient packaging containers, facilitating large-scale and diversified production and yielding more uniformly shaped containers.

In discussions on ancient ceramic packaging, it's important to acknowledge the substantial differences between ancient and modern ceramic packaging designs. While it may be tempting to apply modern definitions and concepts to ancient practices, this can lead to anachronisms. Despite sharing common functions like containment, protection, and decoration, there is a significant temporal and contextual gap between the two.

Ceramic packaging, as a human artifact, was created for the convenience and service of human use. At a foundational level, both ancient and modern ceramic packaging designs are united by their role within human-made design. In this discourse, the traditional term "ceramic container" will be used interchangeably with "ceramic packaging" to bridge this connection.

This book endeavors to provide a systematic overview of China's ancient ceramic packaging. It will chart the evolution of ceramic functions across different historical periods, examining the styles that emerged, material selection and production

techniques, functionality, form and shape development, decorative forms, aesthetic principles, and the cultural meanings embedded within these items. By integrating these findings with modern ceramic packaging design theories, the goal is to offer a comprehensive narrative that could serve as a source of inspiration and a point of reference for contemporary ceramic packaging design. This attempt is not just an academic exercise but seeks to inform and enrich the practices of modern designers.

Packaging markedly diverges from typical artifact-related activities due to its inherent dependency on the objects it encases. Unlike artifacts that can stand alone, packaging is an artifact behavior that exists solely in relation to the items it serves, lacking independent existence. Its presence is invariably defined and limited by the characteristics of the packaged goods. Consequently, the evolution and advancement of packaging are closely tied to the progress and sophistication of the products it surrounds.

The core driver of packaging's development and evolution is intertwined with the broader narrative of human society's advancement, particularly through enhancements in production techniques and elevations in living standards. Throughout human history, ceramic packaging has navigated a path from its initial emergence through developmental phases to its current modern interpretation. This journey is a testament to the dynamic process of evolution, paralleling human innovation in production methods and the ongoing upliftment of quality of life.

Ceramic packaging, like other artifact activities, has undergone a lengthy historical evolution. Its origins, development, and even recent modern transformations are deeply intertwined with human societal progress and closely linked to our production and daily lives. Throughout these stages, perceptions and understandings of packaging have shifted. Therefore, before delving into ancient ceramic packaging, it's essential to define what packaging entails and to explore its scope. This preliminary exploration will help illuminate the development trajectory and key developments of ancient ceramic packaging in China.

The term "packaging" is decidedly modern and is often regarded as a borrowed concept in our country. Notably absent from China's ancient historical records, the term was only officially defined in our country in 1983. Packaging refers to the use of containers, materials, and aids, applied through certain technical methods, to protect

products during distribution, facilitate their storage and transportation, and enhance sales. It also encompasses the operational activities involved in applying these technical methods to achieve the aforementioned objectives. Modern commodity packaging design involves the artistic and technical preparation of products to ease their transportation, storage, and sale, with the product itself being at the heart of packaging efforts. Effective packaging not only seeks to present products in the most appealing and reasonable form but also aims to capture consumer attention and make a lasting impression to succeed in market competition. Moreover, amidst growing environmental concerns in contemporary society, packaging increasingly emphasizes sustainability.

Packaging, in both form and substance, should epitomize the harmonious integration of practicality and aesthetics, tangibility and intangibility, and the relationship between humans, society, and nature. Definitions of packaging vary across different countries and epochs. The American "Packaging Glossary" describes packaging as the preparation of products for transport and sale. The British counterpart defines it as the artistic, scientific, and technical preparation of goods for transport and sale. Canada describes packaging as the means by which a product is delivered from the supplier to the customer in perfect condition. Meanwhile, Japan's Dictionary of Japanese Packaging Terms views it as the utilization of suitable materials, containers, and technology to ensure products reach their destination safely, thereby protecting the contents and maintaining product value during transport and storage.

Here, the term "packaging" is discerned to carry two distinct meanings: one relates to containers and packaging materials, essentially "packaging" as a noun; the other pertains to the act of enclosing or enveloping products, or "packaging" as a verb. Examining ancient historical texts with these definitions in mind, we find no exact ancient counterpart for "packaging." Instead, we encounter words like "package" and "loaded," or phrases that bear resemblance to the modern concept of "packaging," such as various forms of the word "pack."

In ancient Chinese, "package" predominantly conveys notions of encasing, concealing, or wrapping, while "loaded" encompasses meanings like wrapping, filling, concealing, adorning, compiling, and binding. From these interpretations, the

primary sense of "package" unequivocally points to wrapping, and the diverse meanings of "loaded" – from wrapping and bundling to filling and concealing – along with the etymological roots of "package" in characters like " wrap " and " enclose " suggest the act of wrapping an object and placing it inside another.

However, the connotations of these ancient terms and the modern specialized term "packaging" as indicative of human-made activities diverge significantly. Yet, this does not imply a lack of expression for packaging behavior in ancient Chinese language. The concept of "packaging" varies across different times, locations, and fields, leading to diverse interpretations. Thus, the absence of the specific term "packaging" in ancient Chinese texts does not denote a lack of understanding or knowledge of packaging concepts. It is crucial to adopt a dynamic and dialectical approach in comprehending how the meanings and implications of "packaging" have evolved over various historical periods.

Our comprehension of ancient packaging, particularly our insights into its earliest forms, necessitates a clear differentiation between packaging and containers or everyday utensils used independently in ancient times. Central to understanding packaging's basic function as a distinct category of artifacts is its inherent dependence on the item it encases. This relationship, steadfast through historical shifts, fundamentally revolves around safeguarding the item's content and facilitating its consumption and usage. Essentially, packaging's mission is deemed accomplished once it has aided in the transfer, circulation, and eventual consumption or use of the item.

Packaging embodies a dual nature of being both subordinate to and temporary for the item it protects. Its distinctiveness lies in its specific utility, setting it apart from containers and general daily utensils used in people's everyday lives, which operate independently. At its core, packaging serves a critical role in the logistics chain, aiming to ensure the seamless realization of the goods' use-value through a designated function or system. While packaging and daily utensils share a common goal of enhancing the service value of goods, packaging uniquely focuses on preserving the integrity of the packaged goods—encompassing content, nature, form, and quality—with minimal damage throughout the process. Its primary concern lies in safeguarding the continuity of the logistics process. In contrast, everyday utensils are typically used

independently, with no subordinate role, and emphasize the outcome of the goods' usage rather than the intermediary process.

From a macroscopic perspective, packaged goods, as the term suggests, are vessels designed for wrapping and containing items. Thus, in a broad sense, any container used for daily essentials and handicrafts, including parcels and external containers necessary for storage and transportation, falls under the category of packaged goods. This definition encompasses many ancient packaging containers for food, water, wine, and household items made from materials such as woven fabrics, wood, ceramics, and bronzes, provided they are utilized for purposes beyond mere display and decoration. However, such a broad classification may encompass almost all practical artifacts, including water jars, wine-filled copper pots, wooden boxes for clothing, and bamboo baskets for needles and threads, potentially overshadowing the distinct attributes of packaging products.

Adopting a narrower perspective, packaging is characterized by its accessory and temporary nature. It serves as an adjunct to the packaged goods, allowing for separation, and is defined by its transitory usage, being disposable after use (though retention is also an option). Therefore, general containers for water, wine, and food should not be considered packaging since their primary function differs. The essential role of packaging is to minimize damage to the packaged goods during preservation, transportation, and usage, while also simplifying handling, as seen in bundles, parcels, and boxes, which typify packaging products.

It's important to acknowledge that the distinction between broad and narrow definitions of packaging is not always clear-cut, harboring a degree of ambiguity and relativity. Some containers may also be considered packaging, such as trousseau boxes for jewelry, scripture boxes for religious texts, and inkstone boxes. These items often accompany their contents as accessories but lack the temporary quality typical of packaging and are not intended for disposal.

Ceramic artifacts arise from the instinctual needs of humans, serving as functional objects crafted for specific purposes. Among these, ceramic packaging containers are designed with a clear focus on practicality, fulfilling their role through two primary functions. The first is a protective function, ensuring the contents within are safeguarded during circulation, preserving their form and quality to minimize damage.

This protective aspect is crucial for maintaining the value of the goods and guaranteeing their successful utilization.

The second primary function of ceramic packaging is convenience. This encompasses facilitating the real-world application of the goods' value, making handling, transportation, storage, display, and accessibility (including collection, carrying, opening, and usage) more straightforward for users. Essentially, when we discuss ancient ceramic packaging, we refer to its role as a functional container, emphasizing its utility in packaging rather than being an object merely to be packaged.

Indeed, "everything evolves and transforms," and ceramic packaging is no exception. As human society progresses in political, economic, cultural, and ideological realms, the functional forms, concepts, and classifications of ceramic packaging continue to evolve. It's imperative to adopt a historical and dynamic perspective to comprehend ceramic packaging, rather than judging the packaging practices of various eras and stages by a singular standard.

Ancient ceramic packaging initially emerged out of utility, but due to the inherent human desires for aesthetics, emotion, and spirituality, it soon evolved to incorporate a blend of practicality and formal aesthetics as society developed. This evolution has continued to the present day, where packaging, while fulfilling its functional roles, also serves a spiritual purpose through decoration and beautification, reflecting aesthetic values. Decoration is not merely an essential aspect of human culture; it represents the thoughts, feelings, and cultural beliefs of people across different historical periods. Thus, the development of decorative techniques not only chronicles the history of human artifacts and aesthetics but also significantly enriches the art and aesthetic appreciation of ancient ceramic packaging.

Throughout historical development, an enhanced understanding of the natural world and advancements in science and technology have played a pivotal role in shaping the evolution of ancient ceramic packaging in China. Modern ceramic packaging, regardless of its intended purpose, material selection, design modeling, or structural processing, fundamentally aims to protect the goods and facilitate their circulation. Ancient ceramic packaging adhered to the same objectives, embodying simplicity, economy, and practicality as its guiding principles.

From ancient times to the present, China's economy has primarily been based on self-sufficient small-scale farming, resulting in a relatively underdeveloped commodity economy. Consequently, the design objectives and styles of ceramic packaging have been predominantly practical, emphasizing the protection of goods while striving for simplicity, economy, and practicality. This practical approach is evident in the selection of materials—often locally sourced and minimally processed—to maintain simplicity in both the production and the packaging process, whether concerning internal or external packaging.

Ancient ceramic packaging, while not necessarily focusing on the uniqueness of form or complexity of decoration, is deeply ingrained in traditional Chinese culture in both its design and ornamentation. Examining the artefacts that have survived to our times, it's evident that China's Neolithic ceramic packaging reflects the auspicious cultural beliefs through its physical motifs. For example, the colored pottery from Xi'an's Banpo and lintong's Jiangzhai sites from the Neolithic period features fish patterns in various configurations, such as conjoined dual or triple fish bodies, fish with two heads, fish concealing human figures within their bellies, as well as amalgamations of fish and birds, and even fish with human faces, known as "human-face fish patterns."

These fish motifs, abundantly used on packaging containers, symbolize the wishes of ancient ancestors for the prosperity and sustenance of their descendants, embodying auspicious patterns that were hoped to bring material abundance year after year. (as shown in Figure 14).

Figure 14Vase with salamander and fish in human face
Source: Photography by Ye Li, 2023

Ancient ceramic packaging, though not necessarily focused on the uniqueness of design or the complexity of decoration, is deeply entrenched in traditional Chinese culture. Examining extant artifacts, it's clear that Neolithic ceramic packaging from China reflects an embodiment of auspicious cultural concepts through its physical designs. For instance, colored pottery patterns featuring fish motifs, discovered in Xi'an Banpo and Lintong Jiangzhai, depict various symbolic forms such as conjoined fish, humans concealed within fish bellies, and "human-faced fish patterns." These motifs, prevalent on packaging containers, symbolize the primitive ancestors' wishes for clan prosperity and abundance.

However, factors such as geographical and cultural differences inevitably influenced ancient packaging materials and decorative arts, leading to distinct regional variations in ancient ceramic packaging. For example, differences in transportation methods driven by geographical environments resulted in divergent packaging requirements. Historically, the North and South of China primarily relied on water and land transportation, respectively, demanding different packaging solutions. Porcelain packaging for land transport needed higher shock resistance, whereas water transport could afford lower shockproof standards. Consequently, the

North often used barrels with fillers as packaging, even developing a method using sprouted plants like beans and wheat within porcelain to create a cushioning root network. As recorded in Song Meng Yuanlao's "Tokyo Dreaming Records - Tanabata," this innovative technique was known as the "seed of life." Conversely, the South favored wooden barrels, bamboo weaves, and simple grass ropes for securing porcelain, as noted in "Tao Shuo," highlighting the effective yet straightforward approach to ensuring the safety of ceramic products during transport.

Furthermore, the geographical environment's influence on available products, business structures, production customs, and even cultural concepts are reflected in the modeling and decoration of ceramic packaging. The agricultural society's desire for harmony with the heavens and humanity, a prevalent theme in primitive society's colored ceramic packaging, whether through figurative or abstract representations of plants and animals, embodies the ancients' sincere aspirations for natural blessings. At its core, this represents a deep-seated longing for harmony between heaven and humanity, encompassing the cultural essence of humanistic values, ethics, and morality within the terrestrial realm.

Pottery is regarded as the earliest form of man-made packaging utilized by primitive peoples. At the Yangshao culture site in Xi'an, Shaanxi Province, archaeologists unearthed a pointed-bottom pottery jar characterized by a spindle shape. This design allowed the jar to be securely inserted into the soil without toppling over. Its rope ears positioned on the lower part facilitated automatic submersion upon drawing water. The jar would self-right as it filled, stabilizing due to gravity's effect—a slight pour out would rebalance it. Additionally, the jar's surface bore engraved patterns or colored paintings, marrying artistic flair with functionality to achieve an impressively refined design. From a packaging perspective, this pottery jar holds significant value, serving as a crucial storage container and reflecting the prevalent packaging styles of the era through its decorations.

Before pottery production, humans were adept at using rope skills and various basketry and textile technologies, which were integrated into pottery creation. This technique involved using ropes to secure the clay, leaving impressions that gradually evolved into decorative patterns after firing. The presence of mat, rope, and textile imprints on numerous unearthed pottery shards attests to this development process.

Neolithic ceramic packaging containers primarily focused on function, with limited decoration due to the rudimentary understanding of pottery production techniques at the time. Typically, these were plain containers, with any decorations limited to simple polishing, geometric patterns, or embossed rope motifs. However, as practical experience accumulated and the skills of ceramic decorators matured, ancient ceramic packaging witnessed the introduction of painted decorations. These embellishments were applied through painting, engraving, stamping, and other techniques onto red or orange-yellow ceramic bases. The evolution from figurative imagery to abstract patterns is evident, showcasing aesthetic qualities like symmetry, contrast, balance, and the interplay of solid and void. For instance, the Majiayao culture's double-eared pottery jars with spiral patterns exemplify the use of concentric circles and wave patterns to create rhythmic and dynamic designs. The strategic use of scattered painted layouts achieves an overarching aesthetic of progression and confrontation, particularly concentrated on the container's upper portion. This design approach mirrors China's traditional "top-down" perspective. More importantly, these dynamic decorative changes embody a wealth of profound cultural meanings.

From the appearance of primitive porcelain in the Shang Dynasty to the authentic porcelain firing in the Eastern Han period, porcelain packaging containers featured relatively simple decorations and had not yet developed a unique artistic style. The introduction of make-up clay technology during the Wei and Jin dynasties enhanced the smoothness of porcelain packaging containers, and the widespread use of glazing techniques ensured a thick, uniform glaze layer, significantly elevating the artistic and aesthetic value of these containers.

The Sui and Tang dynasties marked a period of rapid development and flourishing in the decorative arts of porcelain packaging, with the emergence of diverse techniques such as printing, piling flowers, appliqués, carving, painting, and various glaze applications. These methods greatly enriched the aesthetic appeal of ancient porcelain packaging, bringing to life decorations that were flexible, vibrant, and expressive of various artistic styles—ranging from rugged and bold to fresh and elegant.

Functionally, porcelain packaging offered superior protective qualities due to its physical properties, in addition to the basic containment function common to ceramic

packaging. The evolution of decorative techniques expanded the decorative possibilities of ancient ceramic packaging.

By the Song Dynasty, ceramic production had reached a zenith, with the era's five famous kilns often drawing inspiration from everyday packaging prototypes. For instance, the Song white glazed engraved mesh cylinder mimicked bamboo basket transport packaging, authentically reproducing life's packaging elements. The widespread production of porcelain necessitated advancements in transport packaging, with strategies developed to minimize gaps and reduce impacts, addressing the primary challenge of porcelain's fragility.

By the Ming Dynasty, porcelain packaging had evolved to include cushioning, nesting, and bundling techniques to mitigate damage, a significant advancement from earlier methods. This period also saw the unique development of minority packaging, which, while adhering to traditional packaging styles, introduced distinctive national characteristics. For example, leather bag-type packaging, used by nomadic peoples, capitalized on the durability and portability of leather, as seen in the Liao dynasty's "green glaze stirrup pot."

The historical evolution of packaging is closely tied to societal development, reflecting contemporaneous socio-economic conditions, cultural practices, and becoming a microcosm of societal culture. Although traditional packaging may not reclaim its past prominence due to modern technological advancements, its natural, simple, and historically rich qualities continue to endear it to modern audiences. These historical legacies offer valuable insights and inspiration for contemporary packaging design in ecology, philosophy, ethics, aesthetics, material science, mechanics, and styling.

3**. The development of Jingdezhen ceramic packaging**

Ceramics holds a significant place as one of China's key cultural heritages, with a vast and diverse range of origins and production sites distributed across the nation. Jingdezhen, known as one of the ancient bases for porcelain in China, has made an immeasurable contribution to the field of ceramics. With its extensive history in pottery, Jingdezhen's ceramic culture has bestowed upon the city a splendid vibrancy, earning it the title of China's Porcelain Capital. Throughout the evolution of porcelain production, the aspect of porcelain packaging has also seen continuous development.

The "Development Process of Jingdezhen Porcelain Packaging" can be broadly categorized into three phases: the sprouting bean and wheat packaging, the straw series packaging, and the carton box packaging. (Guo row,1989) Ceramics hold a significant place as one of China's vital cultural heritages, with its roots and production spanning across the nation. Jingdezhen, recognized as one of China's ancient porcelain foundations, has made an invaluable contribution to the field of ceramics. Boasting a rich history in pottery, Jingdezhen's ceramic culture has imbued the city with a splendid vitality, earning it the title of China's Porcelain Capital. Throughout the lengthy evolution of porcelain production, the development of porcelain packaging has also progressed significantly. The evolution of Jingdezhen porcelain packaging can be broadly categorized into three stages: sprouting bean and wheat packaging, straw series packaging, and cardboard box packaging as shown in Figure 15.

Figure 15 Bean sprout packaging and straw packaging
Source: Photography by Ye Li, 2023

Since the Song and Yuan dynasties, spanning a millennium, Jingdezhen's adept ceramic packaging has been crucial for safeguarding the commercial and economic interests, cultural significance, and aesthetic value of ceramics. In contemporary times, as the need for protection becomes less of a priority, ceramic packaging has transformed into a medium for delighting people, offering cultural enrichment and a visual feast. The history of ceramic packaging, evolving alongside ceramics, has transitioned from rudimentary to sophisticated and from simple to intricate. This progression in packaging design has encompassed various formats, including fine barrels and coarse water bamboo containers. Within each vessel, a mixture of sand,

beans, and wheat is tightly packed, often consolidated into a unit and placed in a moist environment. Sprinkling water over time allows the beans and wheat to sprout, illustrating the meticulous and evolving art of ceramic packaging. (Chen Xianshu,1994) Rope strapping, basket packaging, wooden box packaging, and cardboard box packaging represent the traditional methods of ceramic packaging. In recent years, there has been significant advancement in ceramic packaging techniques. By the early 1980s, the export sector of ceramics had predominantly adopted basic cardboard packaging, while domestically, the traditional straw packaging for ceramics began to be phased out in favor of more modern carton packaging solutions. For premium or artistic products, luxurious brocade box packaging has also been introduced. However, viewed from a developmental perspective, these improvements are just the beginning. The issue of outdated packaging practices has yet to be fundamentally addressed and remains an area in need of further progress.

Ceramic packaging has been effectively utilized by humans since the primitive era. Historical records indicate that the pottery industry in Jingdezhen began during the Han Dynasty, experiencing rapid growth during the Tang and Song dynasties. The development of overseas trade starting from the Song dynasty significantly boosted the export of porcelain. Zhu Yu's "Pingzhou Ketan" describes ships of considerable size, where merchants stored goods and people occupied limited space, often lying atop the storage areas at night. The passage emphasizes the meticulous packing of pottery for export, with sets closely arranged to leave minimal gaps, showcasing the intricate packaging skills required for porcelain transportation.

During the Song Dynasty, Jingdezhen exported a vast quantity of porcelain to East Asia, leading to frequent trade interactions. Archaeological findings across Asia and Africa have uncovered many specimens of Song Dynasty porcelain, indicating the wide distribution of these goods. However, historical records lack detailed accounts of the specific processes involved in ceramic packaging.

Ceramic packaging has been effectively utilized since the primitive era, with historical accounts indicating that Jingdezhen's pottery industry originated during the Han Dynasty and experienced rapid growth during the Tang and Song Dynasties. Records highlight the significance of overseas trade beginning in the Song Dynasty, which substantially boosted porcelain exports. Zhu Yu's "Pingzhou Ke Tan" describes

ships of considerable size, where merchants stored their goods tightly, leaving minimal space, showcasing the meticulous packaging techniques employed for porcelain transportation. This era saw Jingdezhen's porcelain reaching various parts of East Asia, with archaeological findings across Asia and Africa revealing Song Dynasty porcelain artifacts. However, detailed documentation on the packaging processes of that time remains scarce.

The exact commencement of Jingdezhen's porcelain packaging practices is debated within the archaeological community, with existing records providing limited information. One notable record mentions Lu Zishun from Fuliang County tributing 50,000 pieces of porcelain to the Northern Song court in the first year of Zhengtong, illustrating the significant volume of porcelain produced. Despite the lengthy and challenging journey from Jingdezhen to the Northern Song court (present-day Henan Kaifeng), there is no detailed account of the packaging methods used, leaving us with no concrete evidence today. Yuan Jiang Qi's pottery chronicle sheds light on the process of selecting and transporting ceramics, indicating the meticulous planning and calculation involved in trading, yet specifics on packaging remain undocumented. (Jiang Siqing,1959) In this context, "pieces" refer to the dimensions, height, and capacity of the product, representing the overall modern Jingdezhen porcelain packaging in terms of quantity. The term "with" signifies positivity, indicating specific types of packaging forms and tools. This suggests that the Yuan Dynasty saw the emergence of independent packaging practices for Jingdezhen porcelain. During the Yuan Dynasty, porcelain exports expanded significantly from the Song Dynasty foundation, with a particular emphasis on foreign trade and a notable expansion in the export regions. This era marked the most vibrant period for porcelain exports, especially for Jingdezhen's blue and white porcelain, which was exported to Southeast Asia, West Asia, the Middle East, and other regions.

The book "Chinese Ancient Export Ceramics Research Data" meticulously documents a complete vessel unearthed in Onomichi City, Hiroshima County, Japan, engraved with the Yuan Dynasty's "pivot" Mi's words. The vessel's shape, glaze, and decorative characteristics allow for accurate identification as Jingdezhen-made. The "Island Yi Zhiliu" book mentions porcelain containers used for various purposes such as pickling, storing rice and cereals, and holding fresh water. Given the long distances

involved, limited cabin storage space, and the need for optimal commodity storage and packaging design, porcelain containers were designed for dual purposes, serving both as packaging and as containers for the goods themselves.

During the Ming Dynasty, Jingdezhen ascended to the status of the national porcelain production hub, building upon the foundation laid in the Yuan Dynasty to continue its dominance in the field, alongside the early sprouts of capitalism within its porcelain industry. This period witnessed the parallel growth of both government-operated and private kilns. The latter primarily catered to private individuals or were involved in trade exports. Seventeenth-century records reveal that porcelain produced in Jingdezhen for Dutch trade was clandestinely transported back to Europe, with the initial shipment containing 28 packages of porcelain and an additional 14 packages of smaller pieces, marking the first delivery of Chinese porcelain to the European continent.

By 1700, the Macclesfield docked at the port of Guangzhou, with records indicating that barrels of Chinese porcelain onboard were valued at 1147.46 taels, representing the earliest documented ceramics trade with official British merchant ships. In 1720, the Essex shipped 112 boxes and 500 packages of porcelain, with packaging standards generally stipulating around 600 pieces per package, weighing approximately 500 lists. Despite low profits, porcelain was conveniently shipped alongside other goods due to its ease of balance during transport; porcelain was often loaded at the ship's bottom, followed by tea and then silk above, showcasing early detailed records of porcelain packaging and transport processes that, despite their simplicity, were used for an extended period.

In the Ming Dynasty, Jingdezhen's official kilns played a crucial role for the ruling class, exclusively supplying "imperial" porcelain for feudal rulers. This era also saw vigorous tribute activities, with notable figures such as the Dalai Lama, female leaders, and Arabs bringing numerous items to China as tributes, including substantial amounts of porcelain. To ensure the safe transportation of porcelain back to their countries, records describe a meticulous packing process: "After purchasing porcelain, sand and a bit of soybean wheat were first placed into the object, stacked and securely tied together, then placed in wetlands and sprinkled with water. This allowed the beans to sprout, creating a tangled, solid mass, ensuring the porcelain could be

dropped to the ground without breaking before loading onto the carriage." (Yang Yongfeng, 1992) This is the earliest detailed records of porcelain packaging and transport methods, this method reduces the sea long-distance transport in the bumps to the porcelain caused by the loss, of course, the cost of packaging is also ten times the usual packaging, so this packaging is quite strong to modern archaeologists from the sea list up the porcelain are intact.

During the Qianlong period of the Qing Dynasty, Jingdezhen saw the "official appropriation of folk kilns," leading to the emergence of porcelain varieties categorized into coarse ware and fine porcelain. These two categories can be interpreted as indicating the quality or grade of the porcelain varieties. The book "Tao Shuo" in its translated annotations states that porcelain classification involved sorting by density and selecting based on color: single-color, two-color, and three-color, establishing a hierarchy of quality. Three-color porcelain, referred to as "foot loan," was typically sold locally. The porcelain, depending on its color scheme—either single or two-color—was packaged in paper-wrapped barrels by specialized craftsmen. For two-color porcelain, every ten pieces were bundled into a cylinder, wrapped in grass, and distributed provincially. Coarser pieces were wrapped with wild rice grass, packing thirty to forty or fifty to sixty pieces per bundle, akin to a package. Zizania, a type of grass, was used for inner tying, while bamboo strips were wrapped horizontally around the outside for added protection. This method facilitated ease of transport, both by land and water. Jingdezhen's wealth of skilled artisans, notably from the Ying Ge area, contributed significantly to the porcelain's renown. (Zhu Yan Fu Zhen Lun, Tao said,1984) During the Qing Dynasty, Jiangxi province was renowned for leading China's paper production, with raw materials categorized into bamboo paper, cotton paper, and haggard paper. These were further classified based on quality into coarse and fine paper. Coarse paper typically found its use in packaging, firecracker paper, and for ritual purposes. During this period, coarse paper served as the initial layer of packaging for top-grade porcelain, which was then placed into wooden barrels. Medium-grade porcelain was wrapped in grass within barrels, while second-class porcelain was encased in zizania grass and secured with bamboo ties, indicating a hierarchical approach to packaging based on the porcelain's quality.

In the Qing Dynasty's Jingdezhen, the classification of ceramic artifacts into "round" and "faceted" categories played a significant role in determining their molding process. Flat items like plates, discs, and bowls were classified as round ware, while three-dimensional items like bottles, jars, pots, and candlesticks were identified as spot ware. As recorded in "The History of Jingdezhen Ceramics," round Sum ware, including plates, bowls, and dishes, accounted for over six hundred barrels annually. These selections, alongside the second-class color varieties totaling six or seven thousand pieces, were transported to Beijing in barrels as part of preparations for rewards.

In the early Qing Dynasty, water transport was the preferred method for shipping porcelain, utilizing wooden barrels due to their robustness and pressure resistance. The barrels, ideal for carrying large porcelain items, ensured the porcelain was bundled and packed securely, showcasing the meticulous and structured approach to porcelain transport during this era.

Figure 16The locals of Jingdezhen used such simple straw to bundle and pack porcelain to ensure ocean shipping.
Source: photography by Ye Li, 2023

During the Republic of China period Jingdezhen by political influence, porcelain pa ckaging is still a continuation of the process before the Qing Dynasty, there is not muc h innovation. "Republic of seventeen years (1928), the town has a total of wild rice stra w line of more than 140 households, the total number of workers for 2000 people. At t hat time, ceramic packaging materials in Jingdezhen were divided into three categories, straw packaging, wooden cypress packaging and bamboo basket (bamboo basket) pac kaging." (Yang Yongfeng, 1992).Straw packaging (Figure 16) is the cheapest and most practical form of packaging in Jingdezhen for thousands of years, the industry termino logy is called Zizania packaging, the operation is to use straw to the size of different pr oportions of the various types of porcelain neatly bundled up, and then tied up with ba mboo scissors, in order to prevent the not easy to disperse, and then the third process o f knot grass, three processes bundled together no matter how to throw the porcelain wil l not be damaged (Figure 17), with the Jingdezhen local dialect description is to play gr ass knot, rolling grass dragon, tie grass gabions, ceramics, the most traditional packagi ng methods. Wooden meal and bamboo basket is also the most traditional sales tool, w ith natural wood and bamboo as raw material processing production, Express by strong pressure, not rust, not perishable candle and low processing costs. According to "Jingd ezhen ceramics historical manuscript" records "Tizhou basket, a small travelling comp anion, hand-held large basket, picking and selling kiln households porcelain ..... easy o r get good ware, want to call for the Tizhou basket." Detailed description of the Jingde zhen porcelain basket packaging trading transactions.

Figure 17Early 20th Century Local Porcelain Bales Wrapped in Straw in Jingdezhen
Source: photography by Ye Li, 2023

China, a nation steeped in ceremonial traditions, has always placed great importance on the presentation, whether it be in tributing the emperor in ancient times or in the exchange of gifts among the populace, necessitating extraordinary packaging practices. This tradition has evolved alongside human society and civilization, transitioning from the advent of primitive packaging to traditional methods, significantly fostering the development of the packaging industry. This evolution has laid the groundwork for modern packaging techniques and the establishment of the contemporary packaging industry.

Post-liberation, Jingdezhen witnessed a new era in packaging development, with the establishment of numerous factories within a few years, including those dedicated to producing packaging for the porcelain industry, as well as printing presses and paper mills catering to the cultural needs of the populace. The municipal government, in collaboration with the ceramic company and local ceramic enterprises, has propelled advancements in packaging, such as carton, color box, and brocade box packaging, standardizing the standards and designs of ceramic packaging. However, until October 1969, over a span of twenty years, Jingdezhen's porcelain factories lacked specialized institutions and personnel for managing packaging, with the task initially undertaken by a porcelain packaging cooperative. In 1954, the municipal government founded the Jingdezhen Porcelain Packaging Factory on the cooperative's foundation, unifying the porcelain packaging tasks city-wide with over 1,000 packaging workers.

During and after the 1960s, Jingdezhen also utilized wooden box packaging for exporting porcelain and for use by border minorities. Despite its durability, the high cost, expensive transportation, and significant wood consumption—averaging 4200 cubic meters annually—prompted a shift towards carton packaging for exports. Efforts to improve packaging included compiling "Jingdezhen Export Porcelain Packaging Specifications" and creating sample albums for foreign selection, eventually achieving carton packaging for exports in the early eighties.

The success in export packaging led to improvements in domestic sales packaging, focusing on phasing out straw packaging in favor of carton and paper box packaging. The Jingdezhen Domestic Sales Porcelain Packaging Improvement Research Team was established in 1983, leading to the development of local standards for carton packaging of domestic sales porcelain by 1986, standardizing packaging methods, specifications, and material consumption. By 1988, carton packaging had been widely adopted for domestic sales. The evolution into color box packaging, utilizing cardboard and fine corrugated cardboard for their convenience and exquisite printing, has become increasingly preferred by enterprises, marking a significant milestone in Jingdezhen's packaging development. In recent years, brocade box packaging has become a common choice for medium and high-grade porcelain in Jingdezhen, reflecting the ongoing tradition of gift packaging in the Chinese cultural context. (Figure 18) The material selection for processing involves the use of cardboard for packaging molding, with decorative materials including silk and cotton fabrics for a more aesthetically pleasing secondary packaging. Internally, bubble wrap, poly flannel, sponge, and pearl cotton are utilized for additional protection. There has been a noticeable upward trend in the quality of Jingdezhen's medium and high-grade packaging, with various artificial leathers and inlaid ornaments being extensively used to enhance the value of the goods. While the merits and drawbacks of such excessive packaging are debatable, it is undeniably a strategy employed by merchants to promote their products.

In the current era, the evolution of packaging materials continues, not only to ensure product safety but also to address the spiritual and aesthetic demands of consumers. This shift towards a more spiritual appreciation of ceramic packaging has led to its increasing professionalism, standardization, and ecological consideration.

Consequently, the design concept is being explored and evaluated at a higher level, with ongoing efforts to challenge and transcend the limitations of existing models, aiming to fulfill the growing spiritual and aesthetic aspirations of the public.

Figure 18Common brocade box porcelain packaging in Jingdezhen
Source: photography by Ye Li, 2023

4.Market research and studies

4.1 Jingdezhen Ceramic Packaging Market Research

The sites chosen for the field research study included Taoxichuan and Jingdezhen, with a particular focus on the Jingdezhen Sculpture Porcelain Factory, as illustrated in Figure19 The subjects of this investigation were two distinct groups: shop staff and consumers engaging in purchases. This survey research, grounded in a thorough review of literature and online investigations, employed methods such as in-depth interviews and field observations. The primary goal of this fieldwork was to gain an insightful understanding of the Jingdezhen ceramics market conditions and the current state of ceramic packaging in Jingdezhen. It aimed to capture the perspective of buyers regarding their demands for ceramic packaging in Jingdezhen, along with identifying any existing issues and areas for improvement.

Figure 19Jingdezhen Tao Xichuan Jingdezhen Sculpture Porcelain Factory
Source: photography by Ye Li, 2023

Taoxichuan Ceramic Culture and Creative Park in Jingdezhen is a multifaceted project that combines business, tourism, and culture, built upon the preservation and utilization of ceramic industrial heritage. This initiative aims at industrial upgrading and urban revitalization, with a master plan covering 1 square kilometer and a total construction area of 1.6 million square meters. The park has successfully launched and operates various sectors such as the Cosmos Porcelain Factory, For the People Porcelain Factory, and a Ceramic Machinery Factory, attracting over 21,000 artists,

designers, and "Jingpiao" entrepreneurs from across China and abroad. In 2022, it welcomed more than 3.9 million visitors as shown in figure 20.

Taoxichuan stands as the sole national cultural industry demonstration park in Jiangxi Province and has earned several other distinctions: a national innovation and entrepreneurship demonstration base, a national business incubation demonstration base, a national copyright demonstration park, a national cluster for night-time culture and tourism consumption, a national tourism science and technology demonstration park, and a national intangible cultural heritage tourism district.

Taoxicuan Ceramic Culture and Creative Park in Jingdezhen stands as a monumental business, tourism, and cultural endeavor, centered around the preservation and utilization of ceramic industrial heritage. This project is a testament to the fusion of industrial advancement and urban revitalization, sprawling over a master-planned area of 1 square kilometer and boasting a total construction space of 1.6 million square meters. The park is operational with key areas like the Cosmos Porcelain Factory, For the People Porcelain Factory, and Ceramic Machinery Factory, attracting a vibrant community of 21,000 artists, designers, and "Jing Piao" creators from across the nation and beyond. In 2022, it welcomed over 3.9 million visitors, earning the distinction of being Jiangxi Province's sole national cultural industry demonstration park. Taoxicuan also serves as a national model for innovation and entrepreneurship, business incubation, copyright, nocturnal culture and tourism consumption, tourism science and technology, and intangible heritage tourism.

In this enriched study, 20 shops within Taoxicuan were selected for research, with 12 agreeing to participate. The investigation focused on shop attitudes towards packaging, suggestions for improvement, the current state of packaging, and market dynamics, as outlined in Figure 3-2. Statistics revealed a significant consensus on the need for packaging enhancement, with only one of the 12 shops satisfied with the current state of Jingdezhen's ceramic packaging. A staggering 83.3% (5/6) of participants called for improvements. Packaging issues were ranked from most to least pressing as follows: weak environmental consciousness (5/6), limited creativity (5/6), monotonous visual appeal (4/6), simplistic structure (3/6), and inadequate branding (2/6) as shown in Figure 21.

In addressing the current packaging landscape, nearly all participating shops utilized branded packaging. Moreover, they noted that consumer purchase decisions were influenced by factors such as product style preference and the shopping environment. This highlights the critical role packaging plays not only in product protection and branding but also in aligning with consumer values and aesthetic expectations, underscoring the need for innovative, eco-conscious, and culturally resonant packaging solutions in Jingdezhen's ceramic industry.

	Question	Options
1	How do you rate the current recognition of Jingdezhen ceramic packaging?	1-5 scale (1=Very Poor, 5=Excellent)
2	Do you think Jingdezhen ceramic packaging needs improvement?	Yes/No
3	Rate the environmental awareness in current ceramic packaging.	1-5 scale (1=Very Low, 5=Very High)
4	Rate the creativity of current ceramic packaging.	1-5 scale (1=Very Low, 5=Very High)
5	Rate the visual diversity of current ceramic packaging.	1-5 scale (1=Very Low, 5=Very High)
6	Rate the structural complexity of current ceramic packaging.	1-5 scale (1=Very Simple, 5=Very Complex)
7	Rate the branding presence in current ceramic packaging.	1-5 scale (1=Non-existent, 5=Very Strong)
8	Does branded packaging influence consumer purchasing decisions?	Yes/No
9	Do product style preferences influence consumer purchasing decisions?	Yes/No
10	Does the purchase environment influence consumer purchasing decisions?	Yes/No

Figure 20 Ceramic packaging market survey questionnaire
Source: Drawn by Ye Li, 2023

Packaging Aspect	Response
Current Packaging Recognition	Low Recognition
Need for Improvement	83.3% Yes
Environmental Awareness	83.3% Low
Creativity	83.3% Low
Visual Diversity	66.7% Low
Structural Complexity	50% Simple
Branding Presence	33.3% Lacking

Figure 21 Ceramic packaging research results
Source: Drawn by Ye Li, 2023

Established in 1956, the Jingdezhen Sculpture Porcelain Factory specializes in ceramic sculptures while also producing garden and furnishing porcelain among other items. Recognized as a national second-class enterprise, it has been designated as a production base for national tourism commodities by various ministries, including the National Tourism Bureau, and has been acknowledged by the National Environmental Protection Bureau as an advanced enterprise in environmental protection. The factory's offerings extend beyond ceramic sculptures to include garden and furnishing porcelain, industrial mold porcelain, and even urban, garden, and architectural sculptures, marking it as a leading figure in Jingdezhen's ceramic cultural and creative industries.

The significance of packaging design is increasingly recognized. Some stores showcase innovative packaging designs, including reusable and structurally optimized packaging. Most emphasize brand awareness and exhibit a degree of environmental consciousness, predominantly opting for carton packaging. However, collaborative efforts in packaging are insufficient, and there's a challenge in providing a humanized service experience and visual appeal across different events and settings. The Jingdezhen ceramics market faces confusion, with many non-local ceramic products falsely labeled as "Made in Jingdezhen." The selection of packaging options is limited, offering minimal differentiation and identification. The minimum order quantity for custom packaging is overly high, making it challenging to match product sizes with existing packaging templates as shown in figure 22.

Market research indicates a generally low perception of Jingdezhen's ceramic packaging design. The predominant packaging style in Tao Xi Chuan is minimalist, yet it falls short on eco-friendliness, largely utilizing polystyrene and polyethylene. The creativity seen in post-branding is limited, with visual effects and product relevance needing enhancement. The Sculpture Porcelain Factory mainly uses carton packaging, prioritizing the visual appeal of ceramic packaging with a level of innovation and environmental awareness. Jingdezhen's local artisanal workshops often struggle with packaging that doesn't fit their products perfectly due to a limited selection of packaging templates and low levels of collaborative design. Moreover, the high minimum orders for custom packaging, ranging from 500 to 1000 pieces, pose significant challenges for small-scale producers. The use of non-eco-friendly packaging materials contributes to environmental pollution, a serious concern in Jiangxi's humid climate. Storing packaging materials also presents challenges due to the region's weather conditions as shown in figure 23.

Figure 22 Current status of Jingdezhen ceramic packaging market
Source: photography by Ye Li, 2023

Figure 23Jingdezhen Sculpture Porcelain Factory Research Packaging Status
Source: photography by Ye Li, 2023

4.2 Jingdezhen Ceramic Packaging Market Demand Forecast

Market demand forecasting employs several techniques, such as buyer intention surveys, market test marketing, time series analysis, linear trend analysis, and multi-attribute attitude modeling (Guo GQ, 2020). Since market demand is shaped by potential buyers, forecasting it necessitates gauging the probable actions of these buyers, essentially through conducting buyer surveys. The buyer intention survey method stands out for its reliability and accuracy, with data analysis proceeding as outlined.

4.2.1Basic information

The online survey was carried out among a randomly selected group of Internet users. This research, grounded in literature review, utilized social media platforms as the primary method for distributing an online questionnaire. The questionnaire focused on analyzing data across three foundational aspects: X (consumer group), Y

(Jingdezhen ceramics), and Z (Jingdezhen ceramic packaging), examining these dimensions horizontally, vertically, and obliquely.

The horizontal dimension delves into the consumer group's familiarity with Jingdezhen ceramic products, assessing their awareness level (as depicted in Figure 24). The vertical dimension investigates the consumer group's attitudes towards Jingdezhen ceramic packaging, focusing on the emotional response (illustrated in Figure 24). The oblique dimension builds on the previous two, exploring consumer judgments on the characteristics of Jingdezhen ceramic packaging and the factors influencing their purchasing decisions, essentially examining the behavioral level (shown in Figure 25).

Data collection was facilitated through the Internet using Question Star software to disseminate the survey, resulting in 131 valid responses.

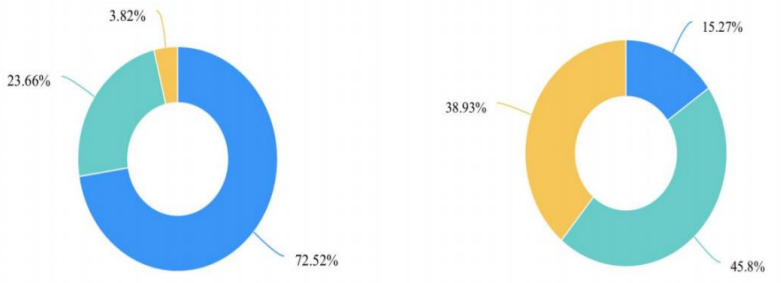


Figure 24Consumer Group Consciousness Level and Consumer Group Emotion Level

Source: Drawn by Ye Li, 2023

Q. No	Question	Options/Expected Answers
Q1	What is the primary purpose of your ceramic purchases?	Personal use, Gift, Collection
Q2	How would you rate your knowledge of Jingdezhen ceramics?	Very excellent, Limited knowledge
Q3	What is your attitude towards the synergy between ceramic packaging and the ceramics themselves?	Highly recognized, Needs improvement, Indifferent/Unsure
Q4	Would you purchase Jingdezhen ceramic products because of the packaging design?	Yes, No
Q5	Do limited-time promotions and cost-effectiveness influence your decision to buy ceramic products?	Yes, No
Q6	Does attractive packaging in your preferred style motivate you to buy ceramic products?	Yes, No
Q7	What issues do you see with the current ceramic packaging?	Open-ended response
Q8	What improvements do you wish to see in ceramic packaging?	Open-ended response
Q9	How do you view the innovativeness of Jingdezhen ceramic packaging?	Too low, Adequate
Q10	What do you think about the visual effects of Jingdezhen ceramic packaging?	Too single, Diverse

Figure 25Respondent Questionnaire
Source: Drawn by Ye Li, 2023

4.2.2 Data analysis

Awareness Level (shown in Figure 26):

1. Among the participants, 90.84% purchase ceramics for personal use at home, 63.36% buy them as gifts, and only 22.9% collect them for appreciation.

2. Regarding knowledge of Jingdezhen ceramics, 72.52% of respondents believe Jingdezhen ceramics are exceptional and rank among the best internationally, while only 3.82% have limited knowledge of them.

Emotional Level:

1. Only 15.27% of respondents highly recognize the synergy between ceramic packaging and the products themselves, suggesting that packaging complements the ceramics. Conversely, 45.8% believe improvements are needed, indicating a mismatch between ceramics and their packaging. Meanwhile, 38.93% are indifferent or uncertain.

2. A significant 91.6% of consumers are willing to purchase Jingdezhen ceramic products because of their admiration for the packaging design, showing a highly positive attitude towards Jingdezhen ceramic packaging.

Behavioral Level:

1. Limited-time promotions and cost-effectiveness are key factors influencing consumer purchases, with 62.6% stating that attractive packaging in their preferred style also motivates their buying decisions.
2. When asked about the current issues with packaging and their expectations, consumers expressed their views on what improvements they wish to see in packaging content.
3. A majority of 80.15% perceive a lack of innovation in Jingdezhen ceramic packaging, and 65.65% find the visual effects to be monotonous. The responses are fairly evenly distributed.
4. The differences in what consumers seek from packaging are minimal, with both positive and negative aspects garnering more than 87% of responses, indicating diverse consumer expectations.

Aspect	Results
Purpose of Purchase	Personal use (90.84%), Gift (63.36%), Collection (22.9%)
Knowledge of Jingdezhen Ceramics	Very excellent (72.52%), Limited knowledge (3.82%)
Attitude Towards Packaging Synergy	Highly recognized (15.27%), Needs improvement (45.8%), Indifferent/Unsure (38.93%)
Purchase Due to Packaging Design	Yes (91.6%)
Influence of Promotions/Cost-Effectiveness	Yes (62.6%)
Motivation by Attractive Packaging	Yes (62.6%)
Current Packaging Issues	Low innovativeness (80.15%), Single visual effect (65.65%)
Desired Packaging Improvements	Varied responses
Innovativeness of Packaging	Too low (80.15%)
Visual Effects of Packaging	Single (65.65%)

Figure 26 Survey Results Summary Table
Source: Drawn by Ye Li, 2023

4.2.3 Research results

Consumers demonstrate a strong recognition for Jingdezhen's ceramic products, appreciating not just the quality but also the rich heritage associated with the "Jingdezhen" brand. This high geographical awareness underscores the city's esteemed

position in the ceramic industry, suggesting that the "Jingdezhen" name itself carries significant weight in consumer perceptions.

The consumer stance on Jingdezhen ceramic packaging is less favorable, with a substantial portion advocating for a redesign. This indicates a disconnect between the product's inherent value and its packaging presentation. Furthermore, the fact that nearly 39% of consumers overlook Jingdezhen ceramic packaging altogether suggests that the packaging fails to make a memorable impact, highlighting issues with product relevance, recognition, and aesthetic appeal. This situation underscores the need for a strategic overhaul to make the packaging as distinguished as the ceramics themselves.

The willingness of consumers to spend on well-designed Jingdezhen ceramic packaging highlights the importance of packaging in the purchasing decision. Consumers value packaging that features prominent brand logos and identities, emphasizing the need for strong brand recognition and image shaping. This suggests that effective branding on packaging can significantly influence consumer perception and loyalty.

Factors influencing consumer purchases extend beyond mere economic considerations to include style, consumer environment, and related options, all of which play a critical role in driving sales. The choice of colors and patterns that resonate with both the product's essence and consumer preferences is vital, underscoring the need for packaging that captures the uniqueness and allure of Jingdezhen ceramics. This approach not only enhances product appeal but also fosters a deeper connection with consumers.

Consumer interest in Jingdezhen ceramic packaging design is geared more towards innovation and enjoyment, with a particular focus on avoiding monotonous visual presentations. This preference indicates a desire for fresh, engaging packaging designs that break from tradition and stimulate visual interest. While structural innovation takes a backseat, the emphasis on novelty, visual appeal, branding, and environmental considerations reflects evolving consumer values and expectations.

The diverse range of content consumers wish to see on packaging, with a preference exceeding 80%, signifies a substantial interest in the information conveyed through packaging. This indicates a consumer appetite for packaging that not only informs but also complements the product, enhancing overall awareness. An integrated design

approach that aligns packaging with product information could significantly boost product recognition, marrying practicality with aesthetic appeal to create a more immersive consumer experience. This strategy could transform packaging from a mere container to a vital element of the product narrative, enriching the consumer's interaction with Jingdezhen ceramics.

4.3 Jingdezhen ceramic packaging marketing positioning assessment

The detailed analysis of market research underscores the critical need for thoughtful and strategic packaging design for Jingdezhen ceramic products, driven by consumer insights. The distinct qualities of Jingdezhen ceramics call for a multifaceted approach in packaging, divided into several key aspects:

Functional Characteristics:

Functional information is crucial, detailing the product's purpose and utility. For daily-use ceramics, packaging should not only showcase the item's aesthetic appeal but also highlight its practical applications—be it for dining, compatibility with microwaves, or specifics like size, capacity, and the diversity of the ceramic set. This approach ensures the consumer fully appreciates the functional value alongside the beauty of the product.

Raw Material Characteristics:

The essence of Jingdezhen ceramics lies in its choice of raw materials, with kaolin clay standing out for its contribution to the porcelain's exquisite quality. Highlighting this in the packaging tells a story of heritage and craftsmanship, linking the product directly to its roots and underscoring the meticulous attention to quality that defines Jingdezhen's porcelain legacy.

Origin Characteristics:

The origin of a Jingdezhen ceramic piece speaks volumes about its heritage, embodying centuries of refined techniques and the spirit of various dynasties' famous kilns. Packaging that delves into the origins offers consumers a glimpse into the rich cultural and historical tapestry that each piece represents, enhancing its value beyond the physical product to become a bearer of culture and tradition.

Technical Process Characteristics:

The technical prowess behind Jingdezhen ceramics, from the raw materials' transformation to the final artistic creation, marks each piece's journey from clay to treasure. Acknowledging this process in the packaging respects the artisanal attribute of the products, celebrating the blend of tradition and technical innovation that Jingdezhen is renowned for.

Marketing Information Collation:

In this era, characterized by the rapid exchange of information, packaging transcends its traditional role to become a medium of communication. The collation and presentation of product-related information through packaging play a pivotal role in connecting with the consumer, making every piece an ambassador of the Jingdezhen brand.

Symbolic Information:

The use of intuitive and memorable graphic symbols in packaging design can significantly enhance user experience and brand recognition. Symbols that indicate product features, such as microwave safety or the item's fragility, serve practical purposes while also educating consumers about the product’s unique attributes. The development of standardized symbols for Jingdezhen ceramics could pave the way for industry-wide practices, setting a new benchmark for clarity and consumer engagement in packaging.

In refining Jingdezhen ceramic packaging, the goal is to weave together the functional, material, historical, and technical narratives of the products into a cohesive visual and informational presentation. This not only serves to inform and attract consumers but also to honor and perpetuate the rich cultural heritage of Jingdezhen ceramics. The challenge lies in balancing tradition with innovation, creating packaging that resonates with modern aesthetics while deeply rooted in centuries-old craftsmanship.

Enhancing Enterprise Information Elements

Enterprise information goes beyond mere identification; it encapsulates the essence of the company behind the product. This includes not only the Corporate Identity System (CIS) and branding efforts but also the narrative the brand wishes to convey through each ceramic piece. Historical practices, such as those mentioned in Lu's Spring and Autumn Annals, underscore the importance of accountability and quality

assurance through artisanal signatures. Modern adaptations see ceramic brands embedding their unique stamps as a testament to authenticity and craftsmanship. The priority in information design is twofold: firstly, to establish a strong corporate image and brand identity, and secondly, to weave product-specific narratives, ensuring a harmonious visual integration of both aspects. This approach not only reinforces brand recognition but also cultivates a deeper consumer connection with the product's heritage and quality.

Expanding Service Information Elements

In today's digital age, ceramic companies must harness new media to extend beyond traditional service offerings, crafting an ecosystem of value-added services. The essence of service information elements lies in creating a robust interactive platform that bridges the gap between consumers and providers, fostering trust through transparent and visually compelling service information. Given the intrinsic fragility of ceramic products, reassurances such as "seven-day no-reason return" policies can significantly enhance consumer confidence in online purchases. Moreover, for connoisseurs and buyers of high-end ceramic brands, the provision of authentication services and anti-counterfeit measures is indispensable. These services not only safeguard the consumer's investment but also enhance the perceived value and authenticity of the purchase, enriching the overall customer experience.

Elevating Interactive Information Elements

The role of interactive information is to knit together a diverse consumer base, facilitating a shared cultural and innovative experience. Outstanding interactive information design transcends mere aesthetic appeal, embodying corporate responsibility and catering to the nuanced demand for personalized, engaging content. This becomes particularly relevant in the ceramics industry, where the unique characteristics and rich cultural heritage of the products may overwhelm or confuse potential buyers. Visual interactive design, therefore, plays a pivotal role, especially for consumers seeking gifts or those uncertain about their choices. By providing intuitive, engaging, and informative interactive experiences, companies can demystify the selection process, guiding consumers towards informed decisions that resonate with their personal or gift-giving needs. In doing so, they not only elevate the user

experience but also foster a deeper appreciation and understanding of the ceramic arts, bridging the gap between tradition and modern consumer engagement.

4.4 Jingdezhen ceramic packaging marketing behavior reference

Understanding consumer behavior in the context of Jingdezhen ceramic packaging design involves a sophisticated blend of theories from economics, psychology, sociology, and cultural studies. Deep insights into these areas can significantly inform and refine packaging strategies, ensuring they resonate more profoundly with consumer preferences and behaviors. This, in turn, can lead to enhanced product distinctiveness, competitive edge, and market presence.

Heinz M. Goldman, an authority on international sales, highlighted the AIDA model (Attracting Attention, Inspiring Interest, Arousing Desire, and Guiding Action) as a fundamental paradigm in understanding consumer engagement. The comparison and contrast between visual marketing strategies and consumer behavior underscore the importance of adopting a nuanced approach to packaging design, one that prioritizes behavioral dynamics. Packaging should be seen through a lens of four critical dimensions: the packaging itself, the consumer, time, and space, creating a holistic framework that connects products and corporate brands directly with their audience.

This approach proposes a comprehensive behavioral trajectory that includes the product, company, designers, and consumers, integrating them within a contextual framework defined by time and space. By employing a task-operation-assessment-feedback mechanism, this model enables an active information exchange between consumers and packaging, enhancing comprehension, interaction, and satisfaction with the product. Consumers' engagement with packaging—assessing aspects like design, material, and color based on personal preferences and needs—leads to improved experiences and more informed purchase decisions.

Jingdezhen Ceramic Packaging Consumer Behavior Decision-making Framework

The consumer behavior decision-making framework for Jingdezhen ceramics encapsulates the processes individuals or groups undertake in the selection, utilization, and disposition of products or services. This journey is influenced by individual differences, environmental contexts, and marketing dynamics, consisting of stages such as need recognition, information search, evaluation, purchasing decisions,

and post-purchase behavior. The design of Jingdezhen ceramic packaging plays a pivotal role at every stage, influencing consumers' motivation to transition from interest to actual purchase as shown in Figure 27.

1. Demand Recognition Stage: The initial appeal and clarity of Jingdezhen ceramic packaging are vital for capturing consumer attention and sparking the desire for purchase.

2. Information Search Stage: At this juncture, consumers seek additional information based on initial impressions from packaging design. Clear, accurate, and engaging packaging information aids in this effective search, bolstering purchase intent.

3. Evaluation and Comparison Stage: Consumers weigh various options against each other, with the packaging's visual appeal, perceived quality, and brand reputation significantly impacting decision-making.

4. Purchase Decision Stage: The decisive moment where the packaging's visual and informational elements can tip the scales towards purchase.

5. Post-purchase Behavior Stage: Post-purchase interactions with the packaging, including its aesthetic and functional quality, can influence future purchasing behavior and brand recommendations.

Jingdezhen Ceramic Packaging Marketing: The Black Box Model The cultural and symbolic dimensions of Jingdezhen ceramics necessitate a nuanced understanding of consumer perceptions regarding their needs and motivations. Attributes such as renowned quality, exceptional craftsmanship, and distinctive designs play into these perceptions. The "black box" model of consumer behavior, which incorporates both external stimuli (e.g., the consumer's perception of packaging design) and internal decision-making processes, highlights how various factors, including individual preferences, cultural norms, social influences, and market dynamics, shape consumer behavior towards Jingdezhen ceramics.

This model emphasizes the significant impact of physical and socio-environmental factors, including spatial arrangements and the regulatory role of brands, as well as the influential power of reference groups in consumer decision-making. Jingdezhen’s unique cultural appeal and its vibrant creative community form a dynamic reference group that influences consumer behavior, necessitating a strategic focus on brand

positioning and community engagement to guide consumer buying behaviors effectively. By leveraging Jingdezhen's cultural cachet and fostering a connection with its artistic heritage, companies can create packaging designs that not only captivate but also deeply resonate with consumers.

Aspect	Description
Understanding Consumer Behavior	Incorporates theories from economics, psychology, sociology, and cultural studies to inform packaging strategies.
AIDA Model by Heinz M. Goldman	Emphasizes Attracting Attention, Inspiring Interest, Arousing Desire, and Guiding Action in consumer engagement.
Behavioral Dynamics in Packaging	Considers four dimensions: packaging, consumer, time, and space for a comprehensive approach.
Demand Recognition Stage	Packaging's initial appeal and clarity play a vital role in stimulating the desire for purchase.
Information Search Stage	Consumers seek additional information based on initial packaging impressions, influencing purchase intent.
Evaluation and Comparison Stage	Packaging's visual appeal, quality, and brand reputation significantly impact consumer evaluations.
Purchase Decision Stage	Decisive moment where packaging's visual and informational elements can influence the purchase.
Post-purchase Behavior Stage	Packaging's aesthetic and functional quality influences future purchasing behavior and brand recommendations.
The Black Box Model of Consumer Behavior	Incorporates external stimuli and internal decision-making processes, shaped by various factors.
Impact of Cultural and Symbolic Dimensions	Strategic focus on brand positioning and community engagement is necessitated by Jingdezhen's cultural appeal.

Figure 27Black Box Model of Jingdezhen Ceramic Packaging Marketing
Source: Drawn by Ye Li, 2023

This chapter meticulously examines the application and impact of visual marketing within Jingdezhen ceramic packaging design, shedding light on its critical role in contemporary marketing strategies. Beginning with an analysis based on comprehensive market research, it evaluates the current dynamics of Jingdezhen's ceramic packaging market. This evaluation encompasses consumer awareness levels, preferences for specific packaging styles, and detailed purchasing patterns. Such foundational insights are paramount in shaping robust visual marketing strategies that can significantly enhance brand positioning and product appeal.

Moreover, this section offers a projection of market demands, anticipating future consumer preferences, innovation trajectories, and emerging trends in Jingdezhen

ceramic packaging design. These forecasts are designed to equip enterprises with strategic market insights, granting them the foresight and agility to capitalize on evolving opportunities and secure a competitive advantage.

The discourse extends into a thorough assessment of Jingdezhen ceramic packaging's marketing positioning, formulating a strategic blueprint for packaging design innovation. It references the marketing behaviors associated with Jingdezhen ceramic packaging to dissect consumer perceptions, demands, and motivations towards these ceramics. The insights derived from this comprehensive analysis inform targeted visual marketing strategy recommendations, aiming to elevate Jingdezhen ceramic packaging design to new heights.

In the evolving landscape of Jingdezhen ceramics packaging design, the exploration of visual marketing emerges as not just essential, but pioneering. The preference for visual designs that offer authenticity, dimensionality, interactivity, and an immersive experience aligns with modern consumer desires, underscoring the escalating importance of adept visual presentation in packaging. The evolution of technology continually transforms visual representation possibilities, reinforcing the need for innovative design approaches that embrace the principles of visual marketing. Leveraging interdisciplinary research methods enriches the conveyance of information, fostering engaging and memorable visual experiences for consumers.

The investigations and discussions presented in this chapter hold profound theoretical and practical implications for the visual marketing of Jingdezhen ceramic packaging design. By navigating the intersections of consumer behavior, market trends, and technological advancements, this research illuminate pathways to innovation, ensuring Jingdezhen ceramic packaging remains not only relevant but also resonant in the ever-changing global marketplace.

5.Ceramics Business Research

5.1 Status of Listed Companies in the Ceramics Industry

Amid China's burgeoning comprehensive national strength and macroeconomic stability, the ceramic industry has seen substantial growth, paralleling the boom in the real estate sector. For years, China has maintained a leading position in global ceramic production and sales. However, the recent downturn in the real estate market, combined with a lack of product innovation and prevalent homogenization among ceramic enterprises, has intensified market competition within the ceramic industry. The situation is further exacerbated by overcapacity issues, with inventories of ceramic industry listed companies constituting 14% of their total assets, significantly higher than the 4% average across all sectors listed in China's A-share market. The challenges have deepened, especially in light of the COVID-19 pandemic in 2020, putting additional strain on the development of listed ceramic companies.

This study focuses on ceramic companies listed on China's Shenzhen and Shanghai stock exchanges. Due to the absence of a specific classification for ceramic companies, this research considers entities primarily engaged in ceramic production, research and development, sales, and related services as part of the ceramic industry. By the end of 2021, 24 companies were identified as part of the ceramic industry through criteria established by financial platforms such as Cloud Finance and Oriental Fortune.

The ceramic sector remains relatively small within China's broader market. Out of nearly 4,700 A-share listed companies as of late 2021, only 24, after careful selection, were identified as primarily involved in ceramics. This modest number underscores the industry's difficulty in achieving economies of scale. Analysis reveals that the total assets and operating income of these companies have not seen significant growth, and have even trended downward. This stagnation is attributed to severe product homogenization, fierce market competition, and challenges from both international ceramic brands and domestic small-scale workshops. Additionally, net profits have also declined, mainly due to reduced operating income and the predominance of low value-added products within the industry's portfolio.

The year 2020, marked by the COVID-19 pandemic, did not witness substantial declines in total assets, operating income, or net profits for the ceramic industry, unlike many other sectors. This resilience can be attributed to the industry's strategic shift towards e-commerce following the temporary closure of physical stores. Companies adapted to the new retail environment by enhancing their online presence and actively participating in government-supported virtual trade fairs like the online Canton Fair. These initiatives helped mitigate the pandemic's impact, showcasing the industry's capacity to navigate through challenges by reimagining traditional sales approaches and embracing digital transformation as shown in Figure 28.

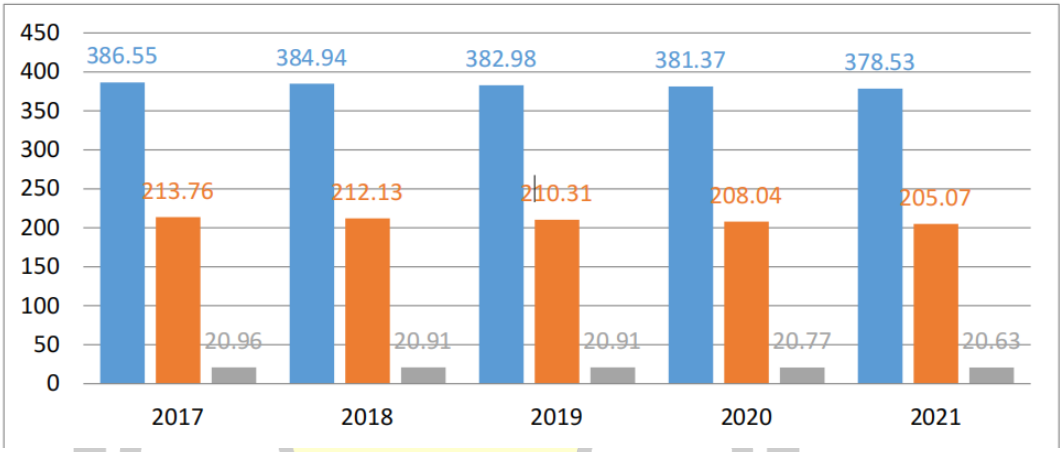


Figure 28Total Assets, Operating Income and Net Profit of Listed Companies in the Ceramic Industry, 2017-2021 (100 million yuan)

Source: Drawn by Ye Li, 2023

Despite these adaptations, listed companies within China's ceramic industry continue to confront significant hurdles in their future development. Consequently, to thoroughly evaluate the current state of these companies, a SWOT analysis method is employed. This approach dissects the industry's landscape by examining the intrinsic strengths and weaknesses of these companies, alongside the external opportunities and threats they face. Through this comprehensive analysis, a clearer understanding of the strategic positioning and potential pathways for growth and resilience within China's ceramic industry can be achieved, offering valuable insights for navigating the complex market dynamics.

6.**SWOT analysis**

6.1 Self-strength analysis (S)

Ceramics represents one of China's traditionally strong industries, boasting a long history and a rich cultural legacy. As the economy grows and living standards rise, the demand for ceramic products has surged, expanding the market significantly. Furthermore, China is endowed with abundant ceramic raw material resources. This analysis will delve into two key aspects based on this foundation.

Abundant Ceramic Resources in China

China is home to substantial reserves of porcelain clay, a crucial raw material for ceramics production. The quality and variety of porcelain clay profoundly influence the features and quality of ceramic products. Spread across regions like Jiangxi, Fujian, Guangdong, and Hunan, China's porcelain clay resources are notably renowned, with Jingdezhen's porcelain clay being particularly celebrated for its superior quality and rich mineral content, making it ideal for crafting high-end ceramic items. Additionally, China's rich ceramic cultural heritage, exemplified by Jingdezhen, Ru kiln, and Yixing, among others, has been inherited over centuries, establishing a distinct ceramic culture. These traditions are vital assets to China's ceramic industry and a significant facet of its cultural identity. Preserving and developing this cultural heritage is crucial for enhancing the ceramic industry's growth while fostering the transmission and promotion of traditional Chinese culture. Moving forward, China's listed ceramic companies are poised to further tap into these resources, elevating product quality and value, and advocating for the industry's sustainable advancement.

Expansive Domestic Market Demand

China's vast population serves as a substantial market for the ceramic industry. The elevation of living standards and shifts in consumer preferences have led to an increased demand for ceramic products, which have transcended their utilitarian origins to become symbols of cultural and artistic expression. Today, ceramics represent not only essential household items but also indicators of lifestyle quality and cultural aspiration. Additionally, as one of the globe's leading exporters, Chinese ceramics hold a competitive edge in international markets. The superior quality and pricing of Chinese ceramic products position them favorably to meet diverse market demands, reflecting the industry's capacity to cater to both domestic and global consumers.

6.2 Self-disadvantage analysis (W)

While China's ceramic industry stands at the forefront of global production and scale, securing its position as the world's premier ceramic producer, challenges persist that curb the sector's profitability and international market penetration. The prevalence of low-value-added products in the global marketplace undermines the potential for enhancing enterprise profitability. Concurrently, the global shift towards greater environmental consciousness places increasing pressure on ceramic enterprises to adopt sustainable practices. The Chinese government has responded with a slew of environmental regulations and standards, imposing stringent controls on the production processes and emissions of ceramic enterprises. These regulatory measures have significantly impacted the development trajectory of ceramic industry-listed companies.

Inadequate Global Brand Influence of China’s Ceramic Products

A persistent challenge facing Chinese ceramic products on the international stage is their relatively weak brand influence. Despite enjoying a substantial market share and popularity within domestic borders, Chinese ceramic products struggle to compete against globally recognized brands in the international arena. This issue is compounded by insufficient international marketing efforts and a lack of effective brand strategies and sales channels by China’s ceramic industry-listed companies. Fierce competition in the domestic market often diverts attention toward local brand building and promotion, leading to diminished investment in international branding efforts. Consequently, this has resulted in the ceramic industry's diminished brand influence on a global scale.

Environmental Challenges Facing China’s Ceramic Enterprises

As China's economy thrives, so too does its manufacturing sector, expanding the use of ceramic materials beyond traditional handicrafts to include an array of tiles and bathroom products. This diversification, however, has led to an increase in ceramic waste and offcuts. It is estimated that waste products generated during the ceramic production process account for approximately 5-26% of total output. The inherent nature of ceramic waste, resistant to natural decomposition, poses significant environmental challenges. Although the government has enacted various

environmental policies and measures, implementation issues persist. Some enterprises' non-compliance with environmental regulations not only risks legal repercussions but also tarnishes their brand image, adversely affecting their long-term development prospects.

Strategies for Future Development

To navigate these challenges, it is imperative for China's ceramic industry to innovate and diversify its product offerings, enhancing the value-added aspect of its exports. Elevating brand recognition on a global scale necessitates a concerted effort in crafting compelling marketing narratives that underscore the unique attributes and heritage of Chinese ceramics. Additionally, embracing environmentally sustainable practices and technologies is crucial. Advancing green manufacturing processes and recycling initiatives can mitigate environmental impacts while aligning with global sustainability trends. Strengthening collaboration with international partners and exploring new markets can also broaden the industry's global footprint. These strategic initiatives could pave the way for a more profitable and sustainable future for China's ceramic industry, reinforcing its esteemed position in the global ceramics landscape.

6.3 External opportunity analysis (O)

As international trade flourishes and global integration accelerates, the ceramic industry is poised to capitalize on expanding global market opportunities. The surge in market demand presents China's ceramic industry's listed companies with a formidable chance to amplify their market presence. Furthermore, governmental support for environmental sustainability and energy efficiency emboldens these companies to enhance their commitment to social responsibility. This support not only favors the promotion of product innovation but also aids in leveraging novel offerings to extend market reach.

Escalating International Demand for Ceramic Products

The global economic progression and an uplift in living standards have spurred a persistent uptick in international demand for ceramic products. The versatility and multifunctionality of ceramic items have rendered them essential in contemporary living. Urbanization trends and heightened preferences for refined living

environments have amplified the utilization of ceramics in construction and décor, including products like tiles, mosaics, and sanitary ware. Additionally, the demand in home living sectors for ceramic tableware, tea sets, and decorative items is on the rise as quality of life becomes a priority. The continuous growth in international demand is tied to the broad application spectrum and the diversity of functions that ceramic products offer, promising sustained expansion in their market demand.

Governmental Policy Support for the Ceramic Sector

The government's backing for environmental and energy conservation initiatives presents a significant opportunity for ceramic enterprises. Such policy support can aid businesses in curtailing costs, augmenting efficiency, and boosting competitiveness. This support manifests through various channels, including tax incentives to foster investments in sustainability, financial grants, and specific funds to bolster ceramic enterprises. Furthermore, policy directives setting environmental and energy standards for products may facilitate preferential market access. Governmental support is instrumental in propelling the ceramic sector's sustainable growth, encouraging industrial transformation, and modernization.

In light of these developments, it is evident that the ceramic industry, supported by strategic policy measures and driven by escalating international demand, stands at the threshold of substantial growth and innovation. The concerted efforts in aligning with environmental objectives and tapping into burgeoning market needs are essential for shaping the future trajectory of China’s ceramic industry, positioning it for global prominence and sustainability.

6.4External threat analysis (T)

The evolution of international trade and the rapid progression of globalization have expanded the global market opportunities for the ceramic industry. The growing market demand presents a potential opportunity for listed companies within China's ceramic industry to increase their market share. The government's heightened focus on environmental protection and energy conservation encourages ceramic industry companies to adopt greener practices and technologies, enhancing their social responsibility and facilitating product innovation to expand market share.

Growth in International Market Demand for Ceramic Products

The global economy's growth and the enhancement of living standards have led to an increased demand for ceramic products. The versatility and diverse functionalities of ceramic items have solidified their essential role in modern life. The surge in urbanization and heightened demand for quality living environments have propelled the usage of ceramic products, such as tiles, mosaics, washbasins, and bathtubs, in construction and decoration. The domestic sphere has also seen a rise in demand for ceramic products like tableware, tea sets, vases, and aromatherapy burners, reflecting the ongoing pursuit for Improved quality of life. This escalating demand is testament to the broad applications and functionalities of ceramic products, ensuring continued growth in international markets.

Governmental Policy Support for the Ceramic Industry

Governmental policy initiatives aimed at environmental conservation and energy efficiency present a strategic opportunity for ceramic enterprises. These policies can help reduce operational costs, increase efficiency, and boost competitiveness. Supportive measures may include tax incentives for investments in environmental and energy-saving projects, financial grants, and preferential market access for products meeting certain eco-friendly standards. Such policy backing is crucial for the sustainable development of ceramic enterprises, promoting industry innovation and transformation.

External Threats to the Ceramic Industry

Despite its dominant position in global production, China's ceramic industry grapples with challenges such as low international market presence, homogenization, and environmental concerns. Advanced ceramic technologies in China lag behind their foreign counterparts, hindering the development of high-performance ceramics crucial for sectors like defense and telecommunications. Moreover, the rising costs of raw materials, compounded by environmental regulations, strain production expenses, diminishing market competitiveness and profit margins.

To navigate these challenges, the ceramic industry must focus on innovation, product diversification, and brand strengthening, both domestically and internationally. Embracing sustainable practices and exploring new materials and technologies are vital for future growth. Strengthening partnerships and expanding into new markets can enhance the global presence of China's ceramic products.

Through these strategies, the ceramic industry can achieve sustainable development, reinforcing its esteemed status on the global stage as shown in Figure 29.

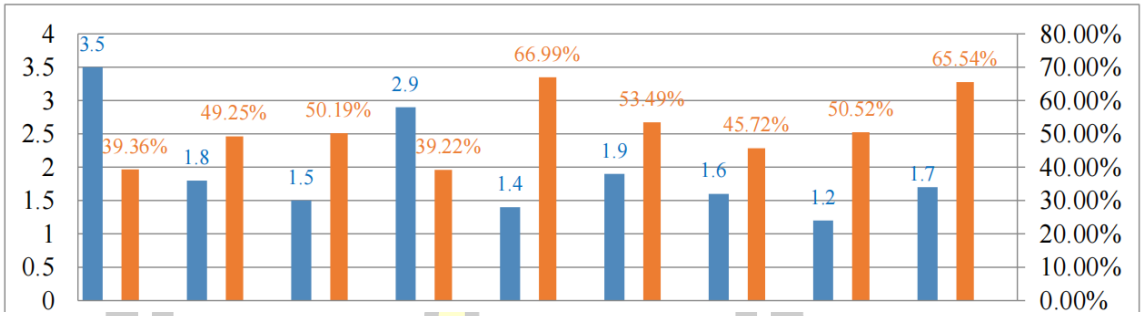


Figure 29Comparison of Solvency Indicators by Industry
Source: Drawn by Ye Li, 2023

6.5Profitability analysis

Profitability is a critical measure of a company's ability to generate capital appreciation from its own funds over a specified timeframe, serving as a key performance metric in business operations. Essentially, profitability indicators reflect the financial success of a company. By evaluating a company's profitability, management can identify operational challenges and implement solutions to enhance overall performance. The analysis of corporate profitability requires a thorough examination of financial health, market competitiveness, and managerial efficacy. This study compares two significant profitability metrics—earnings per share (EPS) and return on net assets (RONA)—among listed ceramic industry companies and peers across various sectors for the year 2021.

Earnings per share (EPS) represents the net profit allocated to each outstanding share, indicating the earnings generated per share within a certain period. This metric is crucial for gauging a company's profitability, directly impacting shareholder returns and market valuation, thereby serving as a valuable tool for both management and investors. According to the data, the ceramic industry's EPS stands at 0.25, positioning it in a relatively strong spot compared to other sectors.

Return on net assets (RONA) measures the after-tax profit as a percentage of net assets, showcasing the effectiveness of a company's capital utilization. A higher RONA signifies more efficient use of the company's equity. Data reveals a 0.94% RONA for the ceramic industry, with sectors like agriculture, construction, and real estate showing negative returns, possibly due to the adverse effects of the COVID-19

pandemic on sales. Ceramic industry companies, however, have pivoted to e-commerce amidst the pandemic, transitioning from traditional to online sales, which has mitigated the impact on their profitability.

Viewing the ceramic industry's position within the broader market landscape, its profitability aligns with the mid-range. Ceramic industry corporations must continue to advance cautiously, striving to enhance their profitability further as shown in Figure 30.

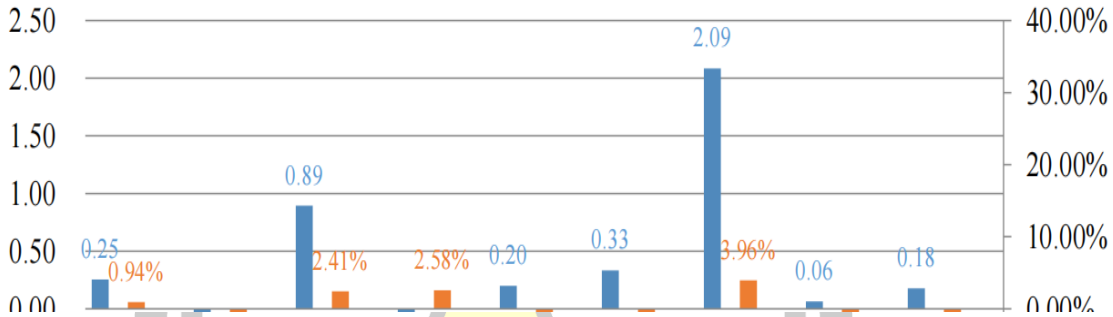


Figure 30 Comparison of Profitability Indicators by Industry
Source: Drawn by Ye Li, 2023

In analyzing the operational capabilities of enterprises, a crucial aspect is understanding how effectively these entities utilize their operational resources in day-to-day activities. This encompasses metrics like asset turnover ratios, which provide insights into the overall efficiency and asset management proficiency of a business. The operational capability directly influences a firm's solvency and profitability, playing a vital role in value enhancement and boosting market competitiveness and earnings. This section delves into the inventory turnover ratio and total asset turnover ratio, utilizing 2021 data from ceramic industry enterprises compared against broader industry metrics for a comprehensive evaluation.

The inventory turnover ratio, an indicator of how swiftly a company cycles through its stock, correlates the cost of goods sold with its average inventory balance. This metric is pivotal for decision-making in enterprise management, assessing the operational efficiency across production and sales, and offering insights into business performance. The ceramic industry's notably low inventory turnover ratio of 3.18, the minimal in its sector, suggests sluggish product circulation and prolonged sales

realization times. Potential stockpiling issues could tie up capital, detract from profitability, and indicate weaker business performance relative to other industries.

Conversely, the total asset turnover ratio, representing the ratio of sales revenue to the average total asset balance, sheds light on an enterprise's overall asset utilization efficiency and the rapidity of asset conversion from investment to returns. With the ceramic industry's total asset turnover ratio standing at 0.62—below the all-industry average of 0.69—it's clear that asset circulation is sluggish and utilization efficiency is wanting.

The findings point to a relatively subdued operational capability within the ceramic industry's listed companies, likely attributed to intense market competition and product homogeneity. Addressing these challenges requires strategic initiatives to enhance operational efficiency and fortify competitive positioning as shown in Figure 31.

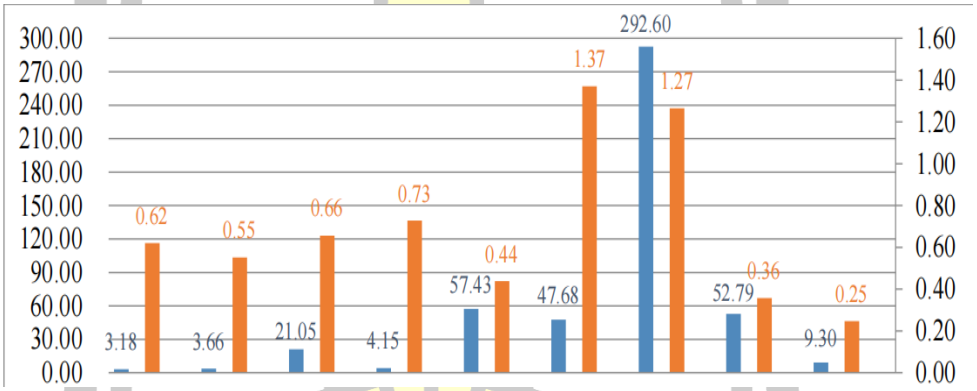


Figure 31Comparison of Operating Capacity Indicators by Industry
Source: Drawn by Ye Li, 2023

The concept of development capacity revolves around a company's prowess in advancing its operational indicators, expanding its scale, and innovating to stay competitive. This capacity underscores the importance of adept financial management and strategic foresight. Companies must continually refine and adjust their strategies to navigate market dynamics and competitive landscapes effectively. This analytical capacity is crucial for understanding financial health, pinpointing challenges, and devising timely resolutions. It also aids in charting future directions, setting realistic financial objectives, and elevating enterprise competitiveness and market presence. In this context, the study focuses on two primary indicators for 2021: the growth rate of

total assets and the growth rate of operating profits, comparing these metrics across listed companies in the ceramic sector and other industries.

The total asset growth rate reflects the efficiency of asset utilization over a specified timeframe. Analysis reveals the ceramic industry's total asset growth rate stands at 0.21, positioning it at an industry median. While certain firms like Jinlitai and Songfa shares witnessed a decline in total assets, Tian'an New Material and other entities experienced growth, stabilizing the sector's overall asset growth at a mid-range level. The operating profit growth rate, indicative of the operational profit evolution, highlights a company's operational efficiency. A higher index value suggests better enterprise-wide operational effectiveness. However, the ceramic industry's operating profit growth rate is recorded at -80.08%, aligning it within the median industry range.

This outcome primarily stems from a limited number of ceramic sector companies registering operating profit growth, with only seven achieving this milestone. The downturn in Songfa shares' net profit, attributed to goodwill impairment provisions, significantly impacts the industry's average, contributing to the observed trend.

Conclusively, while the ceramic industry's development capacity appears moderately placed within the broader industry context, this scenario is largely influenced by singular entities adversely affecting the collective performance. Despite this, the overall developmental prospects for ceramic sector listed companies remain cautiously optimistic, highlighting a need for sustained innovation and strategic adaptation to foster growth and stability.

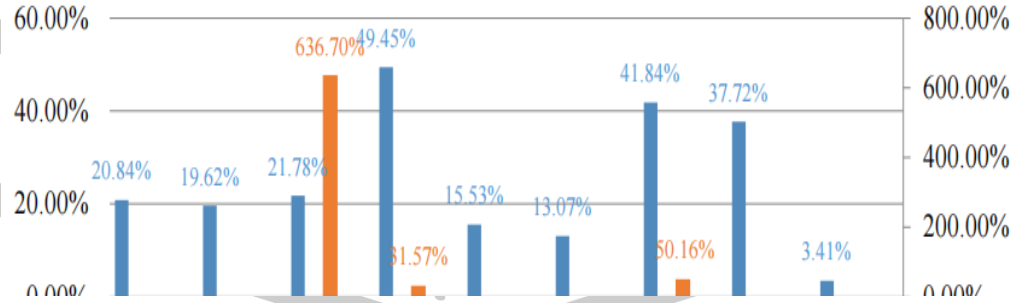


Figure 32 Comparison of Development Capacity Indicators by Industry
Source: Drawn by Ye Li, 2023

Amidst the multifaceted challenges facing the ceramic industry, particularly within the Jingdezhen ceramic packaging sector, several critical issues have emerged.

Firstly, there's a discernible deficit in brand development awareness among enterprises, marked by a failure to integrate packaging design effectively with the corporate ethos, leading to diminished brand visibility. Additionally, the fragile nature of ceramic products presents a substantial risk during transportation due to inadequate packaging solutions. Moreover, a pervasive lack of environmental consciousness within the industry exacerbates material wastage, reflecting deeper systemic issues such as minimal investment in sustainable practices, a low educational threshold among packaging staff, and a shortage of skilled packaging designers.

Addressing these concerns necessitates navigating through a series of potential hurdles and obstacles inherent in implementing eco-friendly packaging initiatives. The transition to sustainable materials often entails a higher cost compared to conventional alternatives, potentially inflating overall packaging expenses. Moreover, integrating novel production methodologies and technological advancements demands significant capital investment. Cost mitigation strategies, such as innovation and economies of scale, could see a reduction in the prices of sustainable materials as demand escalates. Furthermore, companies might explore the long-term financial benefits of enhancing brand equity and aligning with consumer expectations to offset initial costs.

The shift towards green packaging necessitates the adoption of new technologies and production processes, compelling ceramic enterprises to undergo technological upgrades. Collaborations with technical experts and academic institutions could furnish essential support and training, ensuring workforce proficiency in emerging technologies. Additionally, securing access to eco-friendly materials may necessitate supply chain realignment, fostering robust partnerships with suppliers and diversifying sources to enhance supply chain resilience.

Consumer acceptance of green packaging varies, influenced by factors like cost, product quality, and ingrained consumption habits. Effective communication and educational initiatives can underscore the environmental benefits of sustainable packaging, ensuring that product quality and utility are uncompromised, thereby reinforcing the added value of sustainable packaging options like reusability.

Employee engagement and understanding of sustainability practices are vital, necessitating comprehensive training programs to foster a culture of environmental stewardship within the organization.

Overcoming these challenges demands a committed and innovative approach from enterprises, but the shift towards sustainable packaging can afford the Jingdezhen ceramic industry a distinctive competitive edge, catering to the growing consumer base prioritizing environmental sustainability. This strategic pivot not only enhances brand perception and marketability but also aligns with broader sustainability objectives, charting a course for the industry towards a more sustainable and environmentally responsible future.

7.Analysis on the Current Situation of Jingdezhen Ceramic Packaging

China's ceramic tradition is profound, with Jingdezhen, the country's "Porcelain Capital," renowned globally for its distinctive blue and white porcelain. Despite its fame, Jingdezhen's rich ceramic culture has not fully penetrated the market, particularly the international arena, which has not been explored to its full potential. One significant challenge in this regard is packaging. Given ceramics' fragility, the demands on packaging are not just stringent but also call for innovative design solutions. This analysis delves into Jingdezhen ceramic product packaging, focusing on visual decorative forms, image design, and structural cohesion.

7.1 Disorganized Visual Decoration – Aesthetic Direction Lost, Missing Modern Design Orientation

A design's merit fundamentally rests on its content, with richness signifying the quality of creativity involved. A good design springs from innovative ideas, complemented by appropriate forms of expression. The diversity of daily-use ceramics, including items like tableware, tea sets, vases, and jars, offers a broad canvas for packaging design. However, the market displays a trend where packaging designs, regardless of product category, bear striking similarities. This uniformity extends to the decorative style, materials used, and even the design focus, which predominantly aims at protecting the ceramic products as shown in Figure 33.

Figure 33 Brocade box packaging
Source: Photography by Ye Li, 2023

Traditional Chinese brocade box packaging, with its predominant red, yellow, and blue color scheme, is still widely used. Red symbolizes festivity, yellow denotes nobility, reflecting ceramics' historical exclusivity among the upper class, and blue, representing Jingdezhen's iconic blue and white porcelain, is extensively utilized. While these colors are deeply rooted in Chinese tradition, their indiscriminate and unregulated use leads to visual fatigue, diminishing their charm and reducing the level of design sophistication. Furthermore, the typography often leans towards ancient calligraphy styles without considering modern layout strategies. The design also suffers from a lack of discernment in pattern selection, affecting visual impact due to poor differentiation of material information.

These issues stem primarily from a lack of strong aesthetic vision and an incomplete design consciousness. Mere stacking of elements without meaningful integration diminishes their value, losing their application significance in design. Consequently, product packaging appears cluttered and lacks distinctiveness, leading to a homogeneous style that fails to establish unique design identities.

From the perspective of packaging design, daily-use ceramics possess inherent uniqueness. Not only do they carry regional cultural signatures, but their fragility also demands a careful balance between function and aesthetics. As consumer expectations and aesthetic sensibilities evolve, there's an increasing focus on the decorative aspect of ceramic packaging, with higher design standards and conceptual depth. Adapting to ceramics' traits doesn't necessarily mean emulating ancient styles to exude luxury; instead, pursuing simplicity, elegance, and subtlety in packaging that emphasizes

brand identity and aligns with the brand's core philosophy is considered exemplary design as shown in Figure 34.

Figure 34 Daily ceramic packaging
Source: Photography by Ye Li, 2023

7.2 Unification of form - lack of design creativity and weak brand awareness

Ceramics, as exquisite artworks, demand meticulous packaging design due to their fragility. The primary role of packaging is to ensure the safety of ceramic products during transportation. However, existing issues within ceramic packaging design not only compromise the protective effectiveness of the packaging but also diminish brand recognition and appeal.

For uniquely shaped ceramic items, designers do put effort into creating distinctive packaging forms to highlight the product's uniqueness. Yet, for more generic ceramic products, packaging designs often appear monotonous and uninspired. Common external packaging typically involves rectangular boxes, with interiors generally protected by foam and fabric. Although this packaging approach can safeguard ceramic products to some extent, its lack of creativity and individuality greatly reduces product differentiation. Consumers faced with numerous similar packages find it challenging to quickly identify their desired product, undeniably increasing the time cost for both buyers and sellers.

As shown Figure 35, external packaging types mainly include lid-cover style, handle style, box style, and insert style. The differences among these styles are largely

manifested in color, elements, and opening methods. However, such superficial variations cannot mask the lack of thoughtful design consideration. The packaging structure, design level, and even the internal packaging design, all seem too uniform and monotonous.

Figure 35 Ceramic packaging

Source: Photography by Ye Li, 2023

This homogenization in packaging design leads to aesthetic fatigue and psychological burden on consumers. People yearn for more diverse packaging structures to alter the uniformity prevalent in ceramic packaging. This desire is not just about satisfying aesthetic needs but also about enhancing brand recognition and allure.

To address this issue, designers need to focus more on the creativity and personalization of packaging design. They can achieve more unique and appealing packaging by employing different materials, colors, elements, and structural forms. Similarly, brands should strengthen brand identity cultivation, highlighting the uniqueness and value of the brand through packaging design.

In summary, the homogenization of ceramic packaging not only affects the product's protective effectiveness but also weakens brand recognition and attraction. Designers and brands need to work together, leveraging innovative packaging designs to change this situation and provide consumers with a more unique and superior shopping experience.

The differentiation in public aesthetics and the demand for individual development pose the question: how can mass-produced ceramic products achieve personalized development? Tailoring the production process, techniques, and handcrafted uniqueness of ceramic product designs, as well as distinct packaging forms, are effective ways to develop the individuality of ceramic products. Customized design, adaptable to consumer needs and preferences, is also viable. As people's aesthetic abilities improve, producing personalized ceramic products has become feasible, albeit with certain limitations, such as higher costs and a more restricted consumer base. Solutions to this issue can be targeted. Designers can employ flexible design methods when creating high-end custom products, allowing for adjustments based on customer demands to reduce production costs. Daily-use ceramics, aimed at household units, represent the largest potential market for customization. Reusing packaging, thus recycling discarded materials and decorating homes, points to a future direction for packaging design and signifies the trend towards personalized packaging

design, striving for commonality in unique products and seeking innovation within commonality.

Consumer demand for design and the functional form of packaging design

Modern, minimalist design forms are increasingly favored by consumers, and promotional techniques primarily using graphic language are preferred by designers. The formalism of packaging design is evolving towards simplicity, moving away from complex styles, and paying more attention to the post-design processing of traditional elements, resulting in more diversified packaging forms. Unique, novel, and personalized packaging forms are favored by consumers and represent a common psychological trend in the future market. In an environment where ceramic packaging designs are largely homogeneous, making a difference can attract a portion of consumers' attention and stand out. Emergent packaging forms, such as avant-garde design shapes, distinctive styles, and additional advertising by companies, stimulate consumers' senses and gain recognition after a period of market exposure. Compared to traditional packaging forms, simpler international-style paper bag packaging or environmentally friendly packaging forms are becoming increasingly popular. This reflects the importance of personalized consumption in today's design and indicates that stimulating consumption is a direct driving force for the future of ceramic packaging design.

7.3 Obsolete material performance - backward packaging technology, deviation in content and form

The current main packaging forms include: simple packaging, cardboard packaging, gift box packaging, and wooden box packaging. As shown in Figure 36, simple packaging is very casual with a basic form, employing box packaging that only differs in material. It targets the packaging design for general consumer goods, with no complex material application such as twine binding, or even some items directly using plastic bags, and simple bundling forms like wrapping with kraft paper. This type of packaging is suitable for simple goods sales and does not form a sales industry chain. Cardboard packaging is divided into corrugated cardboard packaging and honeycomb cardboard packaging. Such packaging forms are cost-effective but are only suitable for the stacking of general products and offer little protection for

ceramics, thus are relatively used for mid-to-low-end product packaging. The packaging of high-end ceramic products has seen significant improvements not only in material but also in design creativity, with packaging materials often using wood, bamboo, synthetic cardboard, etc., setting them apart from general products in terms of shape, design, and material.

			
convenient pack	Carton	Gift Package	Wooden packing

Figure 36 packaging style
Source: Photography by Ye Li, 2023

Packaging design is the process where designers use computer software to create two-dimensional designs that are applied to three-dimensional space, embodying a philosophical journey from thought to practice. Material, serving as the external structure that carries the product and the texture of the material itself, acts as a medium for expressing the external form of the packaging. Simply put, what consumers touch and feel in terms of packaging appearance includes firstly, the stylistic characteristics of the design, and secondly, the texture and material quality, which impacts consumers visually and tactilely, directly inducing purchasing impulses.

In ancient China, ceramics were exported overseas, and to accommodate long ocean voyages, products were placed in stacked forms to ensure preservation. To safeguard product integrity, older methods of transportation involving layering ceramics are still used today, with modern practices often involving securing ceramics within wooden frames to ensure safety. As for the choice of traditional materials, wood, paper, and fabric are still prevalently used, albeit in slightly altered forms. With advancements in craftsmanship, packaging forms have diversified on the basis of traditional materials, enriching packaging design. The natural decorative patterns formed by different material textures or surface lines can achieve visual effects that other materials cannot, showcasing the unique charm of diverse materials. Materials

have become one of the key competitive elements in products, whether it's paper, wood, synthetic plastics, metal textures, ceramic textures, or other emerging materials, each creating distinct design tactile experiences.

To this day, traditional materials still hold an important place in the Jingdezhen ceramic market. The evolution of packaging materials from straw, rice straw, paper, bamboo products, fabric, and even older methods of object stacking, to fillers still being straw, hay, sawdust, foam, etc., to prevent damage from vibrations, may not be aesthetically appealing but play a crucial role in preserving the integrity of goods. It's essential to absorb the essence of traditional materials for future improvement and innovation. In terms of artistic creation techniques, it advocates for expressing the product's artistry and designing packaging that complements the product's specific temperament.

Since its inception, packaging has evolved from simple forms to a variety of craft-based forms today, undergoing continuous updates in craftsmanship, materials, and technology. With the advent of various processing methods in modern society, the techniques of artistic creation are constantly being enriched, driving the development of design forward. Similarly, advancements in science and technology have also brought convenience to packaging design, propelling its progress.

With technological advances, new types of packaging materials have emerged, such as the development of nanotechnology and the application of compressed synthetic boards. A typical example is IKEA's ceramic dinnerware packaging, which is seamless, with a simple appearance that, while ensuring product safety, also highlights the Japanese design style—simplicity. A mark upwards strengthens corporate brand awareness. This example shows us that to advance ceramic packaging beyond tradition, it's crucial to continuously experiment with new materials. For instance, IKEA's Zakka new bone China coffee cup and pot set with a tea tray gift box packaging and Zakka, IKEA-style high-temperature white porcelain, high white porcelain, export ceramics, PVC packaging, and ceramic plates feature a minimalist design that harmonizes with the unique temperament of bone China—uncluttered as shown in Figure 37, pure, and straightforward, offering convenience in use. This facilitates packaging operations and mass sales of products, with strong integrity and

interesting product design, making it an appropriate gift porcelain. Moreover, its style belongs to the clean and simple design typical of Japanese aesthetics.

Furthermore, the minimalist design style is increasingly accepted by consumers, corresponding to the traditional Chinese design style. It reflects a consumer preference that requires the integration of traditional elements into modern designs that meet the demands of the era. Simplicity is not synonymous with being plain; overly simplified products not only lack substance but also carry no content or connotation, failing to establish a product strategy. Instead, it might backfire, leaving a void of content.

Figure 37 IKEA ceramic packaging
Source: Photography by Ye Li, 2023

Chapter III

Analyzing Green Ceramic Packaging Design

1.Concept and importance of green packaging

Packaging's relationship with the environment and resources is intricately linked. Since the 17th-century industrial revolution, human society's material civilization has seen unprecedented development, transforming nature and economic growth. However, the crude production model of "high production, high consumption, high pollution," irrational resource exploitation, and neglect in managing industrial by-products like waste gas, wastewater, and solid waste have led to resource scarcity, energy shortage, and environmental degradation. This has triggered ecological and environmental issues, including acid rain, ozone layer depletion, global warming, water pollution, water body eutrophication, photochemical smog, and trash accumulation, primarily due to direct discharges into the environment.

Like other sectors, the packaging industry has adversely affected humanity while contributing to commodity prosperity, living standards improvement, and market economy development. Thus, the packaging industry's relationship with the environment and resources exhibits a dialectical duality. On one hand, it enhances economic and social benefits, offering product protection, circulation facilitation, and sales promotion. It prevents damage during circulation and external hazards from materials with flammable, explosive, corrosive, toxic, infectious, or radioactive properties. Packaging aids circulation by easing transport, handling, storage, reducing breakage, and facilitating recycling. Hence, packaging plays a significant role in environmental protection and resource loss reduction, improving ecological conditions and conserving resources.

On the other hand, packaging also raises environmental pollution and resource consumption issues. Packaging's ecological resource consumption is direct, especially for products made from paper, wood, bamboo, and rattan, deriving from natural resources and impacting ecosystems. Ecological damage from packaging primarily stems from resource extraction causing ecosystem imbalances and some synthetic materials (e.g., polystyrene, PVC, polyolefins) potentially producing toxic side effects

under certain conditions. Additionally, packaging waste contributes to environmental pollution and ecosystem destruction.

While packaging has greatly benefited human life, its by-product, packaging waste, severely pollutes the environment, disrupting natural ecosystem balance and threatening human survival and sustainable development. Balancing packaging volume growth with environmental impact has become a pressing issue.

The 1980s saw global attention to municipal solid waste pollution and "white pollution," prompting worldwide action. Countries now require packaging manufacturers to consider waste elimination in material selection. Effective packaging waste management ensures environmental compatibility. Developed countries have shifted focus from landfills and incineration to waste recycling, adopting the "waste management hierarchy" principle. Many have enacted laws on packaging waste management and recycling, sparking a global green wave. Life Cycle Assessment (LCA) evaluates product environmental performance, assessing solid waste generation and raw material consumption.

After over 30 years of rapid growth, China's packaging industry has become a key sector with comprehensive categories, a complete system, and significant industrial relevance. From a 1981 total output value of 7.2 billion yuan, it soared to 328.3 billion yuan in 2004, with an average annual growth rate exceeding 18%, climbing from the last to the 12th among China's 40+ industries. The packaging industry's total profit growth rate reached 44.58%, with sales revenue growth at 21.38%, outpacing other sectors and highlighting its development potential as a "sunrise industry." China's packaging industry has gained status and influence internationally. In 2008, its output value hit 860 billion yuan (over 126 billion USD), making China the world's second-largest packaging country. By 2010, the total output value reached 1.2 trillion yuan. According to Shi Wan Peng, Chairman of the Asian Packaging Federation and President of the China Packaging Federation, the industry aims to achieve a 2 trillion Yuan total output value from 2011 to 2015. The "Twelfth Five-Year Plan" targets stable and healthy development, enhanced innovation, optimized structure, improved sustainable development capability, and advanced industrialization-information technology integration, aiming to match or surpass medium-developed countries' informatization levels by its end. By 2020, China's packaging industry aims to support

a comprehensive moderately prosperous society, creating a new, high-tech, economically beneficial, resource-efficient, low-pollution industry, leveraging human resource advantages.

1.1 Definition of packaging

Packaging, integral to the development of human productive activities, is essential for the commercialization of any product. Its significance in modern commodity production, storage, sales, and social life cannot be understated, though its definition varies across different countries and periods.

The British Standard defines packaging as the art, science, and technology of preparing goods for the market and sale. This broad scope suggests that packaging enhances a product's marketability and sales appeal. Paine further elaborates on packaging as a coordinated system for preparing goods for transportation, logistics, warehousing, retailing, and end-use. It's a means to ensure safe and efficient delivery of goods to consumers at minimal cost, underpinning a techno-economic role aimed at optimizing transport costs and maximizing consumption and profit. This definition underscores the market and economic roles of packaging, with less emphasis on its technical aspects.

The encyclopedia of Packaging Technology presents packaging as part of a manufacturing system with added responsibilities towards consumer convenience and environmental protection. It emphasizes packaging's multifaceted role in product and environmental safeguarding. Conversely, China's national standard (CB4122-83) on packaging terminology describes it as the use of containers, materials, and aids for product protection in circulation, storage, transport facilitation, and sales promotion through specific technical methods. This encompasses the broader "packaging system," highlighting both tangible and intangible aspects of packaging in the industry.

As societal progress diversifies consumer needs—material, spiritual, and economic—the concept of packaging extends beyond mere containment to act as an information carrier for economic activities, brand establishment, and product value addition. This evolved concept entails pre-packaging market research, consumer analysis, commodity planning, and feasibility studies, guiding functional packaging to

avoid investment missteps and enhance product value through commercial activities, including advertising, marketing, and service.

Thus, comprehensive packaging encompasses pre-packaging, functional packaging, and post-packaging processes, merging tangible with intangible aspects. It carries not just the product but also embodies science, technology, culture, art, social psychology, and ecological values, representing a systematic project and a nuanced economic awareness. Packaging, in its modern iteration, transcends its original function to encompass a broader system integral to commodity value addition and market dynamics.

1.2 Classes of packaging

In order to delineate packaging hierarchies, it can be categorized into three levels: primary, secondary, and tertiary packaging. Primary packaging, also recognized as consumer packaging, encompasses packaging that is directly available to consumers or users for home use from retail locations. This category includes products such as cosmetics and toothpaste, where the packaging not only serves to protect the product but also aids in user identification, necessitating the utilization of materials that are both resource-efficient and environmentally friendly. Secondary packaging is designed to consolidate multiple units of primary packaging. It can either be sold as a complete unit to the end-user or function as an intermediary packaging layer. This level of packaging is tailored for ease of retail handling, presenting as a collective unit that can be directly shelved, as opposed to stocking individual primary packaged items. An example would be a corrugated cardboard tray serving as secondary packaging. Tertiary packaging, or bulk packaging, is significantly influenced by the product type and is geared towards optimizing the transportation and handling of numerous primary and secondary packaged goods. Its primary aim is to safeguard the products from damage during transit, typically grouping a vast number of primary and secondary packages onto a pallet for efficient transportation.

1.3 Functions of packaging

Packaging plays a critical role at every phase of production, logistics, usage, and recycling. It essentially serves three primary functions: marketing, logistics, and environmental protection.

Logistical Aspects: This function facilitates efficient handling during the distribution process and by the final consumer, aiming to protect and identify the product. It encompasses the supply of packaging materials, packaging activities, internal material logistics, distribution, unpacking, handling, and the management of returns.

Marketing Aspects: These are activities that enhance the product's value to the end-user, involving packaging design, layout, and ergonomics. This function contributes to generating revenue through packaging.

Environmental Aspects: This includes optimizing economic resources, mitigating environmental impact, and promoting the recovery and recycling of packaging materials.

Specific Packaging Functions Include:

Protective Functions: The foremost role of packaging is to safeguard the product against impacts, vibrations, static pressure, and other stresses encountered in the logistics environment, ensuring the product's safe delivery to the user. The circulation environment's changing parameters, like temperature, humidity, air pressure, light, and pollution, can be quantitatively measured and simulated in laboratory settings to test the package design. However, accurately characterizing the external shocks and vibrations during distribution (due to loading, unloading, transportation modes, etc.) is challenging, as these parameters vary widely. Understanding the physical properties of the product, such as its brittleness value, is essential to design a package that effectively protects it. A comprehensive analysis of all potential hazards and safety factors during the product's lifecycle allows for the creation of a reliable packaging solution that maintains product quality until it reaches the consumer.

Ease of Distribution: Packaging should enable easy and efficient distribution, accommodating various modes of transportation and handling to streamline the supply chain process.

Information and Communication: Packaging serves as a vital communication tool, providing essential information about the product, usage instructions, and brand messaging to consumers.

Environmental Functions: Eco-friendly packaging aims to reduce resource use, minimize environmental impact, and support sustainability by facilitating recycling and waste reduction efforts.

By addressing these functional aspects, packaging not only enhances the product's market appeal but also contributes to efficient logistics and environmental sustainability.

External factors	Functional elements of packaging and packaging materials
Mechanical shocks, vibrations and pressure loads	Shock and vibration absorption compressive strength bending strength tensile strength
biological factor	Resistance or sensitivity
Gases (oxygen, nitrogen, carbon dioxide)	permeability
ray	light transmission light absorption reflexive
temp	heat conduction
(of clothes) classifier for number of washes	resistance absorption

Table 1External factors against which packaging must resist
Source: Drawn by Ye Li, 2023

Facilitating Efficient Distribution One of the principal functions of packaging is to streamline the distribution process, mainly from the manufacturer or supplier to the end user. As the mechanization and automation of goods handling escalate, so does the demand for packaging that supports efficient distribution. The design of packaging often necessitates the use of an optimized series of dimensions to facilitate the automation of manufacturing and distribution processes. For instance, the use of forklift-compatible pallets, trucks, and standardized pallets is encouraged to support mechanized shipments. This aspect of packaging significantly enhances the productivity of products along the packaging line, encompassing elements like internal distribution, external distribution, unit loads, and handling as shown in Figure 38.

Internal Distribution: This is closely linked to the efficiency of the packaging line within the manufacturing process.

The structure of a standard commodity barcode, comprising 13 digits, highlights the emphasis on streamlined distribution:

The first 3 digits represent the country code, illustrating a global standardization effort to ensure smooth international distribution and compatibility with automated handling systems.

By focusing on these distribution-related packaging elements, companies can greatly improve the efficiency of their supply chain, reducing costs and improving speed to market barcode.

■ EAN/UCC company prefix product reference number ultimate code

Figure 38Using bar codes to identify packaged products

Source: Drawn by Ye Li, 2023

Packaging plays a pivotal role from the inception of production activities to logistics, use, and recycling. Essentially, the core functions of packaging are categorized into marketing, logistics, and environmental aspects.

Logistical Functions: These are crucial for efficient handling during the distribution phase and by the final consumer, aiding in product protection and identification. This function encompasses the supply of packaging, packaging activities, internal material logistics, distribution, unpacking, handling, and return processing.

Marketing Functions: These are activities that add value to the product concerning the end-user. Attributes under this category include packaging design, layout, and ergonomics, contributing to the generation of revenue from packaging.

Environmental Functions: These involve enhancing economic resources, minimizing environmental pressure, facilitating packaging recovery, and recycling of packaging materials.

Specific Functions of Packaging Include:

Protective Functions: The primary role of packaging is to safeguard the product from impacts, vibrations, static pressure, and other loads in the logistics environment, ensuring safe delivery to the user. The package design needs to consider various physical factors, like brittleness value, to determine how best to protect the product.

Understanding every hazard that could alter product quality is crucial for designing reliable packaging that guarantees product integrity upon reaching the end user.

Facilitating Distribution: Another significant function of packaging emphasizes distribution from the manufacturer or supplier to the user. As goods handling becomes more mechanized and automated, the requirement for distribution-friendly packaging grows. Packaging should ideally be designed to facilitate automation in manufacturing and distribution, for example, accommodating forklift operations, truck loading, and standardized palletization to support mechanized shipments.

Information and Communication: In the age of information technology and e-commerce, the information and communication functions of packaging have gained importance. Packaging must convey necessary product information, acting as a "silent seller" and successfully communicating product details, credibility, and establishing emotional connections with potential customers to encourage purchasing decisions and enhance brand loyalty.

Environmental Functions: Packaging’s environmental protection function chiefly pertains to minimizing resource consumption and safeguarding the environment by ensuring product safety. This function has gained prominence with the growing awareness of environmental protection, emphasizing packaging's role in preventing product damage, contamination, and environmental pollution from leaking commodities.

In summary, packaging encompasses a myriad of functions across different stages of a product's lifecycle, highlighting its indispensable role in marketing, logistics, and environmental sustainability.

Packaging waste refers to materials that have essentially or entirely lost their utility during production, distribution, and consumption processes and cannot be reused. The distinction between "waste" and "resource" is relative, closely tied to social development stages, technological and economic conditions, and lifestyle habits. Waste, also known as secondary resources or renewable resources, is essentially raw materials misplaced. Solid waste engineering, evolving into an emergent discipline focused on renewable resources engineering, underscores the temporality and spatiality of waste.

Current Recycling Status of Packaging Waste Recycling packaging waste is crucial in the evolution towards green packaging. Distinguishing between recycling and regeneration is essential; recycling serves as a precondition for regeneration. The world harbors no "trash" per se, only misplaced resources. A proactive waste management approach begins at the waste source, aiming to prevent waste generation and fundamentally mitigate pollution.

In Germany, the recovery, processing, and recycling of packaging waste have been scaled, industrialized, and commercialized into a rapidly growing industry since the 1990s. Featuring one-stop services, including multinational recycling companies in a chain-store format, this approach has transformed into an international service industry. Leveraging advanced technology for processing, these services can handle millions of tons annually without generating secondary pollution. This approach not only conserves energy and resources but also yields significant profits.

Mature technologies demonstrate that recycling 1 ton of waste paper can regenerate 800kg of new paper or 830kg of cardboard, saving resources and energy significantly. Similarly, recycling plastics, glass, and metal also results in considerable savings and reduced environmental impact.

In 1998, China produced substantial quantities of packaging products across various materials. With economic growth and the packaging industry's rapid development, the production and resultant waste have only increased. Despite the potential for significant economic benefits from recycling, China's recycling rates for packaging materials remain relatively low compared to the potential waste generated. The Chinese government plans substantial investments in solid waste disposal to address this, aiming to manage and utilize solid waste effectively.

Most Chinese enterprises currently employ consumption-oriented production methods, focusing on consumption levels while neglecting the importance of saving and recycling. The recycling rates for various packaging materials in China are considerably low, highlighting a need for improvement.

The hierarchical management principle for packaging waste emphasizes prioritizing reduction, reuse, recycling, incineration, and landfill in descending order. This approach aims to minimize waste and maximize resource efficiency, representing an effective strategy to tackle the challenge of packaging waste.

Preventing Waste Generation and Source Reduction: This involves minimizing packaging to reduce the amount used and its environmental impact. Effective waste prevention strategies focus on reducing the packaging footprint and minimizing harmful effects on the environment.

Reuse: Reusing products in their original form or for alternative purposes plays a crucial role. Economic considerations of the reuse process are vital, highlighting the need for economically viable reuse options.

Recycling, Recovery, and Regeneration: Full utilization of packaging materials includes material recovery, energy recovery, and composting. These processes ensure packaging materials are repurposed or energy is extracted efficiently, without a strict hierarchy among the methods. The success of recycling industries hinges on economic viability, with energy recovery being common for various materials, especially plastics. Composting involves microbial decomposition under controlled conditions to produce stabilized organic matter or methane.

Landfill/Incineration: This is the last resort for disposing of used packaging. Certain infectious wastes are neutralized through combustion. The calorific value of packaging material for combustion and the presence of infectious materials in landfills are considerations for this disposal method.

Packaging Waste Disposal: Involves transforming wastes into forms suitable for transport, utilization, storage, or final disposal using physical, chemical, biological, physicochemical, and biochemical methods.

Types of Packaging Waste Treatment Technologies: Physical Techniques: Alter the structure of waste for easier transport, storage, or disposal. Includes compaction, crushing, sorting, thickening, and dehydration.

Chemical Technologies: Use chemical processes to neutralize hazardous components or convert them into a safer form. Includes oxidation, reduction, neutralization, chemical precipitation, and leaching.

Biotechnology: Utilizes microorganisms to break down organic matter for harmless use or recycling. Methods include aerobic, anaerobic, and semi-anaerobic treatments.

Thermal Treatment Technologies: Employ high temperatures to destroy or alter waste composition for volume reduction, harmlessness, or resource recovery. Includes incineration, pyrolysis, wet oxidation, and roasting.

Curing Technology: Stabilizes wastes by encapsulation to lessen environmental hazards, facilitating safer transport and disposal. Methods include cement and lime curing, thermoplastic material curing, and glass curing.

Pollution from Packaging Waste Disposal: Environmental pollution and resource destruction have escalated with industrial advancement. Issues like thermal pollution, global warming, freshwater scarcity, soil degradation, gas pollution, chemical pollution increase, and hazardous waste accumulation highlight the urgent need for effective waste management strategies. Addressing packaging waste disposal's environmental impact requires a comprehensive approach to recycling, recovery, and thoughtful waste management practices. These efforts not only mitigate environmental damage but also contribute to sustainable resource utilization and protection.

1.4 Measures to address pollution from waste disposal

Packaging Reduction: Enhance product and manufacturing design processes to cut down on production waste; optimize packaging design by adopting economic packaging or bulk containers; focus on designing reusable packaging, and developing durable and repairable packaging options; minimize the use of toxic chemicals in packaging materials, like adhesives and various coating additives. Favor single-material packaging where feasible for simpler recycling.

Original Quality Reuse: This involves reusing packaging in its original form and quality, recycling and processing it for reuse without altering its function or essence.
Recycling: Post-use packaging or materials are recovered, processed, and transformed into valuable products for reuse. Recycling can be:

Modified Recycling: Where the structure of packaging waste is altered during processing, though its nature remains unchanged, allowing it to be reused for its original purpose, like recycling waste paper and cardboard boxes, or plastic packaging being remelted. Examples include turning waste paper into new paper products or plastic packaging into recycled plastic items.

Transformative Recycling: Completely changing the shape and nature of packaging waste to create valuable non-packaging products, such as converting plastic packaging waste into gasoline through specialized treatment.

Packaging Industry and Sustainable Development: The life cycle of packaging reveals potential environmental interactions, highlighting areas of concern:

Packaging Process Pollution: Emissions from the packaging production process can cause air and water pollution. Unrecyclable materials, industry waste, and hazardous substances can harm the surrounding environment and soil. Rough production methods result in significant emissions, especially in industries like paper manufacturing, metal packaging, and plastic material extraction.

Short Product Life Cycles: Most packaging becomes waste after single use, contributing to resource depletion.

Growing Waste Proportions: With rising consumption levels, packaging waste increasingly dominates urban waste, creating visual pollution and environmental hazards. Non-biodegradable plastic waste, in particular, leads to "white pollution."

Land Use for Landfills: The need for extensive land to accommodate landfill sites is unsustainable, especially as available space diminishes and cannot support the ongoing disposal of packaging and municipal waste.

Environmental Impact of Repeated Washing: Repeated washing of used packaging can pose potential water pollution risks.

Resource Consumption: The production of packaging consumes significant natural resources and raw materials, a concern that's magnified by population growth and urbanization, leading to increased packaging material usage.

Addressing these issues requires a multifaceted approach, including reducing packaging use, enhancing recycling efforts, and developing sustainable packaging solutions that minimize environmental impact and resource consumption.

1.5 Definition of Green Packaging

Green Packaging Evolution: Green packaging emerged in 1987, heralded by the United Nations Commission on Environment and Development's publication "Our Common Future" and further emphasized at the United Nations Conference on Environment and Development in 1992 with the adoption of the "Rio Declaration on Environment and Development" and "Agenda 21," sparking a global wave of ecological and environmental protection. Termed "Green package," "Environmentally Friendly Packaging," or "Ecological Packaging," its aim is to ensure harmlessness to the ecological environment and human health, promote energy and material recycling, and support sustainable development. In essence, green packaging harmonizes social and economic benefits by advocating for packaging solutions that are eco-friendly, health-safe, material-efficient, recyclable, and easily degradable, aligning with sustainable development principles.

Green Packaging Design Principles:

While both green and green packaging design prioritize environmental sustainability, their focuses and application scopes differ. Green design's core, "3R1D" (Reduce, Recycle, Reuse, Degradable), strives to minimize resource and material use, enhance material recyclability, ensure component reusability, and favor biodegradable materials to mitigate environmental impact.

Green Packaging Design zeroes in on packaging's environmental footprint. It champions the use of eco-friendly materials, minimizes resource usage, optimizes structures to reduce waste, and advocates for recyclable and reusable packaging, all while ensuring functionality is not compromised. Thus, green design broadly addresses a product's entire lifecycle, encompassing design, manufacture, use, and disposal, whereas green packaging design specifically targets minimizing environmental impacts of packaging materials and structures, fulfilling functional needs sustainably.

Summarized into the 3F principle:

Fit for Nature: Emphasizes harmonizing packaging design with natural elements and sustainability, utilizing biodegradable, recycled, or recyclable materials to lessen environmental load, and incorporating natural motifs to signify eco-friendliness.

Fit for People: Centers on aligning packaging design with consumer preferences, needs, and experiences, ensuring ease of use, clear information, and attractive presentation, while reflecting brand values and fostering an emotional connection with consumers.

Fit for Time: Stresses adapting packaging design to contemporary trends, cultural shifts, and consumer behaviors, leveraging innovation and digital technology to create engaging, sustainable, and flexible packaging solutions that resonate with modern consumers and remain relevant over time.

Green packaging and green packaging design are vital to sustainable development, advocating for environmentally conscious, consumer-focused, and trend-aligned packaging strategies to promote greener, more sustainable design and production practices.

1.6 Connotation of green packaging

Green packaging embodies the essence of environmental stewardship and resource sustainability. It encompasses packaging solutions that are benign to both the ecological environment and human health, facilitating recycling, reuse, and reclamation, thereby bolstering sustainable economic development. Green packaging mandates that from raw material selection through to product manufacturing, usage, recycling, and ultimate disposal, every phase aligns with ecological and environmental protection standards. This encompasses conserving resources and

energy, minimizing waste generation, fostering ease of recovery, recycling, incineration, or degradation, all in service of ecological sustainability.

Core Principles of Green Packaging:

Safety and Health: This criterion ensures packaging materials are non-toxic and comply with relevant health standards, safeguarding human health. The significance of safety and hygiene fluctuates across different products, being paramount for food, medications, and frequently used consumer goods.

Environmental Protection: Packaging must harmonize with environmental conservation, implying that materials and their production processes should not harm the environment. This compatibility spans the entire lifecycle of packaging, from raw material procurement to waste disposal.

Resource Conservation: This involves the efficient use of materials and energy, extending to the judicious utilization of human resources.

Safety and health are fundamental for protecting human wellbeing, while environmental protection and resource conservation are critical for benefiting current and future generations. Therefore, packaging that embodies these three foundational criteria qualifies as green packaging. Conversely, packaging lacking these traits does not meet the green packaging standard.

Green packaging typically encompasses five key aspects:

1. Packaging Minimization: Packaging should be as minimal as possible, satisfying protective, convenience, and marketing functions without excess.

2. Reuse and Recycling: Packaging should be designed for easy reuse or recycling, aiming for a circular lifecycle through product recycling, energy recovery from incineration, composting to enhance soil quality, etc.

3. Biodegradability: Packaging waste should biodegrade, avoiding permanent waste accumulation and contributing to soil improvement.

4. Non-toxicity: Packaging materials must be safe for humans and organisms, free from toxic elements, pathogens, and heavy metals, or contain them within safe limits as per relevant standards.

5. Lifecycle Harmlessness: From raw material acquisition through to final disposal, packaging should pose no risk to humans or the environment.

Green packaging is poised to evolve with scientific advancements, gaining new dimensions that further its ecological and protective mandate.

Green Packaging Classification:

Grade A: This level of green packaging encompasses solutions where waste is recyclable, reusable, or degradable, and toxic substances are within safe limits.

Grade AA: Represents the pinnacle of green packaging, ensuring safety throughout the product's lifecycle without environmental harm, with toxic substances kept within prescribed limits.

This classification primarily addresses post-use waste management, an ongoing global environmental challenge. It highlights a persistent issue from past to present, underscoring the continuous effort required to resolve it.

1.7 Green Packaging Policy

As global awareness of environmental crises and resource scarcity deepens, the push for sustainable development has become increasingly ingrained in societal consciousness. This shift has catalyzed the emergence of a range of green products championing environmental protection and a natural ethos, igniting a significant green movement worldwide. In response to the burgeoning trend towards green packaging and to foster its global expansion, countries worldwide have introduced legal frameworks governing green packaging standards.

Germany pioneered this effort with the enactment of the German Packaging Ordinance in 1991, subsequently revised in 1998 in alignment with the Guidelines on Packaging and Packaging Waste. Further solidifying its commitment to sustainable practices, Germany introduced the Circular Economy and Waste Management Act in 1996, mandating that producers and distributors take responsibility for recycling their packaging waste. The legislation also stipulates that containers and packages must bear a green symbol, with associated fees varying based on the recyclability of the packaging materials. Driven by the incentive to minimize green label fees, businesses are increasingly adopting simpler, more recyclable packaging solutions.

The United Kingdom followed suit with the Packaging Waste Regulations in 1996. Earlier, in 1993, the packaging industry alongside 28 companies formed the "Producer Responsibility Industry Group" to champion a national framework for the collection and reuse of packaging waste. This initiative has seen wide participation,

encompassing 80% of the populace and involving local authorities in organizing recycling and sorting efforts.

Austria introduced its Packaging Ordinance in October 1992, later complemented by the Packaging Objectives Ordinance. These regulations compel producers and sellers to freely accept and recycle transport, secondary, and sales packaging. They set a recycling and reclamation target of 80% for recovered packaging materials. In 1994, Austria further refined its legislative framework with the Draft Packaging Act, integrating specific legal provisions from the European Packaging "Guidelines." The nation has also established a robust recycling infrastructure, notably featuring "eco-boxes" and "eco-bags" for the collection of empty beverage and milk cartons. These receptacles are delivered to and collected from consumers' homes by manufacturers at no charge, significantly reducing annual waste production.

Through these legislative measures and initiatives, the global community is making strides towards more sustainable packaging practices, reflecting a collective commitment to environmental stewardship and resource conservation.

In France, the Packaging Code introduced in 1993 mandates a reduction in household waste sent to landfills. Additionally, the Transport Packaging Code of 1994 requires all packaging end-users, apart from those dealing with household packaging, to segregate the product from its packaging for recycling and disposal by the producers and retailers. To facilitate this, French producers and importers have established an eco-packaging entity acting as a centralized system for recycling household sales packaging waste. Participants in this program, upon paying a certain fee, earn the right to label their products with the "Punctuation" logo, signifying compliance. France also hosts companies specializing in the recovery and recycling of glass, pharmaceutical packaging, and wooden packaging waste.

Belgium adopted the National Ecology Act in July 1993, effective from July 1995, and introduced an ecological tax exempting food and reusable paper packaging, while imposing it on other materials. "Foster Pallas," a consortium of 28 packaging producers, wholesalers, retailers, and recycling firms, oversees the collection and sorting of residential packaging waste in urban regions.

In the United States, the negative impacts of packaging waste were recognized as early as the 1960s, prompting state governments to legislate mandatory recycling

measures. This intervention sparked a conservation movement aimed at "Protecting America's Beauty." By 1970, the U.S. government had established a resource recovery system. In the late '80s, the federal government formulated a broad policy due to its inability to impose packaging waste solutions on states. This policy encouraged states to adopt programs focusing on source reduction, reuse, recycling, and incineration. In 1993, California implemented the "Beverage Container Ransom System," demanding a 10% reduction in raw material usage for all hard plastic containers since 1991 or a requirement for containers to comprise 25% recyclable material. Connecticut and New York introduced proposals to ban non-recyclable materials in consumer packaging and the use of polystyrene expanded plastics, respectively. Florida pursued the Waste Disposal Advance Fee Law (AFD), shifting packaging waste disposal costs to consumers and incentivizing manufacturers to recycle by offering exemptions from the advance fee for achieving specified recycling rates. According to the Department of Environmental Protection (DEP), containers with a recycling rate exceeding 50% could be exempted from the fee, encouraging producers to ensure at least half of their packaging is recyclable.

Australia's National Packaging Guidelines, established in 1991 by a coalition of government, industry, consumer, and environmental representatives, aim to harmonize practices across the nation, though each state implements its unique legislation. Queensland's Waste Management Strategy (Draft) of May 1994 significantly influenced federal agencies, highlighting the shared responsibility between businesses and consumers for waste management. This draft emphasizes developing markets for recycled materials and removing barriers to recycling, involving 60% of Queensland's population in waste recycling efforts and setting a precedent for packaging waste recycling across Australia.

In Japan, the Ministry of International Trade and Industry (MITI) issued recommendations addressing consumer packaging waste disposal, waste reduction, and recycling encouragement. These include a deposit scheme for environmentally harmful packaging, refundable upon return post-consumption. The Japanese department store sector, aligning with these guidelines, formed a committee to explore energy and resource conservation and collaborate with suppliers and packagers. The committee proposed packaging standards focused on human health

safety, minimal use of non-degradable materials, and packaging size reduction; advocating for simple or no packaging and discouraging difficult-to-dispose materials. Subsequently, Japan has passed several laws, including the Container Packaging Law, Household Electrical Appliance Recycling Law, and Recycling Promotion Law, reinforcing these initiatives.

Over the past three decades, China's packaging industry has grown significantly from its inception to its current size, achieving notable success. However, there's still a noticeable gap compared to the advanced standards of the world, particularly in packaging technology, the use of packaging equipment, and the modes and concepts of packaging design. On the environmental front, global packaging organizations are aligning with international environmental directives, like adopting the ISO14000 series of environmental management standards. Products failing to meet these standards may face import restrictions, potentially excluding them from international trade. China's environmental labeling system currently covers a limited range of product categories, insufficient for the needs of expanding foreign trade. To safeguard China's trade interests fundamentally, it's crucial to adopt and propagate these international standards promptly, converting them into national standards where feasible and developing supportive domestic legislation.

Comparatively, China's eco-friendly packaging sector trails behind, with a relatively low local production capacity for sustainable packaging materials. Given the annual per capita consumption of packaging materials significantly lower in China than in countries like the USA, Japan, and Germany, China's vast population results in a substantial overall consumption of packaging materials. Various countries impose regulatory or mandatory controls on the packaging materials of imported goods, with specific bans on materials like straw to prevent environmental hazards.

China has undertaken significant measures in response:

1. Avoiding toxic materials in packaging, ensuring that paints, dyes, and adhesives do not contain harmful substances and are easily decomposable.

2. Promoting the use of recyclable materials, such as recycled paper, which is widely accepted internationally for its minimal environmental impact.

3. Developing plant-based packaging materials, favored for their sustainability and negligible harm to ecological balance.

4. Opting for single-material packaging to simplify dismantling and recycling, avoiding adhesion methods that complicate these processes.

These steps highlight China's efforts to align with global environmental protection trends in packaging, emphasizing the need for sustainable practices and materials that support ecological balance and resource conservation.

On December 10-11, 2009, the ISO/TC122/SC4 Technical Committee on Packaging and Environment held its inaugural plenary session in Stockholm, Sweden. The China Export Commodity Packaging Research Institute, serving as both the ISO/TC122/SC4 International Secretariat for China and the domestic technical representative, led a Chinese delegation in their capacity as P members to the meeting. The Technical Committee on Packaging and Environment, ISO/TC122/SC4, is co-chaired by the Swedish Standards Institute (SIS) and the Chinese National Standardization Administration Committee (SAC), with the Chinese Export Commodity Packaging Research Institute undertaking the Chinese joint secretariat duties. The conference saw participation from over 70 representatives across 15 countries, including but not limited to China, Sweden, Japan, Korea, the United States, the United Kingdom, Germany, and France.

During this meeting, seven proposals for international standards were adopted, focusing on various aspects of packaging and the environment such as optimization, reuse, recycling, energy recovery, chemical recovery, and organic recycling. The assembly also decided on the appointment of chairpersons, establishment of liaison organizations, formation of working groups, and the division of labor, alongside planning for the subsequent meeting, culminating in the adoption of twelve resolutions.

Notably, the decision was made to assign China the leadership and convener roles for the Working Group (WG1) on "Requirements for Use of ISO Standards on Packaging and the Environment." Additionally, WG3 on "Reuse" is to be collaboratively led by China and Korea, with experts from both countries acting as WG convener and project leader respectively. Following China's proposal at the Belgium meeting to host the 2010 SC4 Working Group and Plenary Meeting in Beijing, the assembly unanimously approved this suggestion. Consequently, the ISO/TC122/SC4 Working Group and Plenary Meeting were scheduled to take place

in Beijing from May 31 to June 4, 2010, with the Working Group sessions and the General Assembly held from June 1 to 4. This event was to be held concurrently with the World Packaging Congress, the China International Packaging Expo, and the International Packaging Standardization Forum, showcasing a significant milestone in the realm of international packaging standards and environmental considerations.

The conference reached a consensus on adopting the EU Harmonized Standards and the "Asian Guidelines for Environmentally Conscious Packaging" as foundational documents for the development of ISO standards. EUROPEN, the European Organization for Packaging and the Environment, also presented an overview of international activities related to packaging and environmental issues, broadening the information horizon for all attendees. Additionally, detailed discussions between Chinese and Swiss representatives on the specific division of labor within the Joint Secretariat fostered a mutual understanding and laid a strong foundation for future collaborative efforts between the two countries in advancing the work of the Sino-Swiss Joint Secretariat.

During their stay, the Chinese delegation visited the Swedish Standards Institute (SIS) and the INNVENTIA R&D Company. These visits offered insights into the standardization efforts and the role of INNVENTIA R&D in research and development in fields such as paper, environmental protection materials, and packaging testing. The exchange was not one-sided; the Chinese delegates shared developments in China’s packaging industry and its efforts in environmental protection and standardization, fostering a deeper mutual understanding and setting the stage for future cooperation in the realms of packaging and environmental standards.

Given the universal concern over environmental issues, legislation, regulations, principles, methodologies, and standards related to packaging and packaging waste are garnering significant international attention. To facilitate discussions and research, here are some abbreviated terms commonly used in the field:

IWM: Integrated Waste Management

LCA: Life Cycle Assessment

PPC: Integrated Pollution Prevention and Control

DFE: Design For Environment

PPP: Polluter Pays Principle

IPP: Integrated Product Principle

EPR: Extended Producer Responsibility

Economic Instruments

Eco-Efficiency

Essential Requirements

These terminologies not only streamline communication but also underscore the intricate relationship between packaging practices and environmental sustainability.

2.Research on rice husk packaging materials

This chapter mainly refers to the book Plant Packaging Research written by Xiao Sheng Ling of Northeast Forestry University. With the support of Xiao Sheng Ling's major academic achievements, I used research data consistent with ceramic packaging for my outer packaging production. In addition, during the research and writing process of the project, I also received strong support and help from researcher Zhang Chan Wu of Heilongjiang Wood Science Institute, associate professor Yue Jin Quan of Northeast Forestry University, and graduate students Chen Yanna and Wang Haili. and all colleagues on the project team. I would like to express my heartfelt thanks to them.

In this study, we explore the fabrication process and technology of composite boards made from mechanically pre-treated rice husk and wood residue shavings, using PAPI and UF as adhesives, aimed at producing packaging boxes. This approach aims to develop eco-friendly, innovative wood packaging materials. Rice, a staple crop in China, generates rice husks as a major by-product, constituting about 20% of its mass. Utilizing rice husk as the primary material for creating composite panels for packaging boxes presents significant advantages in terms of raw materials and cost. Despite this, the utilization of rice husk remains limited, with a low rate of use and rare instances of large-scale production.

Rice husk features a wood fiber structure and offers excellent properties such as waterproofing and insulation compared to wood. However, its dense surface, coated with a non-polar silica film, challenges its bonding with typical adhesives, making it difficult to meet internal bonding strength standards required nationally. Additionally, factors like the structural makeup of rice husk and fiber length impact the product's

appearance and overall mechanical properties, limiting secondary processing capabilities (e.g., sanding, veneering). These issues have hindered the development and use of rice husk panels. To address these, wood residue shavings were incorporated as a reinforcement material to enhance the panels' mechanical properties and produce high-quality packaging materials.

Research on rice husk boards began internationally in the 1950s but saw limited progress for various reasons. Recent efforts by researchers worldwide have involved modifying rice husk's surface to tackle the challenges posed by the silica film, utilizing methods like grinding, cooking, or chemical treatments. These efforts have seen some success, though the complexity and generally low efficiency of rice husk's secondary processing have limited its industrial application.

For rice husk board production, adhesives like urea-formaldehyde resin glue, phenolic resin glue, vegetable protein glue, and modified starch are commonly used. Historically, high-active adhesives or organic coupling agents were employed to mitigate the silica film's adverse effects on adhesive bonding. Numerous methods have been tested to modify rice husk's surface, aiming to disrupt the dense silica film and increase the surface's polarity. Common techniques include grinding, steam explosion, hydrogen peroxide immersion, and sodium hydroxide solution immersion. Findings suggest grinding merely alters the particle size and further damages the fiber structure, adversely affecting the mechanical properties of the boards. Steam explosion modifies the husk's structure and denatures its proteins but is less effective in removing the resilient silica film. Immersion in hydrogen peroxide or sodium hydroxide solution, however, can decompose the silica film, improving the bond between pre-treated husk and adhesives in panel production. It's crucial to control the solution's concentration and immersion time to avoid compromising the board's thermal stability.

2.1 Performance requirements for rice husk composite panels

The performance specifications for composite boards largely depend on their intended applications (He Jin, 2013), and the composite boards developed through experimentation need to adhere to relevant national standards for their use as packaging materials. As the development process for rice husk-wood particle composite boards has not been finalized, there is no established comprehensive

standard to consult. The preparation technology for the surface layer of these composite boards is akin to that of traditional particleboard, and the incorporation of rice husk and isocyanate adhesive in the core layer bears similarity to the technology used for wheat (rice) straw particleboards. Consequently, we reference "Particleboard" (GB/T4897-2015) and "Wheat (Rice) Straw Particleboard" (GB/T 21723-2008) from the current Chinese standards, which provide benchmarks for the performance of rice husk-wood particle boards when utilized as packaging materials. The specific performance requirements are determined by aligning with these standards to ensure the composite boards meet the necessary criteria for their application in packaging shown in Table 2.

norm	reference standard			
	(GB/T4897.2-2003) Particle Boards	(GB/T4897-2015) Particle Boards	(GB/T 21723- 2008) Wheat (rice) straw particleboards	Experimental design values
Density/(g/cm³)	0.4 to 0.9	0.4 to 0.9	0.65 to 0.88	0.75 to 0.85
Water content/per cent	4 to 13	4 to 13	4 to 13	4 to 13
Internal bond strength/MPa	≥0.24	≥0.35	≥0.35	≥0.4
2h water-absorbing thickness expansion/%	≤8		≤6	≤8
Static bending strength/MPa	≥11.5	≥15	≥13	≥18
Modulus of elasticity/G Pa		≥2.15	≥1.60	≥3.00
Grip screw force/N		Plate surface ≥ 1100 Board edge ≥ 700	Plate surface ≥ 1100 Board edge ≥ 700	Face ≥ 1100 Edge ≥ 700

Table 2Requirements for rice husk-wood particle board for packaging boxes
Source: Drawn by Ye Li, 2023

Note: ① "Particle Board" (GB/T 4897-2015) characterizes particle board as follows: panels produced from wood or non-wood plant shavings (such as wood shavings, sawdust, linseed chips, bagasse, wheat straw, rice straw, or similar materials) that are bonded together with an adhesive under heat and pressure. ② "Wheat (Rice) Straw Particle Board" (GB/T21723-2008) describes wheat (rice) straw

particle board in the following terms: Utilizing wheat (rice) straw as the primary raw material, combined with isocyanate (MDI) resin adhesive, and processed through various stages including crushing, drying, sorting, applying adhesive, molding, pre-pressing, hot pressing, cooling, trimming, and sanding to produce the final board. This product is deemed suitable for indoor decoration, furniture manufacturing, and packaging in dry environments.

2.1.1Selection and handling of materials

Sieve Processing of Rice Husk In this study, rice husk, harvested during the season in Jingdezhen City, Jiangxi Province, was the primary raw material for the core layer. To understand the distribution and morphology of rice husk across different sieve sizes, we tested the rice husk using sieves with mesh sizes of 8, 12, 16, 24, 30, 45, and 60.

The sieving experiments utilized an XSB-88 top impact vibration sieve machine produced by Hangzhou Lan Tian Laboratory Instrument Factory. The machine's specifications include 221 shakes per minute, 147 vibrations per minute, a rotary radius of 12.5 mm, operating at a voltage of 380V and a speed of 2800 rpm. Each sieving experiment lasted for 5 minutes. To ensure data reliability and accuracy, we set the experiment's repetition factor to m=3, averaging the results of three separate runs to obtain the final data. This methodological approach aimed to accurately characterize the morphology of rice husk particles of varying sizes. is shown in Figure 39.

Figure 39Morphology of rice husk with different mesh size
Source: Photography by Ye Li, 2023

Comparison shows that rice husk sieved at different mesh sizes has different morphology:

d>8 purposes of rice husk, as shown in Figure 39 (a), mixed with a large number of straw, and most of the rice husk is wrapped or semi-wrapped state, the scoop structure is not completely broken, this type of rice husk in the mixing of adhesive, adhesive cannot enter the rice husk inside, the inner surface of the lack of adhesive in the preparation of panels, is not conducive to obtaining a good adhesive strength, and is very prone to delamination of composite panels.

d>12 purposes of rice husk, as shown in Figure 39(b), there are a small number of wrapped or semi-wrapped state of the rice husk, most of the rice husk is the scoop structure is completely broken flake, is more ideal for the pressure plate material.

Rice hulls with d>16 mesh, as shown in Figure 39(c), are mostly flakes with the scoop structure completely broken and the fiber, structure relatively intact, making them ideal for pressboards.

d>24 mesh of rice husk, as shown in Figure 39(d), mixed with a small amount of milled rice, mostly rice husk fiber.

d>30 mesh rice husk, as shown in Figure 39 (e), mixed with a large number of crushed rice and sand, rice husk fiber, is small, broken, this type of rice husk pressure plate, will cause the mechanical properties of the plate to reduce the waste of adhesive phenomenon, is not very suitable for the raw materials of composite panels.

d>45 mesh and d>60 mesh rice hulls, as shown in Fig. 39(f) and Fig. 39(g), are mostly sand and gravel dust, with a small amount of very fine fluffy rice hull fiber which cannot be used as raw materials for composite panels.

Through the previous exploratory experimental study, the morphology of rice husk was set between 8 mesh and 20 mesh.2 In order to obtain more target rice husk, the rice husk was milled and tested for sieve value, and the results are shown in Table 3. After the treatment, the morphology and structure of the large d>8 mesh and d>12 mesh husks (both milled and unmill) were further destroyed into smaller d>16 mesh and d>24 mesh forms, and the d>45 mesh and d>60 mesh husk components were added. For the composite panel preparation experiments, the original rice husk can be screened first, and the eliminated husk can be milled and then screened a second time to increase the total amount of rice husk for experimental purposes.

Size/eye	d>8	d>12	d>16	d>24	D>30	d>45	d>60
Original/per cent	5.14	84.96	7.40	2.38	0.12		
Grinding/per cent	1.68	38.95	22.54	26.35	4.42	2.41	3.65

Table 3Morphological distribution of rice husk
Source: Drawn by Ye Li, 2023

The vibrating screen used in the plate preparation experiments is HC-400-2P, i.e., a vibrating screen with a diameter of 400 mm, which can be installed with two layers of mesh sieves, and the mesh sizes of the sieves are set at 8 mesh and 20 mesh according to the requirements of the experiments. The vibrating screen can divide the screened rice husk into three parts and discharge the material in three ports. The upper material is larger than 8 mesh rice husk which can be milled and then screened twice to obtain the ideal rice husk; the middle material is rice husk of 8 mesh to 20 mesh for experimental use; and the bottom material is rice husk of less than 20 mesh, which can be directly disposed of as waste material.

2.1.2Mechanical treatment of rice husk

In this study, rice husks are mechanically processed using commercially available grinder. The state of pulverization is closely monitored to ensure that the processed husks retain a milled form rather than turning into powder. The goal is to disrupt the husks' scooped structure and remove the capillary-like fuzz on their surface, thereby enhancing the husks' ability to be effectively wetted by adhesive. Through electron microscopy examination, the surface characteristics of the rice husks before and after milling are observed. is shown in Figures 40 and 41.

Figure 40Rice husk before mechanical milling
Source: Photography by Ye Li, 2023

Figure 41Rice husk after mechanical grinding
Source: Photography by Ye Li, 2023

2.1.3 wood shavings

The incorporation of wood shavings in the experiments aimed to counteract the inherent strength deficiencies of rice husk boards, which are due to the short fiber length of rice husks, without significantly altering the board's wood content. Wood shavings, produced as long strips or rolls during the processing of wood products, can be utilized in panel production to create particleboards (also known as chipboards) characterized by a uniform structure and excellent processing capabilities. The wood shavings selected for this study are processing residues from a variety of mixed woods cultivated in the Northeast, processed through plan and drying. To avoid the potential adverse impact of overly large wood shavings on the board's overall performance, it is essential to sieve the material. This step ensures the removal of sawdust-like wood shavings that could interfere with adhesive application, the quantity of wood added, and other factors, ultimately ensuring the experimental results' accuracy.

2.1.4 adhesive

In evaluating the functionality, cost, and effectiveness of various adhesives, Polymeric Diphenylmethane Diisocyanate (PAPI) and Urea-Formaldehyde Resin Glue (UF) were selected as the optimal adhesives for manufacturing laminated panels and composite boards respectively (Johnson A. C., Yunas N. B., 2009; Wan Caichao, Liu Yu, Jiao Yue, 2014). Additionally, bamboo strands were chosen as the reinforcement material and were soaked in Phenol Formaldehyde Resin (PF) to enhance the composite's strength.

Isocyanates are a broad category of compounds characterized by the isocyanate group (-N=C=O). Known for their polarity and high reactivity, they easily react with substances that contain active hydrogen atoms. This reaction facilitates the formation of robust chemical bonds when isocyanates serve as adhesives, leading to excellent bonding characteristics, efficient use of adhesive, water resistance, and broad applicability across various materials such as plastics, ceramics, wood, glass, and metals. Particularly in the textile and wood industries, the utilization of isocyanate adhesives has seen rapid growth.

Market-available particleboards typically incorporate aldehyde-based adhesives like phenolic resin or urea-formaldehyde resin. However, to enhance production efficiency and cut costs, some manufacturers of lower-quality particleboards may bypass standard production practices, resulting in boards with dangerously high levels of formaldehyde emissions. Employing isocyanates as non-formaldehyde adhesives in particleboard production not only mitigates formaldehyde pollution but also produces boards with superior strength and moisture resistance. Despite their higher cost, which may limit widespread adoption, isocyanates are preferred for high-performance and safety-critical wood-based particleboard applications. Extensive literature reviews and preliminary experiments indicate that using isocyanate adhesives in the production of rice husk boards allows for effective bonding through the formation of strong chemical bonds with the rice husk surface.

In the industrial fabrication of particleboards, the most commonly utilized adhesives are urea-formaldehyde resin adhesive and phenolic resin adhesive. The choice of adhesive is significantly influenced by production costs and the specific application of the product. Phenolic resin adhesive is typically selected for products intended for prolonged outdoor exposure, especially when there is a demand for enhanced waterproofing, moisture resistance, aging resistance, and mechanical properties. Conversely, for applications with less stringent requirements, the more cost-effective urea-formaldehyde resin adhesive is preferred.

Urea-formaldehyde resin, a polymer synthesized through the addition and condensation reactions of formaldehyde and urea under specific conditions (e.g., pH, temperature, catalysts), contains numerous hydroxymethyl and amide groups capable of bonding to bamboo and wood fibers. It is characterized by its affordability, ease of production, accessibility, and its cured product being colorless and free from contaminating the final products. However, its drawbacks, such as low initial viscosity, limited water resistance, absence of aging resistance, and formaldehyde emissions, can be mitigated by refining the resin synthesis process (for instance, by managing the urea to formaldehyde ratio, adjusting the addition stages and rate, and modifying the pH) or by altering the urea-formaldehyde resin adhesive formulation process (by incorporating viscosity enhancers, water-resistant agents, aging-resistant agents, and formaldehyde scavengers). Consequently, urea-formaldehyde resin

adhesive is frequently employed as a bonding agent in the production of plywood, particleboard, and various wood-based products (Zhang, Y.G. Shan, J. Liu, et al., 2006; CHANG Jianmin, LI Xiao Juan, XU Shou Qiang, 2010; Zhang Zhao, Zhang Xianquan, Lu Haixiang, 2013). In acidic conditions, urea-formaldehyde resins can further condense into a low-viscosity gel-like substance (forming a network structure of the material), to prevent gelling and degradation during storage at room temperature, commercially available urea-formaldehyde resins are typically neutral or slightly alkaline. Liquid urea-formaldehyde resins have a shorter shelf life compared to their powdered counterparts, which can be stored for one to six months at room temperature, away from light. (Li XG, Zheng X,2004).

The curing efficiency of urea-formaldehyde resin adhesives is intricately linked to the hot press temperature, along with the type and quantity of the curing agent (Zhu Libin, Gu Ji You, Tan Haiyan, 2008). Without a curing agent, urea-formaldehyde resin adhesives under hot pressing conditions take longer to fully cure, often resulting in incomplete curing and suboptimal adhesive effectiveness. Thus, to ensure the curing efficiency and adhesive quality, the addition of a suitable amount of curing agent is essential in the production of particleboards using urea-formaldehyde resin adhesives, unless the material being bonded is significantly acidic.

Ammonium chloride a strong acidic salt, becomes acidic in aqueous solution due to hydrolysis. As a curing agent for urea-formaldehyde resin, it can absorb a small amount of water from the adhesive in heated and pressurized environments, thereby ensuring a strong bond between the adhesive-coated material and the resin. Moreover, its affordability and significant effectiveness have led to widespread use in the urea-formaldehyde resin adhesive particleboard industry (Ding Bing Yin, 2009). is temperature-dependent. At elevated temperatures and pressures, the resulting ammonia gas and water vapor...

Excessive acidity can expedite the curing of urea-formaldehyde resin but may lead to issues like poor curing outcomes and brittleness. Conversely, weaker acidity minimally boosts curing efficiency but improves the curing effect relatively. In practice, the ammonium chloride addition typically ranges from 0.2% to 2% of the urea-formaldehyde resin's solid content. Given that the experimental shavings were derived from mixed wood residue, determining the overall surface pH of the shavings

was challenging. Therefore, to enhance the experimental success rate, the ammonium chloride level was designed to be between 1.2% and 2%.

Phenolic resins, among the top three widely utilized wood adhesives today, are distinguished by their high strength, excellent heat resistance, flame retardancy, low toxicity, and minimal emission of fumes. They have been extensively developed as impregnating adhesives amid the scarcity of timber resources and the emergence of plantation fast-growing forests and restructured bamboo (B. Xue, X.L. Zhang.2007). Compared to natural forests, plantation forests, and restructured bamboo present challenges such as short fibers, high pH, propensity for drying and cracking, significant deformation, high moisture content, insufficient stiffness, and a high tangential to radial shrinkage ratio. Impregnation with phenolic resins can enhance the strength, corrosion resistance, abrasion resistance, water resistance, dimensional stability, and ease of further processing in plantation forests and restructured bamboo (Yu Wenji.2012, Zuo Yingfeng,2015). This process not only improves the properties of wood and bamboo, making them viable alternatives to natural wood but also helps mitigate the wood supply-demand disparity.

For the impregnation of bamboo bundles, which serve as a reinforcing material, a low molecular weight phenolic resin is selected due to its low molecular weight, low viscosity, and excellent water solubility, facilitating effective impregnation. This type of phenolic resin can cause wood or bamboo to swell, and the network structure within the bamboo creates pathways for the phenolic resin molecules to penetrate, offering optimal conditions for impregnation and ensuring thorough reaction execution.

Curing is pivotal in the adhesive process for manufacturing wood-based panels, as the degree of curing significantly influences the panel’s adhesive strength, formaldehyde emission, and production efficiency. To achieve rapid curing while extending the adhesive's working life, it is often necessary to incorporate a curing agent into the adhesive mix. Curing agents are monomers or oligomers that can transform into polymers or cross-linked network polymers.

In the experiments, urea-formaldehyde resin, typically with a pH of 7.0-8.5, was used as the surface adhesive. Under such alkaline conditions, solely relying on the wood's inherent acidity, achieving complete curing and ensuring the quality of the

bond is challenging (Gu Ji-You, Zhu Li-Bin,2005). Therefore, to guarantee bond quality, it's essential to introduce a curing agent to provide an acidic medium for the urea-formaldehyde resin, facilitating rapid polycondensation and curing reactions, and forming insoluble polymers. Thus, the curing agent for the urea-formaldehyde adhesive should be chosen from acidic materials or substances that can interact with the resin to produce acid (Gu Ji You, Wei Shuang Ying, Zhu Libin.2004, Nie Chan Jie, 1992).

Ammonium chloride, chosen as the curing agent for this experiment, is characterized by its affordability, effectiveness, and widespread use. Its mechanism as a curing agent for urea-formaldehyde resin involves reacting with the resin's free formaldehyde to generate acidic substances, thereby promoting resin curing. The reaction equation $4NH_4Cl+6CH_2O=(CH_2)_6N_4+4HCI+6H_2O$ indicates that insufficient ammonium chloride leads to inadequate acidic conditions, making complete resin curing difficult. Conversely, excessive ammonium chloride can result in overly strong acidity, hastening the curing process but compromising the curing quality and making the panel brittle. Based on prior experimental findings, the quantity of the curing agent was optimized at 1.2%.

2.2 Structural design of laminates for packaging boxes

The chemical composition and staple fiber structure of rice husk, when used as the principal material in panel production, do not facilitate high static bending strength and elasticity modulus. Based on composite material mechanical theories, during bending and torsional stresses leading to bending deformation, the surface layer, having a higher bending modulus, incurs more internal stresses than the core layer. Hence, enhancing the surface material's bending modulus is key to augmenting the panel's capacity to withstand static bending loads (LIU Huan Rong, LIU Jun Liang, CHAI Yubo.2007). Taking into account performance requirements, material costs, and rice husk utilization, the composite panel's structure is designed as follows, as depicted in Figure 38. The rice husk, positioned at the composite board's core, substitutes wood in conventional wood packaging materials, reducing wood consumption and raw material costs; wood shavings, placed on the composite board's surface layer, enhance the board's mechanical properties and surface quality, also improving the quality of the composite board's second layer's surface.

This composite board structure proves more logical than that of traditional rice husk boards. Compared to conventional rice husk boards, the composite board with a wood shavings surface and rice husk core bears a more rational structure. Theoretically, it can endure greater bending loads and has been shown in experiments to effectively enhance the composite boards' static bending strength and elasticity modulus. Moreover, when utilized as packaging material, the wood shavings surface layer facilitates surface sanding of the finished boards and the marking of graphic symbols for packaging, storage, and transport

2.2.1 Preparation of laminates for packaging boxes
Experimental Materials and Equipment Experimental Materials:

The experimental materials are divided into two main components. The surface layer is constructed from wood shavings as the raw material, with urea-formaldehyde resin adhesive and an aqueous solution serving as the curing agent. The core layer consists of rice husk combined with isocyanate adhesive. Detailed sources and specifics are listed.

Experimental Equipment:

Table 4 outlines the names and models of the principal equipment utilized throughout the experimental procedures. This includes small-scale and commonly employed instruments such as an electronic balance (sensitivity: 0.001 g), stopwatch, vernier calipers (precision: 0.1 mm), micrometer (precision: 0.01 mm), infrared moisture content tester, beakers, measuring cylinders, among others, all of which were sourced

from domestic suppliers.

Equipment name	model number	the source (of a product)	experimental role
hot press	KU-HPD-1515	Japanese	Pressing of composite panels
glue mixer	VR-22	German	spray glue
vibrating screens	HC-400-2P	Japanese	Screening of rice husk
Vertical Cutting Saw	SZ3-600D	Japanese	Edge trimming and specimen preparation after pressing of composite panels
Universal Mechanical Testing Machine	UTM-10T-PL	Japanese	Static flexural strength and modulus of elasticity testing
Universal Wood Testing Machine	TOYO BALDWIN	Japanese	Internal bond strength test
thermostatic sink	BK-53	Japanese	2h water-absorbing thickness expansion test
Constant temperature drying box	DX-58	Japanese	Drying of rice husk and wood shavings

Table 4Experimental Equipment
Source: Drawn by Ye Li, 2023

Experimental program:

Selection of Experimental Factors and Levels In the preliminary research, analysis, and exploratory experiments, process parameters significantly impacting the performance of composite boards were identified. Alongside the general production process of particleboard, the experimental factors selected include density, core ply ratio, overall gluing amount, surface layer gluing amount, core layer gluing amount, curing agent dosage, hot pressing temperature, hot pressing pressure, and Hot Press time. The selection of factor levels, under the premise that the produced composite boards meet the relevant standards and usage requirements, is guided by the following principles:

This refers to the overall design density of the composite board, which is closely related to the board's performance. Within a specified range, increasing density can enhance the mechanical properties of the composite boards. However, considerations for conserving raw materials and reducing energy consumption also influence this factor's optimal level.

Selection of Experimental Factors and Levels In the quest to pinpoint process parameters with significant impacts on composite board performance, preliminary research, analysis, and exploratory experiments were conducted. In alignment with the standard production process for particleboard, experimental factors were determined to include density, core layer ratio, total glue amount, surface glue amount, core layer glue amount, curing agent dosage, hot pressing temperature, pressure, and time. The factor level selection was grounded in principles that ensure the produced composite boards not only meet relevant standards and usage requirements but also optimize for raw material and energy savings.

Density is paramount, influencing the composite board's performance. An increase within a specific range can enhance the board's mechanical properties. However, to favor reduced transport and handling costs, a lower density is advantageous. Thus, a balanced design density of 0.75-0.85 g/cm³ is proposed, with a preference for the lower density value to minimize interference from other factors.

The core layer ratio, reflecting the mass of rice husk and isocyanate to the board's total mass, aims to maximize rice husk use and minimize wood shavings. Set between 40%-70%, a higher core layer proportion is favored to enhance mechanical properties without significantly increasing costs compared to traditional wood particleboards.

The quantity of glue, which is defined as the ratio of the solid components' weight in the glue to the weight of the absolutely dry fiber, plays a crucial role due to the different compositions of the surface and core layers along with their unique adhesive needs. This distinction necessitates separate glue mixtures for each layer, thus dividing the glue amounts into surface and core layer quantities. While the glue quantity within certain bounds affects the number of post-spray glue joints, enhancing the board's mechanical attributes, an excessive amount does not correspondingly improve board quality. Considering the high cost of adhesives relative to rice husk and wood shavings, the glue amount significantly influences the production cost of

composite boards. Hence, to curtail overall manufacturing expenses, it's essential to minimize the glue amount without compromising performance standards.

Surface Sizing Amount: This pertains to the quantity of urea-formaldehyde resin adhesive used for the surface layer of wood shavings, a major contributor to formaldehyde pollution during composite board pressing and usage. Aiming at cost reduction and decreased formaldehyde emission, the surface sizing amount is set between 8% and 14%, with a preference for a lower quantity to reduce environmental impact and production costs.

Core Layer Sizing Amount: Referring to the isocyanate adhesive dosage for the rice husk core layer, which represents a significant cost in the raw material composition for composite panels. The core layer's sizing amount is established at 4% to 7%, adjustable through other process parameters for optimal control. A lesser amount for the core layer is favored to economize on material usage.

Curing Agent Dosage: The application rate of ammonium chloride as a curing agent for the urea-formaldehyde resin adhesive in the surface layer can enhance the adhesive's curing rate. However, it simultaneously shortens the adhesive's usable lifespan. In industrial-scale production of certain particleboards, its use is limited to extend the active period of the urea-formaldehyde resin adhesive and streamline production processes. The curing agent dosage ranges from 1.2% to 2%, with a preference for a lower dosage to maximize efficiency and minimize cost.

Hot pressing temperature, pressure, and time are critical factors in particleboard production, influencing uniform heating of the slab, moisture expulsion, adhesive curing, and thus significantly impacting the production cycle, energy consumption, formaldehyde emissions, and the final board quality (YANG Che, LI Xiaodong, 2013). The settings for hot pressing temperature range from 170-220°C, with pressure between 2.5-3.3 MPa, and pressing time from 20-45 seconds per millimeter of board thickness. To enhance production efficiency while aiming to lower energy usage in industrial processes, preferences lean towards the minimal hot press temperature and pressure and a reduction in pressing duration. These measures are designed to

optimize resource utilization without compromising the integrity and performance of the panels.

2.2.2 Designed for homogeneous mixing

Given the complexity of factors involved in the preparation of composite boards for packaging boxes and the variation in levels across these factors, utilizing orthogonal experimental design to identify the optimal process becomes impractical. This approach would result in a vast number of experimental runs, consuming significant time, resources, and labor. In contrast, a mixed-level uniform design allows for a more efficient examination of each factor's impact on the target variable while minimizing the number of required experiments. This makes it a more suitable choice for initial exploratory research stages compared to other methods. Therefore, we have opted to use the "Uniform Design V4.0" software for our experimental design, with the experimental setup detailed in Table5. This configuration results in a total of 21 experimental runs, with a repetition coefficient of m=3, thereby ensuring a comprehensive yet efficient exploration of the process variables.

Test No.	Density/ (g/cm^3)	Core ratio/ %	Surface sizing/per cent	Core layer sizing/per cent	Amount of curing agent/%	Hot pressing temperature/ ℃	Hot Pressure/ MPa	Hot pressing time/ (s/mm)
1	0.75	40	9	5	1.4	210	3.1	45
2	0.75	45	8	6	1.6	180	2.9	35
3	0.75	40	10	4	1.6	190	2.5	40
4	0.77	50	12	6	1.6	200	2.9	40
5	0.77	70	9	6	1.6	220	3.3	35
6	0.77	65	9	6	1.2	180	3.3	40
7	0.77	70	14	7	1.2	190	3.1	25
8	0.79	55	13	7	1.4	180	3.3	25
9	0.79	70	10	4	2.0	220	2.7	30
10	0.79	60	12	5	1.2	200	2.9	20
11	0.79	40	14	5	1.2	220	3.3	30
12	0.81	45	8	6	1.8	210	2.9	25
13	0.81	50	13	4	1.8	190	3.1	35
14	0.81	65	8	7	1.8	170	2.7	40
15	0.83	55	13	5	1.6	180	2.5	45
16	0.83	45	14	6	2.0	170	3.1	30
17	0.83	60	11	4	1.4	190	2.9	20

18	0.83	55	10	5	2.0	210	2.7	25
19	0.85	50	11	5	1.8	170	2.7	20
20	0.85	60	11	4	1.4	200	2.5	45
21	0.85	65	12	4	2.0	210	2.5	30

Table 5 Test program
Source: Drawn by Ye Li, 2023

To account for material losses during the gluing process, adjustments in the actual quantities of materials used are essential. This is due to potential discrepancies from factors such as minor material adherence to the glue mixer or spillages. Given that the quantities of glue and curing agent are proportionate to the raw materials, it's necessary to adjust these quantities to correct for any variations. Thus, recalculations specifically for the masses of wood shavings and rice husks are needed to compensate for these deviations.

Wood Shavings/Rice Husk: Screening: A vibrating screen is employed to ensure wood shavings are larger than 20 mesh, and rice hulls are sized between 8 mesh and 20 mesh.

Drying: Rice husk and wood shavings are dried in a constant temperature drying oven at 100°C for 6 hours, with moisture content checked every half hour. To avoid moisture from rice husk reacting with isocyanate adhesive and impacting the gluing effect, rice husk should be dried until absolutely dry. Wood shavings drying can cease when moisture content is less than 3%. The dried materials are stored in waterproof and moisture-proof plastic bags, tightly sealed. Prior to experimentation, moisture content for rice husk and wood shavings from different bag locations ($\geqslant$3 points) is tested, averaging the results. Moisture content for wood shavings is noted as M Ca, and for rice husk as M Cb.

Urea-Formaldehyde Resin Adhesive: The procured urea-formaldehyde resin glue's indicators are assessed according to "Wood Adhesive and Its Resin Test Methods" (GB/T 14074-2006) standards, with solid content noted as Y.

Curing Agent: - A 20% aqueous solution of NH_4 Cl is prepared in distilled water, ensuring thorough dissolution of NH_4 Cl solid through ample stirring.

2.2.3Composite plate preparation

Calculations were performed by incorporating data such as the solid content of the urea-formaldehyde resin, the moisture content of rice husks/wood shavings, and the mass fraction of the curing agent solution into an Excel spreadsheet. This allowed for the determination of the quantities of materials required for various scenarios, as dictated by the uniform design.

For the adhesive application, rice husks/wood shavings were introduced into a glue mixer. The power was activated, engaging both the external air pump and the mixer's stirring shaft. The prepared isocyanate or urea-formaldehyde resin adhesive (with added curing agent) was gradually introduced. Based on the specified glue quantity and the stirring rate, the duration of spraying and mixing was finely tuned to ensure a thorough and uniform integration of glue with the raw materials. It is important to delay adding the hardener to the urea-formaldehyde resin adhesive until just before spraying, to maximize the adhesive's usable life span and prevent premature addition.

Following adhesive application, the treated materials were weighed and methodically layered by hand for paving. The assembled slabs were then placed in a pre-press for initial compaction and shaping.

For hot pressing, these pre-pressed slabs were transferred to a hot press, set to the designated temperature and pressure, for high-temperature compression.

Upon completion of the hot press cycle, the composite boards were removed and allowed to cool to room temperature, stabilizing their structure.

2.2.4Specimen Preparation

The composite board was prepared and then set aside for 72 hours under environmental conditions of 20°C temperature and 65% relative humidity. This step was crucial to allow the internal stress of the board to equilibrate fully, ensuring its stabilization before proceeding with the preparation and testing of specimens. This process involved a portion of the samples and specimens to ensure they were in an

optimal state for accurate and reliable testing outcomes. shown in Figure 42.

Figure 42Partial Samples and Test Pieces
Source: Photography by Ye Li, 2023

Performance testing Drawing on the GB/T17657-2013 standard for Test Methods for Physical and Chemical Properties of Wood-based Panels and Surface Decorated Wood-based Panels, various properties of the composite boards were evaluated,

including water absorption thickness expansion, internal bond strength, static bending strength, modulus of elasticity, density, moisture content, formaldehyde emission, and screw holding strength (Choi N W, Mor I, Ohama Y. 2006). The test outcomes are presented in Table 6 The programs fulfilling the experimental criteria were duly noted in the evaluation column. The primary source of formaldehyde emission in composite panels stems from the free formaldehyde present in the urea-formaldehyde resin adhesive and the formaldehyde released during the adhesive's curing process (GU Xu Ping, SUN Cui Hong., 2007). Given that the urea-formaldehyde resin adhesive utilized in this study is a low-formaldehyde variant, the formaldehyde emission test results significantly undershot the thresholds set by national standards. Consequently, the analysis primarily concentrated on the impacts of experimental factors on water absorption thickness expansion, internal bond strength, static bending strength, and modulus of elasticity.

Experiment No.	Absorbent thickness expansion rate/ %	Internal bond strength/ MPa	Static bending strength/ MPa	Modulus of elasticity/ GPa	Moisture content/ %	evaluations
1	19.40	0.23	15.20	3.06	2.96	
2	9.94	0.47	18.62	3.36	3.08	
3	15.75	0.33	18.48	3.32	3.58	
4	9.52	0.33	17.17	3.49	2.47	
5	10.94	0.39	15.90	3.12	1.81	
6	6.91	0.50	18.99	3.49	2.89	√
7	6.64	0.67	19.34	3.42	2.88	√
8	5.95	0.82	22.70	4.13	2.72	√
9	14.17	0.35	15.14	3.24	2.59	
10	6.44	0.47	21.28	4.09	3.17	√
11	8.05	0.33	20.10	4.24	2.13	
12	20.40	0.52	18.81	3.36	3.02	
13	11.63	0.43	21.71	4.05	2.79	
14	9.33	0.76	20.04	3.50	2.40	
15	7.51	0.47	20.59	3.87	2.94	√
16	4.95	0.56	21.64	4.45	3.93	√
17	8.22	0.32	21.74	3.93	3.03	
18	12.17	0.50	20.06	3.70	3.39	
19	7.12	0.51	20.97	4.03	4.97	√
20	9.92	0.29	17.79	3.51	3.11	
21	13.36	0.32	18.36	3.71	3.84	

Table 6Test Results

Source: Drawn by Ye Li, 2023

During the preparation of composite panels for packaging boxes, it's common to encounter scenarios where the variation in certain properties of the panels depends on multiple factors. This implies a dependency between one or more dependent variables and several independent variables. It's often challenging to identify the specific

contributions of each influencing factor to the dependent variable, making it difficult to make arbitrary selections. For instance, the mechanical properties of a laminate are influenced not only by the raw materials used but also by the laminate's design density, the amount of adhesive applied, and the pressing conditions. It's also unclear whether there is any interaction among these factors. In such cases, multiple regression analysis serves as a useful tool for predicting the dependent variable. This analytical method explores the pattern of variation between dependent and independent variables, often leading to the derivation of an empirical regression equation.

2.2.4 Influence of manufacturing process on the properties of composite panels for packing boxes

The Influence of Density on Composite Panel Performance The impact of density on the water-absorption thickness expansion of composite panels is depicted in Figure 43(a), demonstrating a slight decrease as density increases. When density ranges from 0.80-0.85 g/cm³, the water-absorption thickness expansion rate satisfies the experimental criterion of <8%. Density plays a crucial role in the dimensional stability of composite panels. A higher density reduces the internal gaps within the panel, making it more challenging for water molecules to penetrate and diffuse within the panel, thereby enhancing its water-absorption thickness expansion rate.

Figure43 illustrates the curve representing the internal bond strength of composite panels as influenced by density. There's a notable increase in internal bond strength as density rises from 0.75 to 0.80 g/cm³; however, beyond 0.80 g/cm³, the internal bond strength decreases with further increases in density. The optimal internal bond strength of $\geqslant 0.40$ MPa is achieved when density is between 0.76-0.84 g/cm³. Increasing density enhances the compaction of the rice husk core layer, improving the intertwining and adhesive bonding between rice husks, which in turn, manifests as an increase in the internal bonding strength of the panels. Yet, as density continues to rise, excessive penetration of low molecular weight isocyanate into the rice husk occurs under hot pressing conditions, reducing surface adhesion and, subsequently, the bonding strength.

The effects of density on the static bending strength and modulus of elasticity of composite panels, shown in Figures 43, indicate that both properties significantly increase with density. When density exceeds 0.77 g/cm³, the panels meet experimental requirements. As density increases, so does the compression between boards and the proportion of reinforcing materials and adhesive, contributing to enhanced panel performance, reflected in higher static bending strength and modulus of elasticity.

The analysis suggests an optimal composite board density of 0.80-0.84 g/cm³, higher than initially designed. Given that density directly affects material consumption and usability, the aim is to minimize density as much as possible, initially setting it at 0.80 g/cm³. Adjustments to density, considering its interaction with other factors and their impact on mechanical properties, may necessitate a slight increase in production costs to prevent any negative effects on panel performance from a reduced density value.

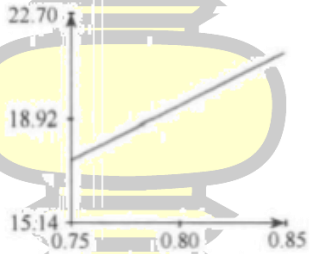


Figure 43Curve of density effect on the performance of composite panels
Source: Drawn by Ye Li, 2023

The Impact of Core Layer Ratio on Composite Panel Performance

The change in the water-absorption thickness expansion rate of composite panels, influenced by the core layer ratio, is depicted in Figure 44(a). This rate decreases and then increases as the core layer ratio rises. Specifically, when the core layer ratio ranges from 40% to 60%, the expansion rate decreases with an increase in the core layer ratio; beyond 60%, the rate increases with the ratio. The optimal water-absorption thickness expansion rate, meeting the experimental criterion of <8%, is achieved when the core layer ratio is between 57% and 65%, with the lowest expansion rate observed at approximately 60%. An increase in the core layer ratio enhances the usage of rice husk and isocyanate. Rice husk's surface is covered by a

hydrophobic Si O_2 film, and isocyanate, upon curing, exhibits a degree of water repellency. Rice husk and isocyanate, therefore, offer superior water resistance compared to wood shavings and urea-formaldehyde adhesive. However, a further increase in the core layer ratio leads to a thicker slab, compromising its overall compressibility and adhesive effectiveness, resulting in a higher water-absorption thickness expansion rate.

Figure 44 showcases how the internal bond strength of composite panels is significantly boosted with an increasing core layer ratio, satisfying the experimental threshold of ⩾0.4 MPa. The internal bond strength is predominantly influenced by the effectiveness of core layer adhesive application. Given rice husk's substantially lower bulk density compared to its actual density, its amount directly impacts the slab's thickness post-spreading. A higher rice husk proportion increases slab thickness. Under identical hot press conditions for the same composite board thickness, a slab with a higher rice husk proportion experiences greater pressure on its core layer than one with less rice husk. This enhances the intertwining of rice husks and their adhesive bonding with isocyanate, macroscopically observed as an improvement in the internal bond strength of the composite panel.

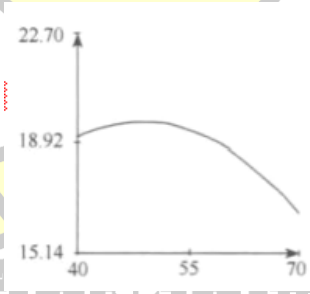


Figure 44Effect of core layer ratio on the performance curve of composite plate
Source: Drawn by Ye Li, 2023

Impact of Core Layer Ratio on the Static Bending Strength and Modulus of Elasticity of Composite Panels

The static bending strength and modulus of elasticity of composite panels are significantly influenced by the core layer ratio, as illustrated in Figures 45. Initially, with an increase in core layer ratio, both the static bending strength and modulus of elasticity experience a slow rise followed by a notable decline. The experimental conditions are satisfied when the core layer ratio ranges from 40% to 63%. Since the

core layer ratio reflects the proportion of rice husk and isocyanate to the total mass of the composite boards, and considering that rice husk's mechanical properties are substantially inferior to those of wood shavings, an increased core layer ratio results in a decrease in the amount of surface wood shavings. The static bending strength and modulus of elasticity of the composite panels are largely dependent on the long-fiber structure of the surface wood shavings. Consequently, the overall performance demonstrates a reduction in static bending strength and modulus of elasticity with an increase in the core layer ratio. Additionally, a lower proportion of the surface layer may lead to uneven spreading of the wood shavings, further negatively impacting the mechanical properties of the composite panels.

From this analysis, it's apparent that the optimal core layer ratio could be set between 57% to 63%. To ensure control over the strength of the composite panel, ease of spreading, and uniformity of spreading, the core layer ratio is determined to be 60%.

Impact of Surface Sizing Amount on Composite Panel Properties The influence of surface sizing amount on the properties of composite panels is examined next, showcasing how varying amounts of urea-formaldehyde resin adhesive applied to the surface layer of wood shavings impact the overall performance and characteristics of the panels. is shown in Figure 45.

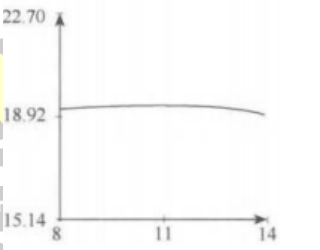


Figure 45Curve of the influence of surface sizing on the performance of composite boards

Source: Drawn by Ye Li, 2023

The trend of water absorption thickness expansion in composite panels as influenced by the surface glue amount is depicted in Figure 45. Initially, there's a slow increase followed by a significant decrease with increasing surface glue amount. For surface sizing above 12%, the water absorption thickness expansion met the experimental criterion of less than 8%, achieving its lowest value at a 14% surface

sizing. The amount of glue applied on the surface layer impacts the quantity of adhesive bonds formed between the urea-formaldehyde resin and wood shavings. Within a specified range, elevating the glue amount enhances the number of adhesive bonds, consequently increasing the stress resilience of the composite boards' interior. Furthermore, urea-formaldehyde resin possesses a degree of water resistance, potentially forming a protective layer on the board surface, which improves the water absorption thickness expansion rate.

Conversely, the variation in internal bond strength of composite boards as influenced by the surface glue amount, illustrated in Figure 45, shows a decrease with an increase in surface glue amount. Given that the internal bond strength test focuses on the core layer and the surface glue is directionally applied only to the surface layer, it is not further analyzed here. variation curves of static flexural strength and modulus of elasticity of composite boards as affected by the amount of surface sizing are shown in Figures 45. The change of static flexural strength with the increase of the amount of surface sizing is not significant, while the modulus of elasticity rises significantly with the increase of the amount of surface sizing and the static flexural strength of composite boards can be increased with the increase of the amount of surface sizing within the experimental range.

The degree and modulus of elasticity meet the requirements. The study shows that the increase of glue application is beneficial to the mechanical properties of composite boards, but after the glue application is greater than a certain value, the increase of glue dosage has no obvious effect on the improvement of static bending strength of composite boards, which is mainly affected by wood fiber in the boards; and the increase of surface glue application is beneficial to the improvement of elasticity modulus of composite boards.

From the above analysis, it can be seen that the amount of surface sizing can be taken at 12% to 14%. For the reasons of reducing the expansion rate of water-absorbing thickness, controlling the cost of surface adhesive and the amount of formaldehyde released, and at the same time, providing room for variation in the adjustment of the density value, it is preferred to choose the amount of surface sizing of 12.5%.

Influence of core layer sizing on laminate properties

The effect of the amount of core layer sizing on the performance of the composite board is shown in Figure 46.

The trend in water absorption thickness expansion of composite panels influenced by core layer glue amount is depicted in Figure 46(a). This trend initially decreases then increases as the core layer glue amount rises. With core layer glue amounts less than 5%, the rate of water absorption thickness expansion decreases with increasing glue amount; between 5% and 5.5%, the rate shows minimal change, marking this range as yielding the lowest expansion rates; beyond 5.5%, the expansion rate climbs with further increases in glue amount. The optimal glue amount for the core layer, fulfilling the experimental criterion of less than 8% for water absorption thickness expansion, falls between 5% and 5.5%.

Figure 46 illustrates how the internal bonding strength of composite boards varies with core layer glue amount, showing a significant increase with more glue. This enhancement in internal bond strength is attributed to the increase in active group content within the adhesive, leading to more bonding points with the rice husk, thus bolstering the effectiveness of the adhesive in the core layer.

The changes in static bending strength and modulus of elasticity due to core layer glue amount, as shown in Figures 46, exhibit minimal fluctuations and hence, are not further analyzed here.

The analysis suggests that the core layer glue amount should be maintained between 5% to 5.5%. This range is pivotal for maximizing internal bond strength. To achieve optimal internal bond strength while allowing for adjustments in density, a core layer glue amount of 5.5% is preferred.

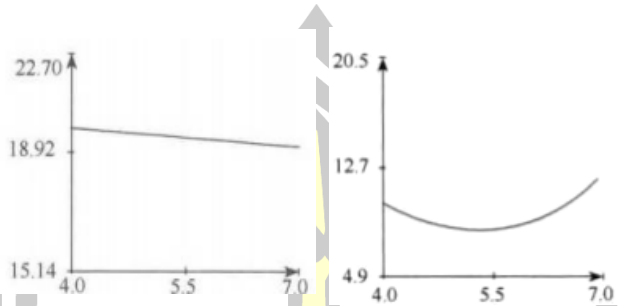
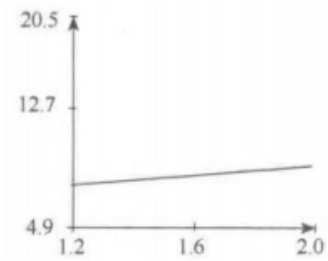


Figure 46 Effect of core layer sizing on composite board performance curve
Source: Drawn by Ye Li, 2023

The influence of curing agent dosage on the properties of composite panels is depicted in Figure 47. The trend in water absorption thickness expansion as affected by the amount of curing agent is shown in Figure 47, revealing a gradual increase with more curing agent. Below 1.4% curing agent, the water absorption thickness expansion meets the experimental criterion of less than 8%, achieving its lowest at a 1.2% curing agent dosage. While adding a curing agent shortens the curing time of urea-formaldehyde adhesive, it may lead to a thicker pre-cured layer on the slab surface and reduce the active period of the urea-formaldehyde resin adhesive, necessitating careful control over the curing agent dosage.

The internal bond strength, static bending strength, and modulus of elasticity of the composite boards, as affected by the curing agent dosage (shown in Figures 47, exhibit minimal fluctuation, hence are not further analyzed.

The composite panels' properties are marginally influenced by the curing agent dosage, with a preference for a 1.2% curing agent content to optimize performance.



(c)

Figure 47 Effect of curing agent dosage on the performance curve of composite boards

Source: Drawn by Ye Li, 2023

The curve showing the effect of hot press temperature on the water absorption thickness expansion rate of the composite board is presented in Figure 48(a). This curve illustrates a significant fluctuation with the increase in hot pressing temperature. When the temperature is below 190°C, the water absorption thickness expansion rate satisfies the experimental requirement of less than 8%, achieving its lowest value at a pressing temperature of 170°C. The reason behind this is that higher pressing temperatures lead to more substantial volume changes in the laminate, both before and after pressing, due to thermal expansion and contraction. Consequently, at higher temperatures, the composite boards experience greater internal stresses from the adhesive's binding effect and the interweaving effect between shavings. This can more likely cause damage to the glued joints compared to boards pressed at lower temperatures, especially noticeable during the water absorption thickness expansion rate test.

The curves depicting the influence of hot press temperature on the internal bonding strength of the composite boards are shown in Figure 48. Here, a notable decline is observed as the hot press temperature increases, yet the internal bonding strengths still meet the experimental criterion of $\geqslant$0.4MPa. The hot press temperature is essential for ensuring the adhesive's curing and moisture removal. However, excessively high temperatures can lead to premature and over-curing of the adhesive, as well as excessive degradation of raw materials (polymers), diminishing the internal bond strength of the composite boards.

The variation curves of static bending strength and modulus of elasticity of the composite plate affected by hot pressing temperature are shown in Fig. 48, and the

static bending strength and modulus of elasticity decrease with the increase of hot press temperature. The static flexural strength and modulus of elasticity of the composite board meet the experimental requirements when the hot press temperature is taken at 170-210 °C. The static flexural strength and modulus of elasticity of the composite board meet the experimental requirements. The hot press temperature of urea-formaldehyde adhesive particleboard is usually 140～180 ℃, but in industrial production, in order to obtain high production efficiency and particleboard output, further heating is often used, and the hot press temperature can be as high as 190～220 ℃. High temperatures are prone to premature curing of the adhesive on the surface of the composite boards and excessive degradation of the polymers in the rice hulls and wood shavings, leading to a reduction in the strength of the composite boards.

From the above analysis, it can be seen that reducing the hot press temperature is conducive to improving the water-absorbing thickness expansion rate, internal bond strength, static curvature strength and modulus of elasticity of the composite plate, and the hot press temperature of 170 ℃ is preferred.

The effect of hot press pressure on composite panel properties is shown through the variation curves. the curve illustrating water absorption thickness expansion rate of the composite panels decreases as the hot press pressure increases. Specifically, when the pressure exceeds 3 MPa, the thickness expansion meets the experimental criteria of less than 8%, achieving its minimum at a pressure of 3.3 MPa. This reduction in expansion can be attributed to the surface layer of the slab undergoing rapid deformation upon contact with the hot press plate, with increased pressure significantly reducing the voids in the surface layer. This contributes to a higher density in the surface layer, enhancing the panel's water resistance and consequently reducing the water absorption thickness expansion rate.

shows the internal bond strength of the composite panels as influenced by hot pressing pressure, displaying a slight decrease with increased pressure. However, the curve fluctuates minimally and thus does not warrant detailed analysis.

Figures 48 depict the static bending strength and modulus of elasticity of the composite panels as impacted by hot pressing pressure. These figures reveal that static bending strength improves with rising pressure, while changes in modulus of elasticity are not significantly noticeable with pressure variations. When the hot press pressure is above 2.6 MPa, the composite panels meet the experimental requirements for static flexural strength and modulus of elasticity. The pressure facilitates closer bonding of raw materials and adhesive within the slab, affecting material contact area and heat transfer. Due to pressure loss, there's a gradient from the surface to the core layer of the composite board, resulting in a density that diminishes towards the core, where it's lowest. Given rice husk's low volume density and the substantial thickness of the slab's core layer, pressure loss leads to much smaller pressure variations at the core compared to the surface layer. This accounts for the negligible impact of hot press pressure on the internal bond strength of composite panels. Increased pressure can thin the pre-cured layer on the panel's surface and densify the structure, aiding in enhancing the static bending strength and modulus of elasticity of the composite panel.

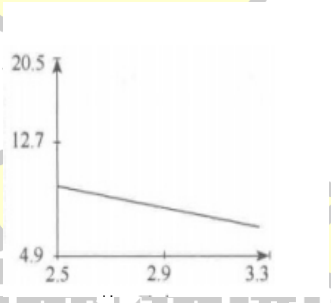


Figure 48 Curve of influence of hot press pressure on the performance of composite plate
Source: Drawn by Ye Li, 2023

From the analysis, it's evident that pressurization aids in reducing the water absorption thickness expansion rate of the composite panel while also achieving higher static bending strength. With a pressure range of 3-3.3 MPa, the composite panel's performance aligns with experimental requirements. Considering energy

efficiency and environmental friendliness, a hot press pressure of 3 MPa is recommended.

Regarding the impact of hot press time on composite panel properties, the curve showing the water absorption thickness expansion rate, as seen in Figure 49, does not exhibit significant change with increased hot press time, and thus, was not further analyzed.

The internal bond strength of composite panels, as demonstrated in Figure 49, significantly decreases as hot press time increases, yet still meets the experimental threshold of $\geqslant 0.4$ MPa. The hot press time is a critical factor for production efficiency. While extending the hot press time within a certain limit can enhance the core layer's temperature of the slab, too prolonged hot press times at higher temperatures can lead to further degradation of the composite panels' raw materials, adversely affecting their mechanical properties.

As depicted in Figure 49, both static flexural strength and modulus of elasticity significantly decline with an increase in hot press time. However, the composite panels' static flexural strength and modulus of elasticity are within experimental standards across the explored range. While extending hot press time can promote uniform heating of the slab to some extent, the high-temperature and high-pressure conditions of industrial production mean that prolonged hot press times may result in over-curing and degradation of raw materials. Such conditions are detrimental to achieving desirable mechanical properties in composite boards.

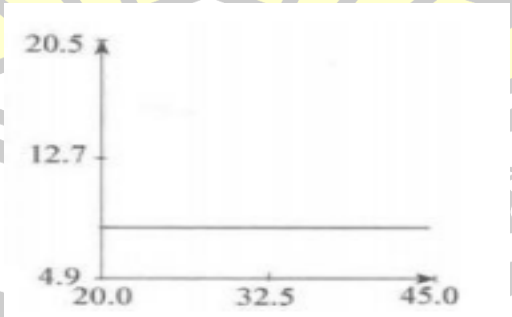


Figure 49 Curve of the influence of hot press time on the performance of composite plate

Source: Drawn by Ye Li, 2023

Based on the analysis, shortening the hot press time is beneficial for enhancing the internal bond strength, static bending strength, and modulus of elasticity of the

composite panel, without significantly affecting the water absorption thickness expansion rate. Furthermore, considering factors such as production efficiency and resource consumption, a hot press duration of 20 seconds per millimeter thickness is recommend.

2.2.5 Effect of interaction effects between density and other factors on the mechanical properties of composite panels for packaging boxes

Following a univariate analysis, the optimized process parameter values, excluding density, were identified as follows: a core layer ratio of 60%, surface layer glue application of 12.5%, core layer glue application of 5.5%, curing agent concentration of 1.2%, hot pressing temperature of 170°C, hot pressing pressure of 3.0 MPa, and a hot press duration of 20 seconds per millimeter thickness. An examination of these parameter values alongside the composite board density revealed that the board structure was more compact under these conditions.

To achieve lower density values while meeting experimental requirements (0.75-0.80 g/cm³), the influence of interactions between density and other factors on the water absorption thickness expansion, internal bond strength, static bending strength, and modulus of elasticity of composite boards was investigated. These interactions include those between density and the core layer ratio, surface layer glue amount, core layer glue amount, curing agent amount, hot pressing temperature, hot pressing pressure, and hot press duration. as shown in Figure50.

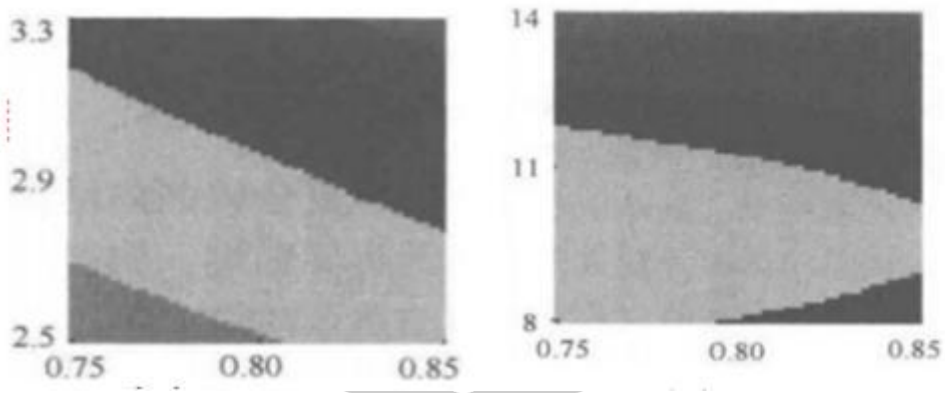


Figure 50Effect of the interaction effect between density and other factors on the expansion of water absorption thickness of composite panels

Source: Drawn by Ye Li, 2023

When setting other process parameters to their preferred values, a density range of 0.75 to 0.80 g/cm³ was found to achieve a water absorption thickness expansion rate of less than 8%, which is considered reasonable. This finding is detailed in Table 51. Apart from the interactions between the density and the amount of core layer sizing, and the density and the hot press time, which did not fulfill the requirement for less than 8% thickness expansion as shown in Table 7, the interaction plots for other process parameters at a density of 0.78 g/cm³ did meet the experimental criteria for a thickness expansion rate of less than 8%.

prerequisite	surface layer sizing	Core layer Amount of glue applied	Curing Agent Dosage	hot pressing temp	hot pressing strains	hot pressing times	preferred
	12.5 per cent	5.5 per cent	1.2 per cent	170°C	3 MPa	20smm¹	
Density values/ (g/cm³)	≥0.75	insoluble (i.e. unable to solve)	≥0.77	≥0.75	≥0.78	insoluble (i.e. unable to solve)	≥0.78

Table 7Reasonable Density Values to Satisfy Absorption Thickness Expansion <8%

Source: Drawn by Ye Li, 2023

The impact of the interaction between density and other factors on the internal bond strength of composite panels includes the interactions between density and the core layer ratio, the amount of surface layer gluing, the amount of core layer gluing, the curing agent amount, the hot press temperature, the hot press pressure, and the hot press time, as shown in Figure 51

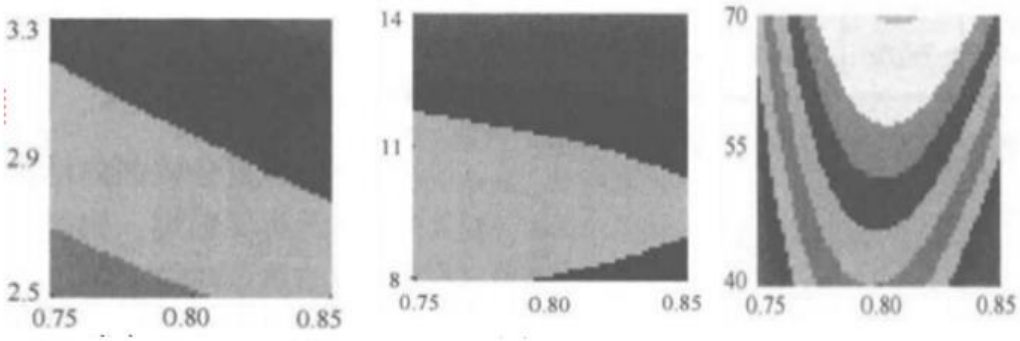


Figure 51Effect of interaction effect between density and other factors on bond strength within composite panels
Source: Drawn by Ye Li, 2023

Analyzing when other process parameters are set to their optimal values, a reasonable density value that satisfies an internal bond strength >0.4 MPa falls within the range of 0.75~0.80g/cm³, as indicated in Table 8. The interaction effect plots for all process parameters with density at 0.77g/cm³ meet the experimental requirement of an internal bond strength >0.4 MPa.

prerequisite	core layer proportions	surface layer sizing	core layer sizing	Curing Agent Dosage	hot pressing temp	hot pressing strains	hot pressing times	preferred
	60 per cent	12.5 per cent	5.5 per cent	1.2 per cent	170 °C	3 MPa	20 s - mm^{-1}	
Density values/ (g/cm^3)	≥0.76	≥0.77	≥0.76	≥0.76	≥0.75	≥0.76	≥0.75	≥0.77

Table 8Reasonable Density Values to Satisfy Internal Bond Strength >0.4 MPa
Source: Drawn by Ye Li, 2023

2.2.6 Effect on static flexural strength and modulus of elasticity of composite plates

The effects of the interaction between density and other factors on the static flexural strength and modulus of elasticity of composite panels were the ratio of density to core, the amount of glue applied to the surface layer, the amount of glue applied to the core layer, the amount of curing agent, the hot press temperature, the hot press pressure, and the time of hot pressing, respectively, as shown in Figure 52 and 53.

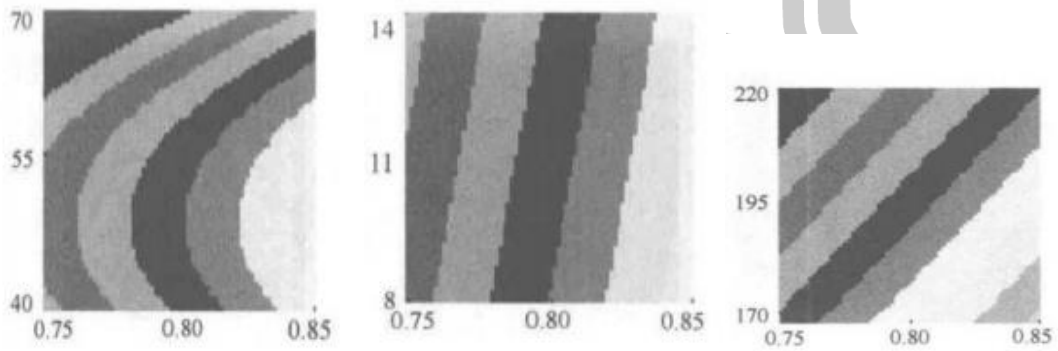


Figure 52 Effect of interaction effects between density and other factors on static flexural strength of composite plates
Source: Drawn by Ye Li, 2023

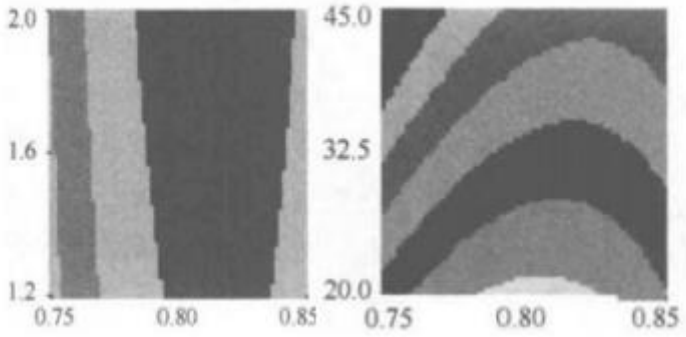


Figure 53Effect of interaction effects between density and other factors on the modulus of elasticity of composite plates
Source: Drawn by Ye Li, 2023

When setting other process parameters to their optimal values, the analysis identifies a reasonable density range of 0.75~0.80g/cm³ to achieve static flexural strength greater than 18 MPa, as detailed in Table 9. The modulus of elasticity, which meets the experimental criteria of greater than 3.00 G Pa, is not further analyzed. The interaction effect plots demonstrate that at a density of 0.78g/cm³, all process parameters align with the requirement for a static flexural strength exceeding 18 MPa.

prerequisite	core layer proportions	surface layer sizing	core layer sizing	curing agent dosage	hot pressing temp	hot pressing strains	hot pressing times	preferred
	60 per cent	12.5 per cent	5.5 per cent	1.2 per cent	170°C	3 MPa	20 s-mm	
Density values/ (g/cm³)	≥0.78	≥0.77	≥0.77	≥0.77	≥0.75	≥ 0.76	≥0.75	≥0.78

Table 9Reasonable Density Values to Satisfy Static Bending Strength >18MPa
Source: Drawn by Ye Li, 2023

Infrared Analysis of Coupling Reinforced Composite Panels The principle of infrared spectroscopy is predicated on the understanding that molecules within a substance can produce distinct infrared spectra reflective of their vibration frequencies, earning infrared spectroscopy the moniker "molecular fingerprint." By comparing characteristic peaks within the infrared spectrum of a sample, it is possible to study molecular structures and chemical bonds, thereby facilitating the characterization and identification of chemical species. During the synthesis of composite materials, certain chemical groups vanish while new ones form due to reactions between the constituents. These changes, marked by the disappearance or

emergence of characteristic absorption peaks, can be detected through infrared spectroscopy. Fourier Transform Infrared Spectroscopy (FTIR) was employed to analyze the rice husk, coupling agent, urea-formaldehyde resin adhesive, and the rice husk layer within the composite board, with findings illustrated from Figures 54 to 55.

Figure 54 displays the infrared spectrum of the utilized rice husk, identifying its characteristic absorption peaks at 3438.80 cm^{-1}, 2923.56 cm^{-1}, 1639.18 cm^{-1}, 1400.27 cm^{-1}, and 1030.23 cm^{-1}, where peaks at 3438.80 cm^{-1}, 2923.56 cm^{-1}, and 1030.23 cm^{-1} are indicative of cellulose and lignin. The presence of additional peaks within the spectrum corroborates the rice husk's composition of various substances.

Figure 55 presents the infrared spectrum for the silane coupling agent KH-550, highlighting characteristic peaks at 3434.86 cm^{-1}, 2974.71 cm^{-1}, 2886.10 cm^{-1}, 2177.33 cm^{-1}, 1574.97 cm^{-1}, 1481.80 cm^{-1}, 1390.05 cm^{-1}, 1250.24 cm^{-1}, 1166.92 cm^{-1}, 1103.68 cm^{-1}, 1076.67 cm^{-1}, 957.63 cm^{-1}, 857.73 cm^{-1}, and 773.48 cm^{-1}, elucidating the distinct signature of KH-550.

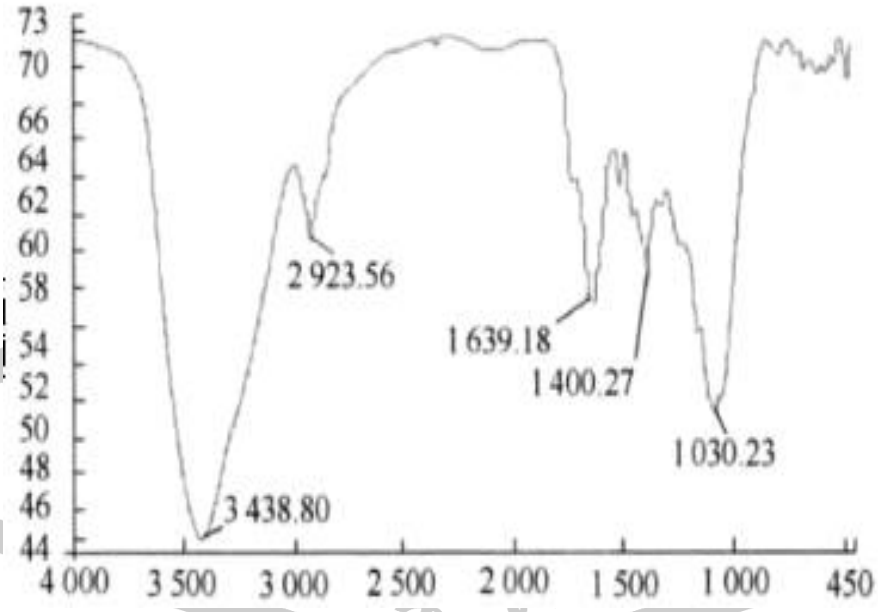


Figure 54 Infrared spectrum of rice husk
Source: Drawn by Ye Li, 2023

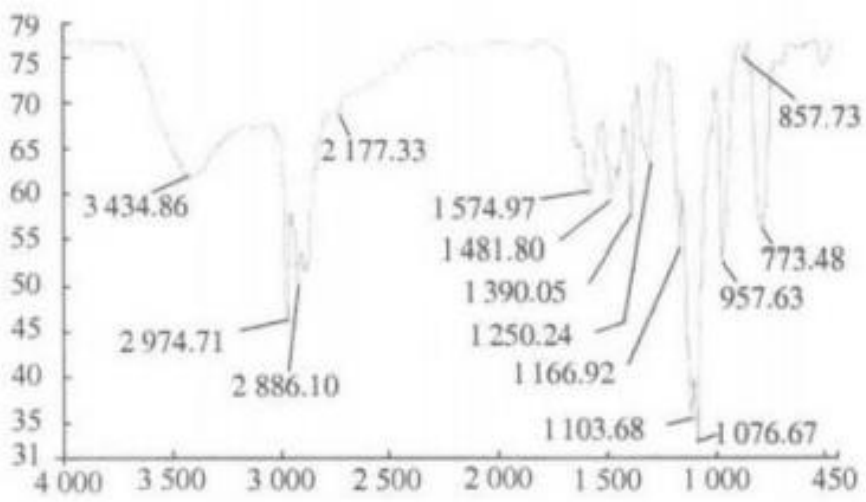


Figure 55 Infrared Spectra of Silane Coupling Agents
Source: Drawn by Ye Li, 2023

Figure 56 illustrates the infrared spectrum of the urea-formaldehyde resin used, with characteristic peaks identified at 3428.99 cm^{-1}, 2960.66 cm^{-1}, 2352.22 cm^{-1}, 1653.14 cm^{-1}, 1555.02 cm^{-1}, 1384.35 cm^{-1}, 1254.35 cm^{-1}, 1135.03 cm^{-1}, 1090.39 cm^{-1}, 900.97 cm^{-1}, 686.91 cm^{-1}, and 593.42 cm^{-1}, which are the main characteristic peaks of urea-formaldehyde resin.

Figure 57 presents the infrared spectrum obtained experimentally for rice husk within the core layer of the composite panel, with characteristic peaks at 3441.83 cm^{-1}, 2922.81 cm^{-1}, 1543.51 cm^{-1}, 1515.40 cm^{-1}, 1384.54 cm^{-1}, 1240.23 cm^{-1}, and 1095.92 cm^{-1}. These peaks are indicative of the core layer's composition. A comparison of the peaks reveals changes across the spectrum, except at 2900 cm^{-1} and 3500 cm^{-1}, where no changes are observed. The disappearance of certain absorption peaks from the silane coupling agent and urea-formaldehyde resin signifies actual chemical reactions within the composite system. Notably, the characteristic absorption peak at 1095.92 cm^{-1} corresponds to Si-O-Si, evidencing the formation of Si-O-Si bonds. This confirms the reaction between the silane coupling agent and rice husk, thereby validating, on a microscopic level, that silane coupling agents and urea-formaldehyde resin are viable for the manufacture of rice husk composite panels.

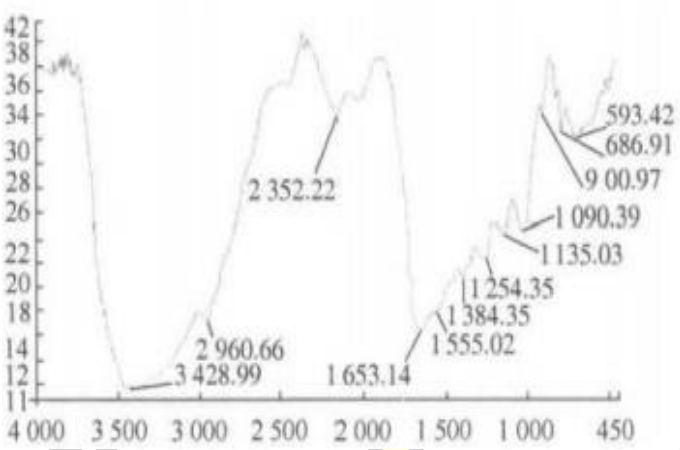


Figure 56 Infrared spectra of urea-formaldehyde resins
Source: Drawn by Ye Li, 2023

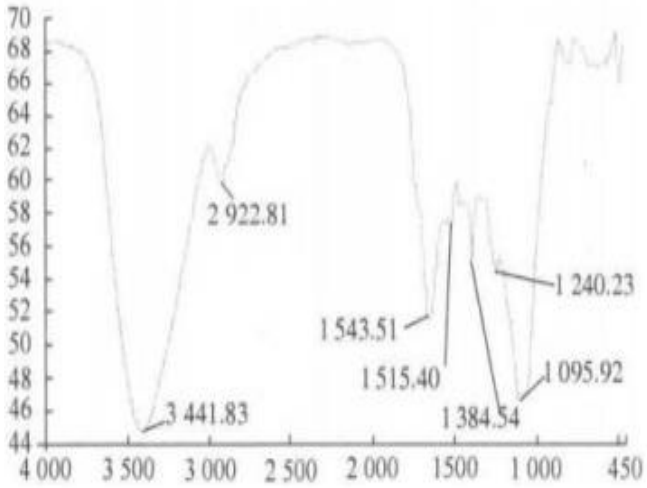


Figure 57 Infrared spectra of rice husk in the core layer of composite panel
Source: Drawn by Ye Li, 2023

2.2.7 Tests and Experiments

Validation of the experimental programs showed that density significantly influences the performance of the composite panels. The choice of density affects not only the panels' final properties but also the consumption of raw materials during production. Consequently, two density values were finalized: 0.77 g/cm³ and 0.78 g/cm³. The latter, 0.78 g/cm³, was a conservative estimate, while 0.77 g/cm³ served as an exploratory predictive value. For factors other than density, the chosen values were: core layer ratio at 60%, surface layer glue amount at 12.5%, core layer glue amount at 5.5%, curing agent at 1.2%, hot pressing temperature at 170 ℃, hot pressing pressure at 3.0 MPa, and hot press time at 20 s/mm. Composite boards were fabricated based on these parameters with a replication factor of m=9 for each of the

two proposed protocols. Following performance testing of five boards randomly selected from each protocol set, the 0.77 g/cm³ density option was eliminated due to unsatisfactory outcomes. The 0.78 g/cm³ density solution, however, met all experimental requirements except for the screw-holding capacity and was therefore selected as the optimal process for this study.

Performance Testing The outcomes of the validation experiments are detailed in Table 10. Under the optimal process conditions, the composite panels exhibited average values for water absorption thickness expansion, internal bond strength, static flexural strength, and modulus of elasticity at 7.92%, 0.43 MPa, 20.70 MPa, and 3.40 G Pa, respectively. These results align with the initial experimental objectives, demonstrating satisfactory performance across all measured parameters.

Item	test piece serial number	Board 1	Board 2	Plate 3	Board 4	Plate 5	average value	maximum value	Minimum value	variance (statistics)	average value
Absorbent thickness Expansion/%	1	8.50	10.45	6.81	10.69	11.49	9.59	11.49	6.81	3.62	7.92
	2	9.20	7.49	6.85	7.51	10.53	8.32	10.53	6.85	2.29	
	3	7.74	11.60	7.32	6.78	7.45	8.18	11.6	6.78	3.78	
	4	5.10	5.04	5.38	7.53	4.93	5.60	7.53	4.93	1.20	
Internal bond strength/MPa	1	0.41	0.36	0.35	0.37	0.34	0.37	0.41	0.34	7.30 x 10+	0.43
	2	0.43	0.48	0.43	0.40	0.42	0.43	0.48	0.40	8.70 x 10-	
	3	0.43	0.49	0.47	0.49	0.52	0.48	0.52	0.43	1.10 x 10-3	
hydrostatic force Degree/MPa	1	18.31	14.64	14.27	15.94	16.60	15.95	18.31	14.27	2.63	20.70
	2	23.97	23.58	21.38	23.92	20.75	22.72	23.97	20.75	2.36	
	3	25.61	20.96	23.50	23.53	23.62	23.44	25.61	20.96	2.73	

Table 10Verification experiment test results
Source: Drawn by Ye Li, 2023

Screw Holding Strength Test Results

The screw holding strength results for the composite board are presented in Table 11. As seen from Table 11, the average values for the surface screw holding strength and the edge screw holding strength are 920N and 620N, respectively. These results did not meet the initial experimental target values, indicating that further improvements are necessary to enhance the screw holding capacity of the composite board.

Item	Group I	Group II	Group III	Group IV	average value	Specimen diagram
Plate grip screw force/N	950	960	930	870	920	
	770	900	1070	700		
	940	1060	890	950		
Plate edge grip screw force/N	710	560	590	600	620	
	550	640	630	660		

Table 11Nail Grip Test Results
Source: Drawn by Ye Li, 2023

Error Analysis In the validation experiments for the chosen optimal process, discrepancies arise as the patterns of material property variation don't align perfectly with the predictive model. This misalignment is evident in the outcomes displayed from Figures 58 to 60, where the test results and their corresponding curves are detailed. These discrepancies highlight the need for further refinement and adjustment in the experimental approach to ensure closer alignment with the predictive model, as showcased in the graphs presented from Figures 58 through 60.

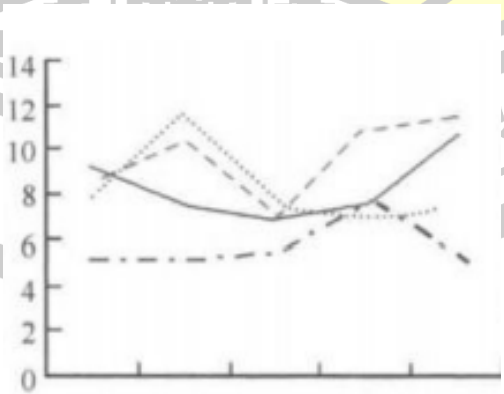


Figure 58 Validation Experiment Absorption Thickness Expansion Rate Curve
Source: Drawn by Ye Li, 2023

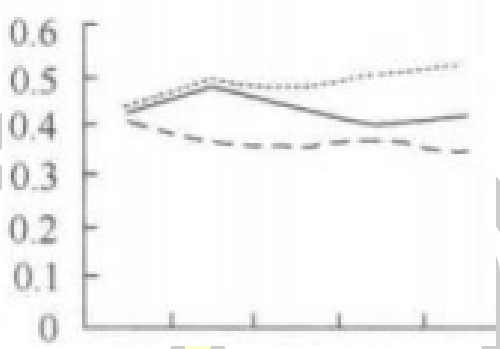


Figure 59 Internal bond strength curves for validation experiments
Source: Drawn by Ye Li, 2023

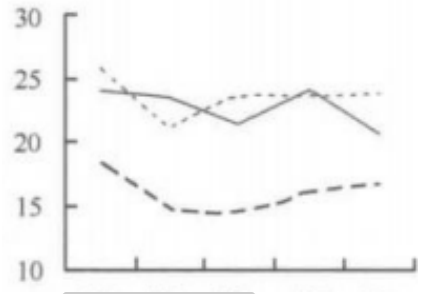


Figure 60 Verification Experimental Static Bending Strength Curve
Source: Drawn by Ye Li, 2023

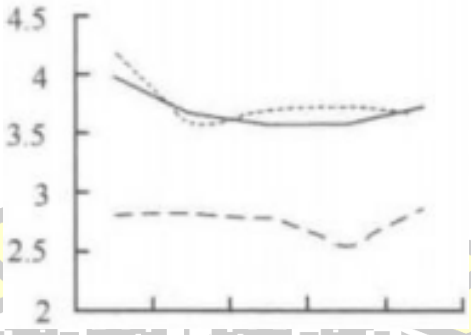


Figure 61 Verification experiment modulus of elasticity curve
Source: Drawn by Ye Li, 2023

From Figure 59, we observe that the distribution of water-absorbing thickness expansion rates of composite boards is uneven, with a significant span between the highest and lowest values, lacking a consistent trend. This suggests an opportunity to enhance the boards' water-absorbing thickness expansion rate by selectively applying a water-repellent agent to the surface layer of the wood. Figures 60 and 61 reveal a clear order in internal bond strength across specimens, with specimen 1 being the weakest and specimen 3 the strongest. Similarly, for static flexural strength and

modulus of elasticity, specimen 1 performs the worst, with specimens 2 and 3 showing better and comparable results, indicating a significant disparity. The preparation of the specimens is depicted in Figure 61, where TS represents the 2-hour water-absorbing thickness expansion rate, IB denotes internal bond strength, MOR is the static flexural strength, MOE signifies the modulus of elasticity, and SHC stands for the screw-holding capacity. The shaded areas indicate the sections that have been trimmed.

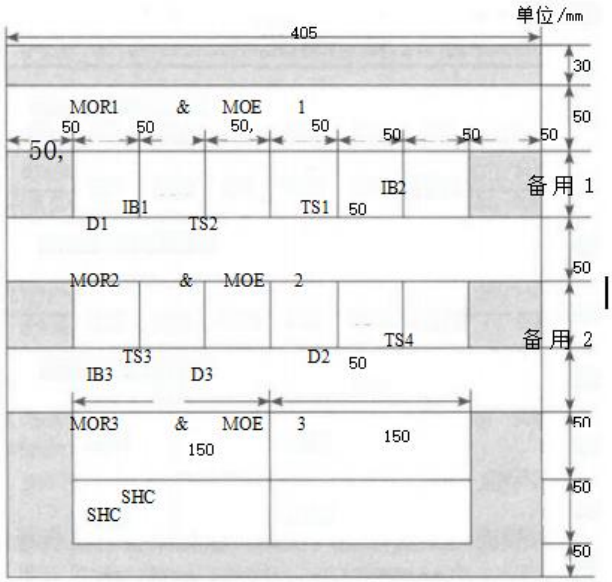


Figure 62 Specimen Preparation

Source: Drawn by Ye Li, 2023

As illustrated in Figure 62, the specimen with the highest internal bond strength, specimen 3, is situated at the center of the composite board, whereas specimen 1, which demonstrates a lower bond strength, is positioned closer to the edge. This distribution suggests that the edge of the composite board is less dense compared to its center. The test results for static bending strength and modulus of elasticity support this observation, with the central specimens, 2 and 3, showing higher and nearly identical values, while the edge specimen, 1, exhibits a lower value. This highlights that averaging the properties of composite panels can introduce significant errors. To mitigate the influence of edge variability, separate analyses of specimens from different board locations could be conducted, employing a weighting method if necessary. Furthermore, for boards with a large width, increasing the trimming margin or directly discarding edge values might be advisable to obtain more accurate data.

2.2.8 Feasibility analysis

The production cost for packaging box laminates is evaluated using the market prices for raw materials and figures from Alibaba.com. The prices are as follows: wood shavings at 650 yuan/ton (with a general drying process to prevent decay, moisture content measured at 5%), rice husks at 200 yuan/ton (with a moisture content of 9%); urea-formaldehyde adhesive at 2,000 yuan/ton (with a solids content of 60 ± 2%, calculated based on 60%), isocyanate (PAPI) at 12,500 yuan/ton, and ammonium chloride at 400 yuan/ton.

Comparing the costs of producing a standard size particleboard (1220mm x 2440mm x 20mm) to that of a similar specification composite board, the analysis, as detailed in Table 12, shows that, without accounting for the cost of additives typically added to standard wood particleboard, the production of the composite board can achieve approximately a 7.25% reduction in material costs compared to the wood-only particleboard.

(Unit: Yuan)

Various costs	laminate	Pure wood chipboard
wood shavings	11.254	28.135
rice husk	5.757	
urea formaldehyde glue	6.870	17.176
isocyanate	18.157	
ammonium chloride	0.010	0.025
reagent		k
Total material costs	42.048	45.336+k

Note: k unknown.

Table 12Material cost analysis of composite panels versus conventional particleboards

Source: Drawn by Ye Li, 2023

Feasibility Analysis of Production Compared to the current industrial production of wood packaging boards, the experimentally prepared composite boards are performance-wise capable of meeting the general usage requirements for packaging

boards. Regarding material sourcing, rice husks offer a significant advantage over wood. Given the widespread cultivation of rice throughout the country, a substantial quantity of rice husks is produced annually across most regions, far exceeding current demand. Utilizing rice husks on a large scale for composite board manufacturing can address the issue of rice husk disposal and waste prevalent in many areas. Moreover, it can help mitigate the gap between the substantial domestic demand for timber and its limited supply, carrying profound social implications.

For the industrial production of composite panels to be feasible, this experiment has focused on streamlining the manufacturing process and enhancing the technology, with no additional additives beyond the curing agent. This approach not only eliminates the risks and errors associated with superfluous procedures but also reduces costs. Through the adjustment of various processing parameters to enhance the mechanical properties of the composite board, a high-performance composite board has been developed that sufficiently meets the common packaging requirements. Furthermore, in actual production scenarios, leveraging existing large-scale equipment such as glue sprayers, sieving machines, and spreaders can more effectively address the issues of uneven spraying, sieving, and spreading caused by experimental small to medium-sized equipment or manual labor, favoring the production of composite boards with more consistent performance.

3 Green Ceramic Packaging Case Study

Innovations in green ceramic packaging design prioritize eco-friendly and sustainable concepts and materials to minimize environmental harm while enhancing packaging effectiveness and durability. These innovations include employing biodegradable materials capable of naturally decomposing, thus diminishing environmental pollution. The choice of suitable biodegradable materials considers aspects like product characteristics, usage, environmental conditions, and decomposition pace. Common biodegradable materials encompass biodegradable plastics such as polylactic acid (PLA), polyhydroxyalkanoates (PHA), and polybutylene adipate terephthalate (PBAT), as well as biodegradable starch, fibers (e.g., corn, bamboo), plastic films, foams, paper, cardboard, and films. These strategies enhance packaging sustainability and lessen environmental impacts. Highlighting the inefficiency of conventional waste management, Greek designer

George Bosnas developed a novel, sustainable egg packaging. Made from clear, purified pulp, flour, starch, and bio-seeds, this compact box snugly holds four eggs, mitigating breakage risk. This packaging visually demonstrates the advantages of sustainable solutions post-use, as it can directly serve as planting soil, embedded with legume seeds that sprout in six days and mature in thirty. Moreover, growing legumes enriches soil fertility by atmospheric nitrogen fixation via rhizomes. Bosnas's biodegradable packaging design serves as an exemplary model for green ceramic packaging, emphasizing the blend of functionality and environmental stewardship as shown in Figure 63.

Figure 63Biodegradable egg packaging
Source: Drawn by Ye Li, 2023

Designing reusable ceramic packaging, like attractive gift boxes, encourages consumers to retain and repurpose the packaging, thereby reducing disposable packaging usage. Utilizing eco-friendly inks and printing methods for ceramic packaging diminishes harmful chemical use, safeguarding the environment and staff health. Incorporating natural materials, such as bamboo fiber and algae, into ceramic packaging enhances environmental performance and recyclability. By marking the packaging with a green design logo, the packaging's eco-friendly attributes are communicated to consumers, boosting their awareness and inclination towards purchasing sustainable products. Investigating multifunctional ceramic packaging designs, like boxes or containers with alternative uses, can elevate packaging reuse rates. Adopting recyclable paper fillers for ceramic product protection replaces conventional materials like plastic bubble wrap, contributing to plastic waste reduction. As illustrated in Figure 64, this rice packaging crafted from rice bran, a by-

product of the milling process, features a lid embossed with a rice grain motif. This simple, natural box can also serve as a tissue box, courtesy of the rice-shaped aperture on the top layer. This packaging isn't just visually appealing; it perpetuates the sustainability ethos, offering a vision of a greener future.

Figure 64 Recyclable material reusable rice packaging
Source: Drawn by Ye Li, 2023

Simplifying package structure entails reducing the packaging design to its essential elements, eliminating unnecessary decorations and complexities to conserve materials, cut costs, and minimize resource usage. Such streamlined package designs prioritize utility and functionality while preserving the package's quality and protective features. Common approaches to simplifying package structures include using basic shapes like squares, rectangles, or circles; minimizing package size to prevent material and space wastage; reducing component and connection use by merging several parts into a unified structure; employing straightforward sealing techniques like folding, gluing, or simple fastening to forego complex sealing mechanisms; and simplifying design by limiting decorative elements to essential logos and information only. Designing reusable packaging, like collapsible boxes and storable containers, further diminishes the need for single-use packaging options. Opting for eco-friendly, recyclable, or biodegradable materials lessens environmental impact. A simplified packaging structure not only reduces production costs and conserves resources but also curtails waste generation, enhancing packaging efficiency and lowering the time and energy expended in packaging activities. For

instance, the packaging design for Anaya's Jin Shan ling honey exemplifies this approach effectively. Anaya is a high-end real estate brand.

Figure 65 Anaya Jin Shan ling honey packaging
Source: Drawn by Ye Li, 2023

The packaging was crafted for two unique honey variants from Jinshanling, the site of Anaya Jinshanling, a luxury eco-friendly property venture. The box's angular design draws inspiration from the client's slanted brand logo, aligning with their brand identity. Moreover, its glue-free folding architecture underscores their commitment to eco-conscious values. The external packaging's embossed motif and the honey jar label's unbroken mountain ridge silhouette distill the essence of the local landscape. Inside, a terrain contour map reinforces the brand's "immersed in nature" ethos. This streamlined packaging approach diminishes environmental impact, embodying sustainable development principles and catering to contemporary consumers' preferences for green products.

Leveraging such green packaging innovations in ceramic packaging design can propel the ceramics sector towards greater eco-friendliness and sustainability, minimizing resource use and environmental harm. Furthermore, these creative strategies enhance corporate competitiveness by addressing the growing consumer appetite for eco-friendly products and fostering a green corporate image.

Chapter IV

Integration of local culture and ceramic packaging

In the wave of global economic integration, ceramic products to succeed in the market competition, as before, simply rely on the excellence of the ceramic product itself is not enough. In ceramic packaging design, the flexible use of excellent traditional culture as ceramic packaging design elements, through the adoption of modern science and technology, adding modern design concepts and ways of expression, so that the excellent local culture to show new life. Make ceramic packaging more unique, heritage and the times, which can make ceramic goods have more personality and characteristics.

Local traditional patterns can best reflect the national characteristics and the cultural heritage of the region, is to convert an abstract concept into a concrete physical form and the carrier of the communication process. Ceramic packaging is one of the main design elements is the pattern, the pattern has a simple and clear expression of the effect and its own strong infectious force, in the fierce competition of modern ceramic products is also occupies a very important position. Jingdezhen ceramics in the traditional art patterns of various kinds of very much, successive dynasties have left a wealth of ceramic decorative patterns, such as Figure 66 shows some of the ceramic vessels painted on the figures and animals, etc. These patterns are reflected in the workers' exquisite handicraft and are typical of our country's traditional patterns. These traditional patterns on ceramics are very rich in content, and the selection of topics is also very broad, vivid, natural and exquisite. Whether they are used as the main pattern or used in the background, corners or borders, they can give people a kind of simple and classic atmosphere, and have a very strong decorative flavor. The characteristics of these traditional patterns can be very well used in ceramic packaging design, but also the form of modern ceramic packaging pursued. Ceramic packaging design can take these precious materials as the basic material, to be collapsed, with the formation of ceramic packaging exclusive pattern shown in Figure 67, in the ceramic pattern to choose the auspicious cloud pattern for the design of deformation, while retaining the traditional modelling elements of modern interpretation, which is usually a common pattern in traditional Chinese art

and culture, representing good luck and good fortune. This motif is usually represented in the form of clouds, signifying a bright future and happiness. Ceramic motifs convey the characteristics of the local culture and explore and discover traditional Chinese images from these motif materials to spread the local ceramic culture.

Figure 66 Pattern on ceramic

Source: Drawn by Ye Li, 2023

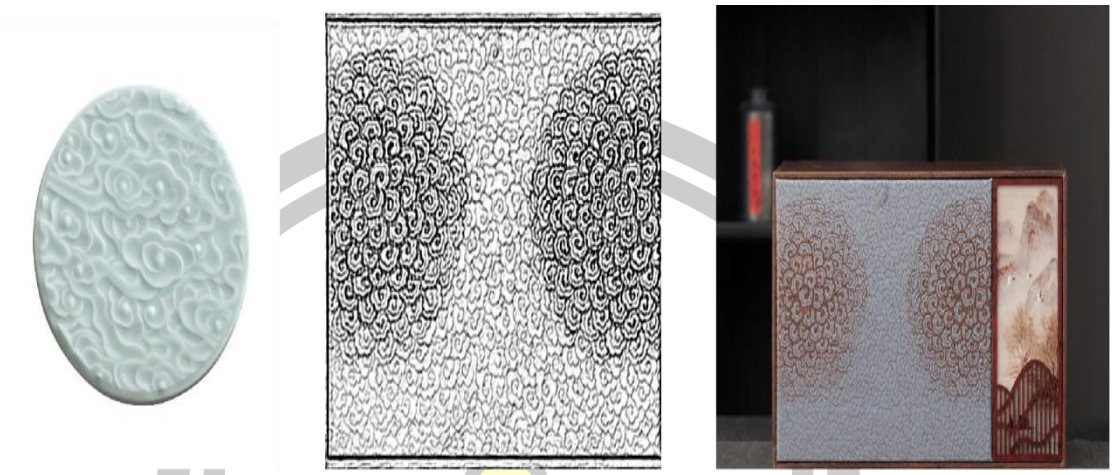


Figure 67Ceramic patterns integrated into packaging design

Source: Drawn by Ye Li, 2023

Jingdezhen ceramics are renowned for their distinct image and symbolic colors, integral to their packaging design. Image color captures the immediate visual impression and sentiment associated with Jingdezhen ceramics, while symbolic color conveys specific meanings or symbols that these ceramics embody. These elements often evoke color psychological recognition or associations with certain objects. Beginning with the shadow green glaze, Jingdezhen's artisans have pioneered numerous monochrome glazes, capturing the essence of mountain greens, ocean blues, brook lightness, spring greenery, and autumn yellows. Notably, cyan stands as a traditional hallmark of Jingdezhen ceramics, embodying a rich Chinese cultural aura along with historical depth. Design considerations must align the chosen image color with the packaging content's attributes. For instance, the Jingdezhen Qian li Jiangshan tea canister set, depicted in Figure 68, utilizes the product's inherent blue hue, amplified visually to enhance impact, thereby fostering a complementary visual effect. Beyond image colors, the strategic application of symbolic colors plays a crucial role. Red, denoting prosperity, celebration, and fortune, frequently adorns ceramics designed for festive occasions and weddings. Yellow, symbolizing royalty and nobility, adds a touch of dignity and grandeur to ceramic pieces. Purple, conveying mystery and elegance, is often selected for ceramic crafts to articulate a unique aesthetic sensibility.

Figure 68Ceramic tea caddy packaging
Source: Drawn by Ye Li, 2023

In Jingdezhen ceramic packaging design, symbolic colors rich in regional characteristics and cultural meanings are frequently employed, reflecting Jingdezhen's cultural heritage. Effective packaging design should leverage these colors thoughtfully, aligning with the product's background and qualities through storytelling, events, and symbolic representation to maximize color's visual impact. This approach requires careful consideration of product positioning, target audience, and cultural significance, while also maintaining consistency with the brand image and overall packaging design to optimize visual and marketing outcomes. A color scheme, as a specific arrangement of colors, evokes distinct emotions and responses, playing a critical role in packaging design for Jingdezhen ceramics. This product's color scheme must resonate with its aesthetic values and cultural background. Traditional Jingdezhen colors like blue and white, pastel, and glaze red, encapsulate the ceramics' cultural essence and can be utilized in packaging to underscore traditional attributes.

Japanese design master Hiroshi Oh chi emphasized the crucial role of packaging color in differentiating products in competitive markets. The primary colors of ceramics significantly contribute to Jingdezhen ceramics' recognizability. Local artisans such as Yu Tien and Wan Liang have meticulously mixed glazes in diverse

colors, using techniques like fluorescence spectroscopy for precise color analysis, thereby creating a comprehensive color archive for Jingdezhen. Despite the challenges in achieving high success rates due to the intricate variables influencing ceramic glaze, firing, and clay composition, these vibrant colors can transcend technical constraints in packaging design. Modern designs that play with color brightness and purity can yield visually appealing, recognizable, and enjoyable ceramic pieces, establishing a rhythmic color harmony that offers a cohesive visual experience, even among distinct hues.

This approach not only crafts a complete color system and visual style for Jingdezhen ceramic products but also evokes deeper meanings, showcasing the cultural DNA of the Chinese nation. The color matching in Jingdezhen ceramic packaging must align with consumer aesthetics and cultural context, considering product characteristics and positioning. Selecting an appropriate color combination that resonates with the product's emotional essence and target audience can enhance mutual reflection and complementarity. By categorizing ceramic colors into nine major families and creating a chromatogram for ceramic packaging, as shown in Figure 69, designers can accurately represent the spirit and luster of ceramic colors. Modern packaging that incorporates these representative colors not only carries forward traditional Chinese wisdom but also vividly reflects local ceramic culture, facilitating an intuitive integration of local culture into packaging design.

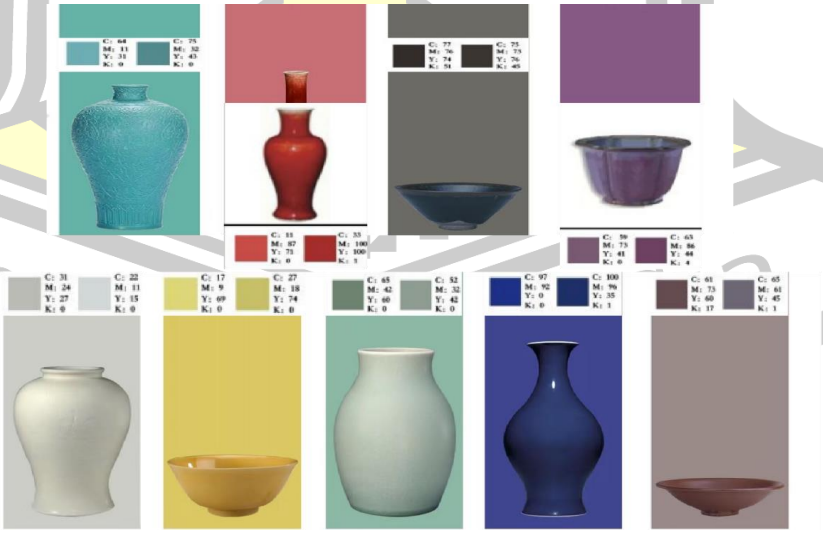


Figure 69Nine Colou of Jingdezhen Ceramics

Source: Drawn by Ye Li, 2023

1.Jingdezhen ceramic packaging design in the practice of visual marketing principles

Key principles of visual merchandising, such as purpose, aesthetics, utility, consistency, legibility, and continuity (Hou Delin, Feng Can Jun, 2018), guide the strategic presentation of visual content. In applying these principles, special attention is given to aesthetics, legibility, and continuity within the framework of meeting marketing objectives. This ensures that visual content is not only attractive and easy to understand but also maintains a seamless flow. Moreover, it aligns marketing messages cohesively with visual communication strategies. Integrating these principles with the context of Jingdezhen ceramic packaging allows for a deeper understanding of the foundational logic behind effective visual marketing strategies.

1.1Embodying the aesthetic tendency of Jingdezhen ceramics

Aesthetic activity involves the subject's sensory experience and response to an object, representing a form of human self-awareness and emotional expression (Jing Zu, 2002). This dynamic interaction between consumers and products embodies a holistic aesthetic engagement. Jingdezhen ceramics, with their distinguished and graceful character, alongside rich cultural and artistic forms, encapsulate the aesthetic sensibility of the Chinese ethos, blending traditional and contemporary aesthetic values. The traditional aesthetic appreciation emphasizes the reverence for and recognition of classical ceramic pieces, underlining their cultural depth and legacy. Conversely, contemporary aesthetics focus on the design and uniqueness of products, heralding innovation and personal expression.

Jingdezhen ceramics' design, ornamentation, and color draw inspiration from nature and everyday life, incorporating elements like flora, fauna, landscapes, and human figures, alongside their subtle hues and textures. The design and emotional appeal of these ceramics have always been pivotal, valuing both the beauty of form and the evocation of mood.

The beauty of form concentrates on visual appeal, spotlighting the tangible aspects of objects. Jingdezhen ceramics exhibit elegance through simple, fluid, and symmetrical lines, emphasizing balanced proportions and embodying the concept of harmonious beauty. Traditional methods like sketching and coloring bring to life

natural scenes with vivid clarity and dynamism, incorporating aesthetic principles such as contrast, unity, balance, repetition, variation, and rhythm.

Conversely, the beauty of mood prioritizes the spiritual resonance between the observer and the object, like the evocative power of poetic imagery. Jingdezhen ceramics strive for a harmonious blend of natural beauty and human spirit. Landscape depictions on ceramics offer exquisite compositions, translating scenic beauty into high ornamental and artistic value. Floral and faunal motifs are depicted with elegance, capturing their essence through intricate details and conveying deep emotional undertones, thus creating unique visual artistry. This aesthetic richness, imbued with deep philosophical insights, emphasizes the interplay between vivid imagery and the conceptual depth of painting, highlighting themes of tranquility, emptiness, transformation, and the paradoxical coexistence of simplicity and complexity.

1.2Grasp the product characteristics of Jingdezhen ceramics

Packaging's purpose is to convey product characteristics, enabling consumers to grasp product details and spark their interest. For this to be successful, packaging design must comprehensively understand and ingeniously represent product features to enhance the product image, clarify product details, and prevent misuse. Ceramic products, specifically, offer both visible (such as shape, pattern, and material) and invisible elements (like cultural essence). Jingdezhen ceramics, recognized for their cultural significance, anchor their competitiveness in quality and craftsmanship. The industry focuses on maintaining high-quality standards and the continuation of traditional techniques, while integrating modern technology to elevate both product value and appeal. Understanding the intangible aspects is crucial as it informs the utilization of visual elements in design, thus accentuating the packaging's cultural richness.

Product features and advantages are key differentiators and are vital for achieving product uniqueness. In packaging design, it's imperative to effectively showcase the product characteristics that consumers value. When leveraging Jingdezhen ceramics' attributes, highlighting the product and brand image becomes essential. Identifying consumers' purchasing motives and addressing their unique needs can transform

product traits into appealing aspects, fostering competitive distinction. Representing these characteristics through graphics or illustrations can further elevate the product's perceived value and allure.

1.3 Highlighting Jingdezhen's regional characteristics and brand value

Jingdezhen, acclaimed as the "Porcelain Capital of the World," boasts a strong urban identity. Craftsmen from diverse backgrounds converge here, their skills manifested in the myriad potteries, kilns dotting the villages, and homes filled with ceramic artistry, making Jingdezhen's porcelain celebrated both domestically and internationally. Known for its "travel across the nine provinces and beyond," its unique regional traits and rich cultural legacy are embedded in its creations. Utilizing these distinct regional cultural elements in design concepts significantly enhances the portrayal of the ceramic brand's identity and image.

With the advent of the fourth era of consumerism, marked by a shift from egoism to altruism, consumers' pursuits have evolved. Today's consumers seek beyond immediate gratification, gravitating towards products that offer lasting satisfaction and an enhanced experience over time. To counter the trend of ephemeral "happy consumerism," it's imperative for brands to define and assert their value, fostering a long-term, healthy relationship and a sense of belonging with their audience. Jingdezhen’s ceramic enterprises, focusing on artistry and design innovation, continuously introduce products of artistic merit that attract consumer and collector interest. Beyond assuring quality, these brands encapsulate numerous cultural advantages, articulating regional distinctiveness, personal tastes, and values in a refined and nuanced manner, thereby cultivating a belief system and framework.

Regional branding aims to elevate product value, widen market presence, and unlock the brand's commercial potential. These designs not only enrich the product and service offerings but also communicate regional virtues and traditional culture. Showcasing Jingdezhen’s unique cultural identity not only reinforces its esteemed image but also champions the preservation and promotion of local and national cultures and traits. The ultimate goal is to develop a comprehensive ceramic cultural ecosystem, establish a modern economic model, and drive Jingdezhen’s economic advancement.

1.4Compliance with Packaging Regulations and Design Self-Regulation

Packaging design represents a fusion of creativity, combining human intuition, materiality, and logic. In the realm of product packaging, the artful amalgamation of trademarks, graphics, imagery, and text, alongside structural design, forms the core of its expressive content. Hence, the visual marketing design for Jingdezhen ceramics must adhere to packaging standards and self-regulatory design principles to ensure the design is legal, compliant, and logical. Jingdezhen's porcelain production has woven many historical tales, celebrated for its "widespread reach across the nine provinces and beyond." Yet, the industry's competitiveness has waned due to some entities adopting aggressive pricing strategies for market dominance. In this light, visual marketing for Jingdezhen ceramic packaging must integrate considerations for sustainable development. It's imperative to avoid resource depletion merely for visual appeal, striving instead for packaging design that supports sustainable, rapid, harmonious, and healthy growth. This approach is crucial for realizing sustainable development objectives in visual marketing and establishing a solid foundation for future progress.

In the design of Jingdezhen ceramic packaging, attention should be directed towards the following five key aspects:

1. Resource Efficiency: The selection and design of packaging materials should prioritize sustainability and recyclability. This involves opting for biodegradable or recyclable materials to diminish environmental pollution and waste, thereby enhancing the efficiency of resource utilization.

2. Life Cycle Analysis: A comprehensive life cycle analysis of Jingdezhen ceramic packaging is essential. This analysis should cover the production, usage, recycling, and disposal stages of the packaging to enable a holistic optimization of the design, aiming to minimize resource wastage and environmental pollution.

3. Health and Safety: The design must safeguard the health and safety of consumers, avoiding the use of materials or chemicals that could pose risks. This principle ensures that visual appeal does not compromise safety standards.

4. Sustainable Development Goals: Packaging designs should align with sustainable development objectives, ensuring that environmental preservation and sustainable practices are integral to the design process.

5. Collaboration Among Stakeholders: Achieving sustainable development in packaging requires the collaborative efforts of all parties involved, including manufacturers, designers, consumers, and government entities. This cooperative approach is crucial for realizing the shared goal of sustainability.

By adhering to these guidelines, the design of Jingdezhen ceramic packaging can contribute to a more sustainable, efficient, and safe production and consumption cycle, reflecting a commitment to environmental stewardship and societal well-being.

2.Jingdezhen ceramic packaging design in the visual marketing of the form of expression

Kotler has comprehensively summarized the facets of visual marketing across various contexts, highlighting the influence of elements such as color, light, size, and shape within retail environments (Kotler P., 1973). Similarly, Arnheim, in "Art and Visual Perception," deconstructs the visual components of art into categories like shape, form, space, tension, motion, balance, light, color, and symbolic representation (Arnheim R., 1974). Drawing upon these analyses and considering the specific context of Jingdezhen ceramic packaging, we propose a visual dimension framework. This framework is designed to establish standardized criteria for expressing and evaluating the visual aspects of packaging, ensuring a cohesive and impactful visual marketing strategy tailored to Jingdezhen ceramics.

2.1 Jingdezhen ceramic packaging color and graphic expression

Color significantly impacts human psychology, as evidenced by research indicating that packaging color can influence consumer attitudes and decision-making behaviors (Bruhier C. M., 1976). Moreover, studies have found a positive relationship between the color of packaging and its perceived taste quality, as well as purchase intentions (Yuan Wei, 2010). Color not only challenges conventional perceptions but is also deeply intertwined with physiological and psychological responses, underscoring its substantial effect on consumer visual perception. Jingdezhen's traditional ceramics are celebrated for their "vivid colors and gold, intricate carvings and multi-color applications, and fine gold and blue hues," characterized by their clarity, elegance, and vibrant life essence. The warmth and elegance of its blue hues, as referenced in Emperor Qianlong's poetry, highlight the distinct color characteristics

of Jingdezhen ceramics, likened to "the redness of the sky after rain." The unique hues and color temperaments of Jingdezhen ceramics, forged by the flames, not only visually represent the product's features but also establish a distinct color style that fully captures the allure of Jingdezhen ceramic products.

The graphic visual art built upon this color design possesses visual appeal, offering a refined conceptualization and expression that communicates product characteristics. It emphasizes non-objective and non-figurative graphic expression, creating visual abstract beauty. This not only enriches the objective expression but also, more critically, enhances the commodity's attributes and characteristics from various perspectives, evoking an artistic sensibility aligned with the product's inner meaning and spirit. Jingdezhen ceramics' traditional patterns, such as the luxurious brocade and various auspicious motifs, are highly cherished and lauded. Skillfully incorporating these traditional motifs and their represented spiritual qualities is crucial to showcasing Chinese ceramic culture.

2.2 The performance of Jingdezhen ceramic packaging form and mood

Consumer perceptions significantly vary across different types of shapes, influencing not only their decision-making process but also their ability to make recommendations for others. It's crucial to focus on the three-dimensional uniqueness of product packaging, as the congruity of shape directly impacts the perceived consistency of the product's qualities. Therefore, creating an overall sensation is important, transcending mere two-dimensional composition studies. The more pronounced the product's artistic expression, and the greater the emphasis on simplicity and purity of form, the more critical it becomes to emphasize the total design impact, thereby enhancing packaging design possibilities. Hence, evaluating the comprehensive cognitive image of Jingdezhen ceramics is essential, drawing on Gestalt theory's principles of psychological completion.

For instance, the packaging design of Jingdezhen ceramic tea sets often incorporates elements related to tea culture, such as tea leaves, teapots, and tea cups, as well as landscape, flora, and fauna motifs to create a visually rich cultural atmosphere. Jingdezhen ceramics boast unique artistic achievements, with ceramic decorations heavily influenced by Chinese painting traditions, exhibiting a scholarly ambiance and a transcendental quality that merges reality with imagination. This

includes motifs like interwoven branches and panoramic landscapes. The expression content appeals aesthetically while being both refined and widely appreciable, offering a vibrant and elegant artistic impact.

Packaging processing for Jingdezhen ceramic art styles should evolve from mere replication to expressive representation, from exterior form to inner essence, and from transformation to the creation of abstracted, pure forms of beauty. In composing ceramic designs, it's important to consider cohesion and spatial perception. The structure and themes of Jingdezhen ceramics resonate with traditional Chinese aesthetic sensibilities, utilizing classical Chinese compositional techniques. These traditional ceramic motifs share an emotional and psychological structure with Chinese aesthetics, establishing an isomorphic relationship.

2.3 Jingdezhen ceramic packaging image and the composition of the performance

Ogilvy & Mather emphasizes that every brand should possess a distinct personality and characteristics, including unique cultural traits and a spirit that captivates consumer attention and loyalty (Yu Mingyang, Yang Fangping, 2005). A brand's image represents its core essence and values. Despite Jingdezhen's recognition as a major hub for ceramic production, with hundreds of enterprises, fewer than five report annual sales exceeding 100 million. This highlights a gap in the strategic positioning and planning of brand images within the Jingdezhen ceramic industry, where visual representation often lacks individuality, making it difficult to distinguish between similar brands or products.

In packaging Jingdezhen ceramics, it's crucial to harmonize the composition, with product specifications playing a pivotal role due to the unique nature of these ceramics. This necessitates special attention to the visualization of service attributes in packaging design, implying that packaging must offer practical functions relevant to the product. On one hand, product manuals should enhance the packaging's overall aesthetics and professionalism. Given Jingdezhen ceramics' distinctive materials, craftsmanship, and shapes, detailed manuals can better showcase these attributes, aligning more closely with the product's essence and capturing consumer interest.

On the other hand, product descriptions can disseminate extensive knowledge and cultural insights. For instance, the rich cultural heritage of Jingdezhen ceramics could be explored in manuals through the history, cultural significance, and manufacturing

techniques of these ceramics. This approach not only boosts consumer interest and brand loyalty but also fosters the preservation of traditional Chinese culture.

Furthermore, incorporating anti-counterfeiting measures in product manuals can elevate trust and security among consumers. By including product batch numbers and anti-counterfeiting codes, the circulation of inferior products can be curbed, safeguarding consumer rights. Through thoughtful design and organization, product manuals can thus enhance the aesthetic and professional appeal of packaging, educate consumers about ceramics and their cultural value, and reinforce anti-counterfeiting efforts, ultimately bolstering consumer trust and protection.

2.4 Jingdezhen ceramic packaging development performance and trends

As the packaging industry evolves, the concept of packaging transcends its traditional role, leveraging its potent aesthetic and informative capabilities beyond mere commodities. Packaging now plays a pivotal role in crafting and disseminating the images of celebrities, enterprises, cities, and even national identities. This expansion in the concept of "packaging" mirrors the changing dynamics of our times, society, and daily lives.

The artistic essence of Jingdezhen’s ceramic culture has been shaped by the cultural, customary, and societal consciousness of various eras, influenced by the aesthetic values and styles unique to each historical period. From the grandeur of the Qin and Han dynasties, through the opulence of the Tang dynasty, the meticulousness and timelessness of the Song dynasty, the boldness of the Yuan dynasty, the refinement of the Ming dynasty, to the intricate beauty of the Qing dynasty, ceramics from each period reflect their distinct historical backdrop and aesthetic appeal.

In this context, the core of "development" within Jingdezhen's packaging industry is fundamentally about shifting objectives, with a renewed focus on the comprehensive benefits to people, society, and nature. The aim is no longer solely on maximizing material functionality but on emphasizing the utmost value of culture and civilization. Such a shift in goals naturally triggers a transformation in packaging design concepts, leading to profound changes in the integration and innovation across the entire industrial chain of packaging production and consumption.

Based on the analysis of Jingdezhen ceramics' product attributes, the development and trends in visual marketing packaging are specifically manifested in the following

five aspects: 1, Highlighting Ceramic Materials: Jingdezhen ceramic packaging design places a strong emphasis on showcasing the characteristics of ceramic materials to display the texture, luster, and finish of ceramics; 2, Emphasizing Craftsmanship: Jingdezhen ceramic packaging products often utilize artistic and handcrafted techniques, such as gilding, painting, carving, etc., underscoring the importance of craftsmanship in ceramic development. This enhances the aesthetic appeal and cultural connotations of the products; 3, Heritage of History and Culture: Jingdezhen ceramic packaging designs frequently incorporate historical and cultural elements, such as styles from the Ming and Qing dynasties, traditional painting, and calligraphy, to reflect its rich traditional craftsmanship and cultural legacy; 4, Incorporating Modern Elements: While preserving historical and cultural heritage, Jingdezhen ceramic packaging also integrates modern elements, including minimalist styles, trendy designs, and technological innovations, catering to the aesthetic preferences and lifestyles of contemporary consumers; 5, Personalized Customization: Jingdezhen ceramic packaging often offers personalized customization services, tailoring designs to individual customer needs and preferences, thus enhancing the product's uniqueness and added value.

3.Aesthetic value of Jingdezhen ceramic packaging

3.1Establishment of Jingdezhen ceramic image color attributes and color matching system

Wang Zhang Wang, in his book "Introduction to color in Packaging Design," emphasizes the fundamental role of color language in packaging as leveraging the visual impact of image color and fully harnessing their emotional power to maintain a connection with the market. The use of image and symbolic color in packaging helps to delineate product characteristics while adhering to the principles of balance, unity, echo, prioritization, and rhythm in the color scheme. Moreover, employing techniques like color contrast and hue matching enhances the emotional communication through color, aiming to create maximum appeal while aligning with product positioning. In this context, Jingdezhen ceramic packaging design can be analyzed from two perspectives: the use of image and symbolic color attributes.

Jingdezhen ceramics' image and symbolic color are pivotal elements in packaging design. Image color conveys people's immediate perceptions and impressions of Jingdezhen ceramics, whereas symbolic color uses hues to express specific meanings or symbols associated with Jingdezhen ceramics. Often, these two attributes involve color psychological cognition or associations linked to certain objects. Starting from celadon, Jingdezhen artisans developed a multitude of monochromatic glazes, including the greens of mountain landscapes, the blues of seas, the lightness of streams, the freshness of spring, and the yellowness of autumn. Blue and white represent the traditional hallmark color of Jingdezhen ceramics, embodying a deep Chinese cultural essence and historical significance. Effective expression in this realm requires selecting suitable image color based on the characteristics of the packaging content. For instance, the packaging of Jingdezhen's "Tao xicuan Qian li Jiangshan" coffee cup and saucer sets exemplifies this, as depicted in Figure70 and 71. The blue hue of the product is visually enhanced to intensify impact and achieve a complementary visual effect.

Besides literal color interpretation, the application of symbolic colors holds significant importance. Red, symbolizing prosperity, happiness, and good fortune, is frequently utilized in ceramics designated for celebrations and matrimonial ceremonies. Yellow represents royalty and nobility, adding a layer of dignity and grandeur when used in ceramic designs. Purple, associated with mystery and elegance, is commonly employed in ceramic art pieces to convey a unique sense of beauty.

Moreover, Jingdezhen's ceramic packaging design often incorporates colors that embody regional characteristics and cultural nuances, establishing a deep connection with Jingdezhen’s cultural heritage. When designing packaging, it’s essential to align with the product’s background and attributes, leveraging narratives, events, and symbols to maximize color’s visual recognition. The choice of colors should consider product positioning, target demographics, and cultural implications, while also maintaining coherence with the overall packaging design and brand image to optimize visual appeal and marketing effectiveness.

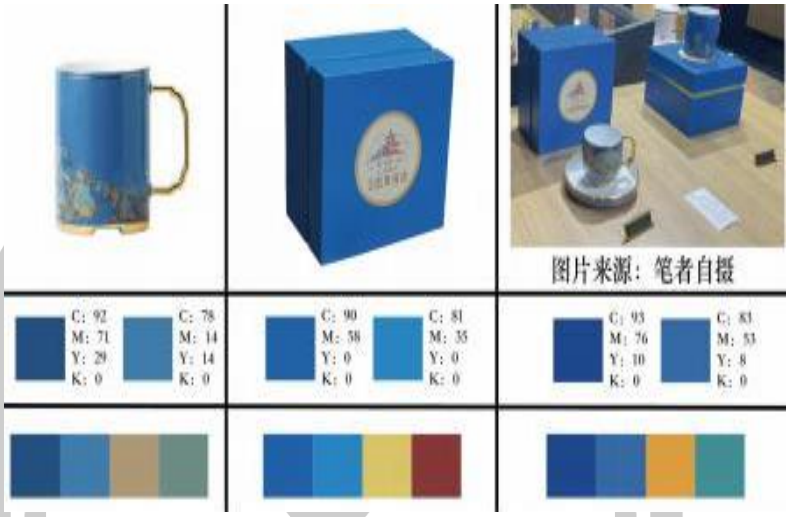


Figure 70 Jingdezhen Taoxicuan Qianli Jiangshan coffee cup and saucer set packaging display table
Source: Drawn by Ye Li, 2023

Figure 71Ceramic Packaging Matching Color Chart
Source: Drawn by Ye Li, 2023

3.2 color matching and color system style establishment

Color serves as a distinctive combination that can elicit specific emotions and feelings in individuals. The color scheme and stylistic approach to color are critical

elements in the packaging design of Jingdezhen ceramics. Given the unique nature of these ceramics, their color coordination must align with specific aesthetic demands and the cultural backdrop of Jingdezhen. Traditional colors associated with Jingdezhen ceramics, such as blue and white, pastel, and underglaze red, play a pivotal role in packaging design, accentuating the ceramics' rich cultural heritage.

Hiroshi Oh chi, a renowned Japanese designer, emphasized the critical role of color identification in competitive market settings. The primary color matching of Jingdezhen ceramics is crucial for showcasing the brand's distinctiveness. Artisans like Yu Tian and Wan Liang have devoted years to experimenting with various glaze colors, utilizing fluorescence spectroscopy for quantitative analysis and meticulously documenting each hue to compile a comprehensive color database for Jingdezhen. Despite the low success rate of these experiments—attributable to the numerous variables affecting ceramic glaze, firing, and clay composition—these exceptional colors can overcome technical constraints in ceramic packaging design.

Modern designs that amplify the luminosity and purity of colors in ceramics create an appealing, identifiable, and enjoyable aesthetic. This distinctive method focuses on the relationships between colors, enabling what might appear as isolated hues to integrate seamlessly into a harmonious visual experience within the artwork. Thus, this strategy devises a comprehensive color system and visual style for Jingdezhen ceramic products, adeptly mirroring the region's unique ceramic culture and aesthetic predilections.

Color styling evokes deeper meanings and extensions of connotations, becoming a crucial aspect of Chinese cultural identity. The color coordination in Jingdezhen ceramic packaging design must align with consumer aesthetic preferences and the cultural backdrop while considering the product's characteristics and positioning. Choosing the appropriate color combinations according to product features and target audiences is essential to resonate with the emotional essence of ceramics, ensuring a mutually enhancing effect.

Utilizing an inductive analysis approach, ceramic colors are classified into eight primary color families. This classification aids in creating a color matching chart for ceramic packaging, as depicted in Figure 72. The vibrancy and dynamics of colors on

ceramics demand thoughtful application and pairing in modern packaging, embodying the Chinese tradition of categorizing and utilizing colors with wisdom.

3.3 Sample Extraction of Ceramic Pattern Elements in Jingdezhen and Their Application

Modern designs that amplify the vibrancy and purity of colors in ceramics can create an aesthetic that is both appealing and recognizable, bringing delight to viewers. This approach, which emphasizes the relationship between colors, allows for a cohesive visual experience within the artwork by making seemingly isolated colors work together harmoniously. As a result, this method establishes a comprehensive color system and visual style for Jingdezhen ceramic products, effectively capturing the unique ceramic culture and aesthetic preferences of the region. The use of color style can evoke deeper meanings and extend the connotation of the imagery, making it a critical factor in the cultural DNA of the Chinese people. Color matching in Jingdezhen ceramic packaging design must satisfy consumer aesthetic preferences and the cultural backdrop, as well as consider the product's characteristics and positioning. When employing color styles, it's essential to select combinations that align with the product features and target audience, ensuring they complement the emotional connotation of the ceramics and enhance each other, leading to a synergistic effect. Utilizing an inductive analysis approach, the colors of ceramics are classified into eight major families, establishing a chromatogram for ceramic packaging. This vibrant spectrum of colors should be leveraged and harmonized in modern packaging, embodying the Chinese wisdom of categorizing and assigning colors.

The incorporation of graphic elements into packaging design requires a balanced and harmonious approach, avoiding excessive complexity or clutter that might detract from aesthetic appeal and recognizability. Featuring a complete image of the product on the packaging can fulfill consumers' ultimate expectations, enabling them to quickly grasp the product's appearance and key features. This type of illustration accelerates the psychological recognition process, serving as an effective "connector." Employing real photographs or realistic illustrations to artistically represent the product's image on the packaging allows consumers to instantly appreciate its appearance and distinct qualities.

Moreover, the use of graphic and pattern elements, typically manifested as dots, lines, and planes, transcends mere reproduction of objects. Instead, they involve the extraction, reorganization, and synthesis of objective elements, elevating the packaging design's form and infusing commercial packaging with a distinctive artistic essence. These elements can adorn the products directly or serve as supplementary visuals, enhancing their aesthetic and commercial value.

Utilizing figurative or abstract folk patterns on packaging accentuates cultural identity and regional traits. It's essential, however, for the modern reinterpretation of traditional motifs to align with the brand's ethos and visual identity, offering fresh perspectives while preserving their core essence. Innovations in design should respect and safeguard these traditional elements, ensuring any alterations do not undermine their fundamental characteristics and significance as shown in Figure 72.

Figure 72 Extraction table of graphic elements of ceramic packaging of Guanfu Museum

Source: Drawn by Ye Li, 2023

3.4Compositional aesthetics of Jingdezhen ceramics and fusion-type arrangement of elements

Hegel remarked in "Aesthetics" that beauty manifests through imagery. In packaging design, the arrangement and composition of elements seek the essence of this beauty. The distinct and culturally rich elements of Jingdezhen porcelain serve as a vital part of Chinese heritage, embodying deep historical significance and a unique artistic style, making them highly relevant to modern packaging designs. By weaving these traditional art elements with contemporary design techniques, we can craft packaging that not only enhances product appeal but also acts as a vessel for cultural transmission. This approach not only serves promotional purposes but also aids in preserving and passing down cultural values through artistic expression in packaging design as shown in Figure 73.

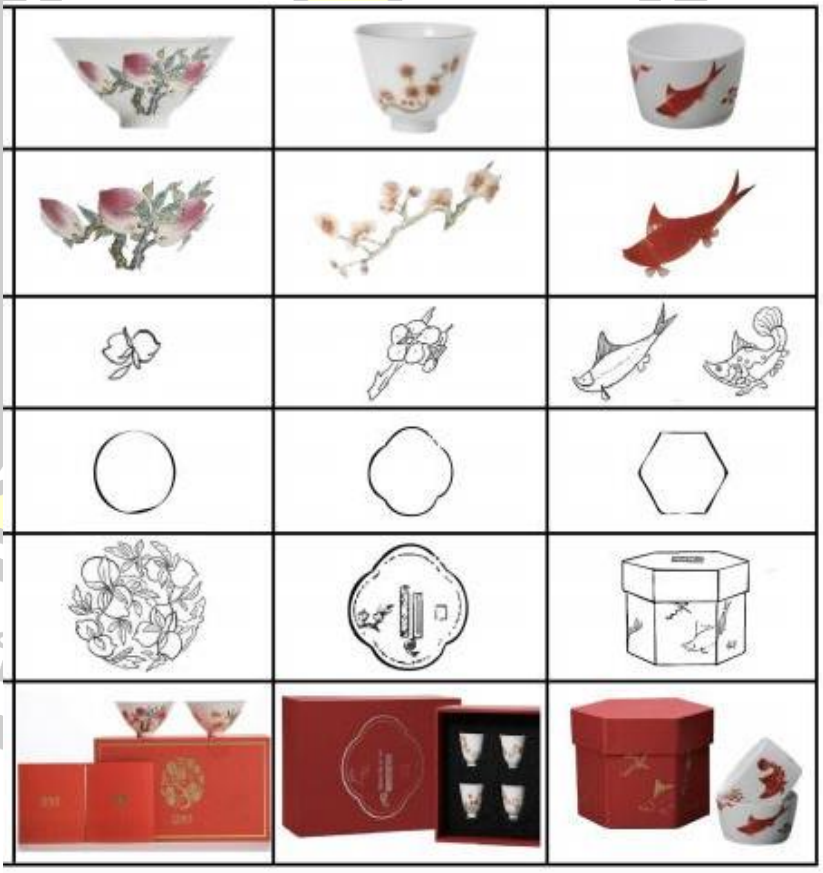


Figure 73 Compositional Aesthetics Analysis Table of Ceramic Packaging of Guanfu Museum

Source: Drawn by Ye Li, 2023

The aesthetic appeal of Jingdezhen ceramic packaging composition lies in how various elements like proportions, dimensions, positions, and shapes interplay within the overall layout, presenting a visual harmony. The essence of traditional decorative arts in contemporary packaging design is evident in the abstract and simplified representation of natural forms. Jingdezhen ceramics showcases a distinctive compositional structure and artistry, marked by its unique decorative style and cultural expression. These traditional motifs evolve in both two-dimensional and three-dimensional spaces, transitioning from singular expressions to a variety of forms. As artistic symbols, traditional Jingdezhen ceramic patterns increasingly merge with modern design principles, contributing their linguistic essence to global culture. Formal aesthetic principles such as skeletal forms, symmetry, balance, and wholeness are vital to traditional ceramic composition, reflecting a strive for orderly pattern layouts and impeccable form integrity. Such compositional practices in packaging not only preserve specific cultural icons but also ensure compatibility with the ceramic products' characteristics and styles. For instance, the packaging design for the Guanfu Museum's ceramics considers the unique shape and texture of the ceramics, aiming for a cohesive and aesthetically pleasing packaging design that complements the intrinsic beauty of the ceramics themselves as shown in Figure 74.

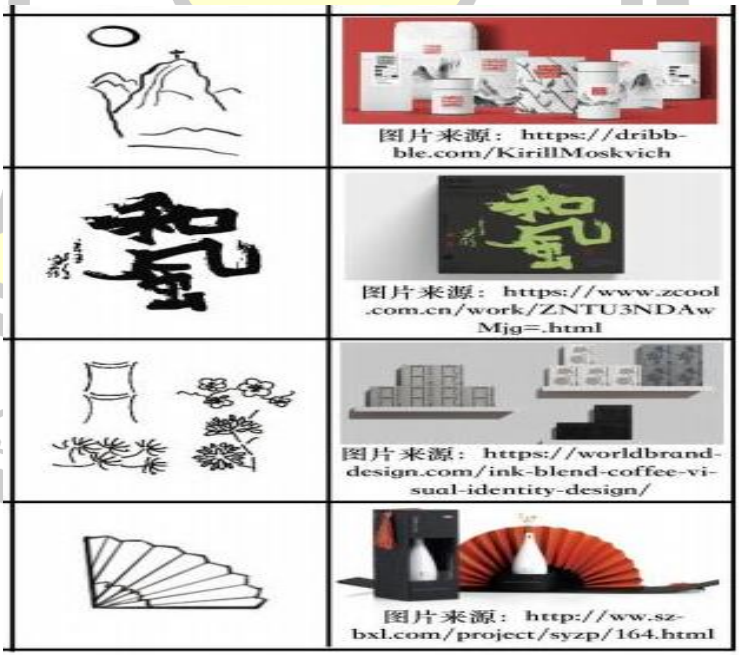


Figure 74Ceramic Packaging Fusion Contextual Elements Analysis Table
Source: Drawn by Ye Li, 2023

The fusion of Jingdezhen's ceramic aesthetics into packaging design emphasizes embedding the region's traditional visual motifs and ornamental culture to craft packaging that resonates with regional identity and cultural depth. The design objective lies in forging distinct visual narratives and refined aesthetic appeal through meticulous arrangement and symbiosis of design elements. Incorporating ceramic motifs not only narrates the cultural essence and historical depth but also seeks to forge a connection and identification with consumers. Achieving such design involves harmonizing spatial dynamics within the packaging, employing strategic use of space to craft depth and focus. Moreover, delineating the hierarchy between titular and descriptive text via diverse typographies enhances visual distinction and readability.

To encapsulate the essence of ceramic artistry more vividly, a blended approach of text and imagery is pivotal, as depicted in Figure 74. This methodology aligns the visual impact closer to the tangibility of the objects, imbuing the packaging with a nuanced, artisanal quality. Such an approach mirrors the modern design ethos of "formal purification" while resonating with traditional decorative arts' inclination towards symmetry, completeness, and impeccable arrangement. Traditional ceramic art, with its focus on formality and structured composition, reflects a cultural and psychological inclination towards idealistic harmony and beauty, deeply rooted in Chinese aesthetic tradition.

Emphasizing the application of decorative ceramic elements—like avian and floral motifs, landscapes, and ornamental patterns—enriches the packaging's visual allure. This not only cultivates an artistic ambiance but also accentuates the product's cultural significance, thereby elevating the overall artistic merit of the packaging design.

3.5 Functional value of Jingdezhen ceramic packaging

Packaging design serves multifaceted functions that span across both intrinsic and extrinsic attributes. Inherently, it facilitates transportation and protection; socially, it extends into various realms: consumer interaction, corporate promotion, societal engagement, and environmental consideration. The dialogue between packaging and consumers focuses on clarity and understanding of the product, while its relationship with businesses emphasizes on sales enhancement. Societal interactions stress the

promotion of public welfare and moral values, and its bond with the environment advocates for sustainable and eco-friendly design principles.

The exploration of visual marketing's value delves into the social and extrinsic aspects, aiming to optimize Jingdezhen ceramic packaging's visual appeal. This exploration is anchored in three pivotal areas: enhancing consumer engagement through clear and appealing product representation, leveraging packaging as a tool for sales promotion and brand differentiation, and underscoring the commitment to social responsibility and environmental sustainability. These focus areas align with the goal of elevating the visual impact of Jingdezhen ceramic packaging, while simultaneously honoring the broader functions of packaging in a modern, socially conscious marketplace.

4 Cultural visualization of Jingdezhen ceramic packaging folk aesthetics

The comprehensive cultural system of Jingdezhen ceramics endows it with profound cultural significance. Packaging design, as a form of cultural creation, encompasses both the expression of physical forms and the conveyance of cultural messages. The visual design of Jingdezhen ceramic packaging should delve into and manifest the rich cultural essence of Jingdezhen ceramics, employing visual strategies to evoke unique experiences and emotional connections.

Societal culture, shaped by history, influences contemporary thought just as natural laws guide rational processes (Petr Lavrov, 2022). Packaging design serves as a conduit for interaction among individuals, objects, and society at large, embedding substantial cultural and artistic value while addressing the diverse emotional and cultural aspirations of humanity. This intangible worth is vital for the ongoing, healthy progression of society (Jing Zu, Pan Lu Sheng, 2002).

Therefore, uncovering the non-visible elements in Jingdezhen ceramic packaging involves two primary aspects:

The cultural integrity of Jingdezhen's ceramic tradition bestows it with a distinct cultural allure. Packaging design, as a facet of cultural creativity, transcends mere material expression to also serve as a conduit for cultural narratives. Jingdezhen ceramic packaging's visual design should delve deep into the cultural essence of its

ceramics, bringing to life these cultural facets through visual articulation. This approach is aimed at crafting a singular visual narrative and emotional engagement.

Influenced by historical developments, social culture shapes our modern intellectual endeavors, setting boundaries similar to how natural laws govern physical activities. Packaging design, bridging objects, individuals, and societal interactions, encapsulates a wealth of cultural and artistic significance. It addresses the varied emotional and cultural desires of humanity. This ethereal value is crucial for the sustained, wholesome progression of society.

For Jingdezhen ceramic packaging, the visual representation of craftsmanship is highlighted through the depiction of the production journey, showcasing the distinctive textures and finesse unique to Jingdezhen ceramics. Traditional craftsmanship methods like intricate hand-painting, vibrant decorations, and gold leaf application are emblematic of the meticulous artisanal effort required for achieving visual excellence. As noted by Malinowski, art plays a pivotal role in advancing technology, craft, and economic growth, emphasizing the perpetual need for material innovation and cultural refinement at the heart of societal development.

Viewing from a cultural perspective, the strategic incorporation of cultural themes within packaging is not merely a laborious endeavor but a key value-addition aspect. Jingdezhen's ceramic practices, with their vibrant cultural symbols and comprehensive craftsmanship, from raw material treatment to packaging, narrate stories of unparalleled skill at every production stage. By employing traditional artistic techniques like cloisonné, colorful glazing, and intricate carvings, designers can authentically convey the essence of Jingdezhen's ceramic artistry, its unique textures, and its intrinsic cultural worth.

4.1 Jingdezhen ceramic folk visualization improves publicity

Enhancing visibility and boosting sales through the visualization of Jingdezhen ceramic folklore Incorporating folk aesthetics into Jingdezhen ceramic packaging design showcases traditional culture through a melding of ceramic cultural elements with modern packaging aesthetics, enriching the products with deep cultural significance and regional identity. Jingdezhen's ceramic folklore, characterized by its richness and broad scope, epitomizes the core of Jingdezhen's ceramic heritage with distinct cultural markers. For instance, ceramics featuring auspicious themes

symbolize well-being and happiness, encompassing elements of "luck, wealth, longevity, joy, harmony, auspiciousness, and felicity." These motifs serve as potent narratives for marketing, enhancing product recognizability and appeal while fostering consumer trust and emotional connection through the conveyance of cultural and historical essence.

Such thematic elements not only elevate product recognition but also solidify consumer trust and emotional engagement by narrating cultural and historical tales. This approach underscores the product's value and quality, potentially increasing sales. Consider the application of specific animal motifs as an example, which symbolize good fortune. This symbolism resonates with consumers, whether gifting or personal use, engendering a sense of delight as shown in Figure 75.

The visualization of Jingdezhen's ceramic folklore is a powerful promotional tool. Its implementation should align with the brand's image and stylistic ethos, ensuring a cohesive visual impact across packaging, advertising, and displays. This strategy aims to broaden the reach of ceramic culture, bolster brand visibility, and amplify sales rates.

Figure 75 Folklore Visual Analysis Table of Animal Subjects in Ceramic Packaging of Guanfu Museum

Source: Drawn by Ye Li, 2023

4.2 Emotional visualization of Jingdezhen ceramic craftsmanship

The Jingdezhen ceramic artisan spirit encompasses a profound commitment to excellence and the relentless pursuit of perfection, not merely in the production process but also in the product's quality and cultural depth. The visualization of this artisan spirit through visual elements and techniques enables the audience to grasp the rich cultural and emotional essence behind each piece. This spirit operates on two levels: the tangible spirit of the ceramic industry and the intangible or metaphysical spirit.

4.2.1Tangible Spirit of Daily Life

This concept refers to imbuing daily existence with a noble essence, allowing individuals to express refined sentiments in everyday life. In Jingdezhen, this philosophy is vividly expressed in both the porcelain-making process and the master-apprentice relationship. Artisans and apprentices in Jingdezhen not only strive for technical mastery and excellence but also infuse each creation with their "spirit." This approach permeates the behavior and lifestyles of those within the ceramic community, reflecting values such as integrity, reliability, compassion, and love. These virtues are not confined to professional guilds or collectives but extend into social customs, living standards, festival observances, and the lyrical heritage of the porcelain workers, integrating a noble spirit into the fabric of daily life.

4.2.2Intangible Spirituality of Faith

On a metaphysical level, the spirit of Jingdezhen's ceramic industry transcends abstract concepts, manifesting through both the porcelain creation process and the conduct and lives of its artisans. It's not just a relentless pursuit of craftsmanship and excellence but also a commitment to and expression of high-minded values. Honesty, trustworthiness, empathy, and love are virtues consistently demonstrated in the lives of those dedicated to the ceramic arts. This "metaphysical" spirit extends beyond professional diligence, embodying a deeper pursuit and expression of noble values and beliefs.

The Jingdezhen ceramics craftsman spirit embodies a dedication to excellence and a quest for perfection in both the production process and the resulting quality and

cultural depth of the products. Visualization of this craftsmanship spirit through visual elements and methods allows audiences to appreciate the rich cultural connotations and emotional value behind each piece. Jingdezhen's ceramics spirit operates on two levels: the tangible practices within the industry and the intangible, metaphysical spirit that underpins it.

4.2.3 Spirituality in Daily Life

This aspect signifies embedding noble spirits into mundane activities, allowing individuals to express high ideals in everyday life. Jingdezhen's porcelain production epitomizes this spirit, with craftsmen adhering to technological excellence and striving for superiority in every creation. This ethos extends beyond production into the behaviors and lives of those within the porcelain community, where virtues like integrity, credibility, and compassion permeate the industry's social fabric and daily customs. The "spirituality of daily life" in Jingdezhen is not just an abstract concept; it manifests through the diligent work of porcelain craftsmen and the cultural practices of those in the industry.

4.2.4Spirituality of Belief

Sentiment, as a refined expression of thoughts and emotions, plays a crucial role in Jingdezhen's enduring legacy. The city's spiritual and cultural identity is deeply intertwined with its millennium-old ceramic tradition, which has weathered historical vicissitudes while nurturing the Jingdezhen ceramic spirit across generations. This metaphysical spirit evolves from nature, dedication, and the admiration of heroes, encapsulated in myths and legends that articulate the interplay of natural mysteries and human emotion. These narratives not only mirror the inner world of Jingdezhen's ceramic artisans but also their labor and life, embodying their vocational and existential convictions. Incorporating iconic figures like the Ming Dynasty's porcelain technician Tong Bing and the master Zhao Liao as IP symbols serves to narrate this rich cultural tapestry.

4.3 Graphical information recognition of Jingdezhen ceramic products

In today's era of information overload, users increasingly struggle to sift through information, making the acquisition of quality information more challenging. The core and aim of visual communication through packaging imagery lie in information

recognition cognition. This involves the receiver's ability to filter and discern the authenticity and utility of information, guided by their existing knowledge, experience, and specific objectives. Given that the goals of products and services are deeply intertwined with information, gauging information's utility is essential for unlocking its value. Packaging imagery facilitates this through cultural recognition functions, primarily reflecting the branding and quality encapsulated by the packaging. This imagery enables consumers to discern the quality attributes and economic value of products. Moreover, it conveys a wide array of information, including moral and ethical standards, aesthetic preferences, psychological desires, and fashion trends that are of interest to product makers as shown in Figure 76.

Figure 76 The type of packaging information of Jingdezhen ceramic products display table

Source: Drawn by Ye Li, 2023

In today's era of information overload, it becomes increasingly challenging for consumers to sift through and access quality information. This complexity underscores the vital role of information recognition cognition in the visual communication of packaging imagery. It involves the recipient's capability to filter and discern the authenticity and utility of information, leveraging their existing knowledge, experience, and specific intent. Given that the objectives of products and services are intricately linked to information, evaluating information's utility is fundamental to unlocking its value.

Packaging imagery employs cultural recognition to appraise information, primarily emphasizing the branding and quality conveyed through packaging. This imagery allows consumers to ascertain the quality attributes and economic value of products. Concurrently, it unveils a spectrum of information, including moral and ethical values, aesthetic preferences, psychological needs, and current trends that are of interest to the product manufacturers.

Focusing on Jingdezhen ceramics, a product with distinctive informational attributes, enhancing the ease with which consumers can obtain quality information becomes crucial. Information identification relies on understanding service goals in-depth and demands a pragmatic, scientifically inclined mindset with proficient knowledge and analytical skills. These elements are pivotal in establishing the standards for quality information.

To align with consumer information desires, gleaned from survey data, Jingdezhen ceramic product packaging must undergo a meticulous screening process. Quality information should be immediate, efficient, definite, and useful, tailored to the unique characteristics of the product. Following this screening, establishing a hierarchy within the demand chain, based on varying consumer group needs, is essential. This prioritization process considers different consumer demographics, purchase behaviors, product positioning, and characteristics to determine which information should be prominently featured or secondary in the packaging design.

Jingdezhen ceramic product packaging thus encompasses several key information categories, including variety (educating consumers on product types and features), process (highlighting product quality and manufacturing intricacies), themes (conveying traditional Chinese values), patterns (showcasing Jingdezhen ceramic

craftsmanship and Chinese aesthetic philosophies), and regional branding (enhancing brand image and recognition). By meticulously screening and disseminating such information, manufacturers can better satisfy consumer information needs, bolstering trust and satisfaction with the product.

Graphical representation of identification information significantly enhances the efficiency of information dissemination. For Jingdezhen ceramics, crucial identification details such as product name, brand, origin, material, and style hold substantial value for consumers. From a business perspective, graphically processing identification information can make the dissemination more explicit, engaging, and captivating, thereby boosting product awareness and purchase intent. Moreover, such graphical enhancements infuse creativity and visual appeal into the packaging design, elevating the product's brand value and market competitiveness.

For consumers, the graphical display of information not only elucidates product details but also aids in informed purchasing and usage decisions. This is achieved through the harmonization of content and form elements. Content elements encompass texts and data, with texts requiring clear structuring for ease of understanding. Data, representing objective observations, measurements, and recordings, when accurately presented, not only bolsters persuasiveness but also ensures efficient information transmission. Given Jingdezhen ceramics' premium nature, enhancing focus on product certification and detailed descriptions, alongside a robust after-sales service framework, is advisable.

Form elements include figurative graphics, abstract graphics, and color, forming the visual backbone of graphic design. By amalgamating images with textual information, visual design can substantially enrich content. For instance, taking commonly used ceramic bird motifs like cranes, chickens, and mandarin ducks, and abstracting them into specific visual icons with symbolic significance to the product, as illustrated in Figure 77. This method effectively transmits product information to consumers, leaving a lasting visual impression and facilitating memorable identification.

Figure 77 Birdprint Information Visual Design Path Display Table
Source: Drawn by Ye Li, 2023

5.Communication value of Jingdezhen ceramic packaging

As a manifestation of cultural imagery, packaging design must convey distinct individuality and cultural worth, characterized by materialization, modernization, and localization. It should revolve around the product's background and brand essence, leveraging storytelling, event organization, and symbolic representation to harness visual recognition effectively. Amidst swiftly evolving times, a crucial objective of packaging design is to ignite visual identification and psychological connection among consumers, ensuring that it stands out with its unique personality and cultural value.

5.1Jingdezhen ceramic regional brand image deepening and visual style embodiment

Jingdezhen ceramics embody rich national and aesthetic attributes, making packaging a crucial medium that encapsulates tradition, history, and individuality. This necessitates meticulous consideration in packaging design. The ceramics' origin often symbolizes quality and uniqueness, implying that thoughtful packaging design

can underscore the brand's distinctive personality and cultural value. A pivotal role of packaging design lies in leveraging visual elements to enhance the ceramic brand's interactivity. This encompasses identification, protection, communication, commitment, continuity, positioning, and fostering excellence within the ceramic industry. Achieving this not only boosts the brand's market share and reputation but also elevates brand image perception and recognition, thereby unlocking additional business opportunities and development prospects for ceramic enterprises. Establishing a brand's visual style and differentiating it from competitors are essential strategies in this process. To facilitate better comparison and analysis, we propose constructing a comparative table of domestic and international ceramic brands based on their reputation, thereby analyzing competitors of exceptional brands from various countries. see Fig.78 and Fig.79.

Figure 78 Foreign excellent ceramic brand packaging style display table
Source: Drawn by Ye Li, 2023

Figure 79 domestic excellent ceramic brand packaging style display table
Source: Drawn by Ye Li, 2023

Differentiation involves distinguishing a brand from its competitors, simplifying consumer recognition of the brand and its product attributes. Brand identity significantly impacts packaging design by addressing over-packaging issues and

transforming simple packaging into a comprehensive brand representation. In contemporary society, there's a growing appreciation for traditional cultures with deep-rooted intrinsic values, enriched with new connotations and meanings (Li, Yan-Zu.2000). The value proposition of Jingdezhen's ceramic regional brand should consider the brand's core values, product features, and consumer needs comprehensively. Reflecting the brand's uniqueness and value through the inheritance and innovation of Jingdezhen's traditional ceramic crafts is crucial. In articulating its value proposition, it is beneficial to highlight aspects such as traditional culture, exquisite craftsmanship, design innovation, and superior quality, emphasizing the brand's cultural depth and product advantages. This approach not only establishes brand uniqueness but also creates differentiation from competitors. Jingdezhen's regional cultural traits not only underscore its unique core values and spiritual essence but also lend traditional artistic elegance to the ceramic brand, thereby fostering brand differentiation. Thoughtfully designed packaging and brand imagery effectively convey regional cultural information, presenting a holistic view of local lifestyles, culture, and national heritage. Additionally, paying close attention to the interactive force and visual details of services helps deepen and enhance the regional brand image.

The relationship between companies and their consumers is a dynamic interplay involving sensory experiences, information exchanges, and emotional connections. Consumers' responses play a crucial role in shaping brand evolution and identity, reflecting the importance of a brand's genuine concern for its patrons (Bai Dandan, 2021). Effective visual design of service information demonstrates this concern, thus molding and deepening the brand image through thoughtful visual representation. The refinement of interactive service visuals hinges on three primary aspects: precise targeting, comprehensive regional representation, and enhanced storytelling capabilities.

For instance, the British ceramics brand Wedgwood's official website showcases an array of gift suggestions organized by criteria such as gender, occasion, recipient's relationship, and price range, along with specialized collections for events like Christmas. This meticulous, personalized service experience mirrors an advanced consultative approach, fostering communication with consumers. Similarly, the

ceramics industry necessitates nuanced visual design for customer interactions, given the nuanced properties and cultural significance of ceramics that many consumers might not fully understand.

Wedgwood's website's visual style accurately reflects the brand's ethos, offering a broad engagement scope. For instance, Fruit porcelain red Leaf's website utilizes a red color scheme, emblematic of the brand, alongside well-crafted subsections with designed pop-up options like "Table Art," "Coffee Story," and "Tea Taste," perfectly aligning with its "Chinese Porcelain" central theme and spotlighting Chinese cultural heritage. Additionally, platforms for interactive information, such as "Pottery Friends Interaction," are established to enable enthusiasts to share insights and connect, enhancing the brand's community engagement and consumer interaction.

5.1Expansion of Jingdezhen Ceramic Visual Culture Based on New Media Marketing Fractionality

Leveraging new media marketing to expand Jingdezhen ceramic visual culture involves utilizing new media technologies and the internet's capabilities for distinct dissemination, thereby broadening brand influence and achieving marketing goals.

The operation of brand communities and niche expansion in ceramic culture communication entails adopting social marketing, a digital marketing strategy that fosters brand-consumer interactions. As digital and network technologies evolve, virtual communities have emerged as new social constructs, supplanting traditional geographical communities. The transformations in time and space facilitated by the internet have revolutionized social interactions and communication, leading to the emergence of novel thought patterns and norms.

To innovate in ceramic cultural heritage, packaging design must employ diverse communication media to enhance the connection between design and dissemination. In today's market, characterized by a surplus of products but a scarcity of innovation (Xu Lu, 2018), Jingdezhen ceramic brands can establish their own communities on social media platforms. By sharing stories behind their designs, production processes, and the application of their ceramic products, brands can build a reputable word-of-mouth presence.

Furthermore, Jingdezhen ceramic brands can leverage social media niches to tailor brand messages for specific audiences. For instance, accounts targeting younger

demographics might focus on the brand's modernity and creativity, whereas those aimed at older consumers could emphasize traditional cultural values and quality assurance. This strategy helps attract diverse consumer segments.

Jingdezhen ceramic brands can also engage in community operations on social media platforms, collaborating with other brands or institutions for cross-promotion or co-branded products. Such partnerships can extend brand visibility and enhance its reputation, offering consumers a broader range of options.

By leveraging big data to analyze search engine usage and keyword trends, new media platforms can tailor content suggestions for users, facilitating deeper insights and a holistic understanding of diverse information facets. In today's market, consumers increasingly value choice and personalization. Offering a broader range of options can thus enhance sales opportunities for Jingdezhen ceramics, provided that product quality and brand consistency are maintained.

The integration of physical storefronts with online experiences, utilized by numerous domestic and international porcelain brands, offers consumers valuable reference points while ensuring cohesion between tangible and virtual packaging presentations. This dual approach broadens exposure to ceramic products and brands, enriching consumer understanding.

Moreover, by fostering co-creation, encouraging user interaction, and enhancing participation, brands can cultivate a more involved and creative consumer base. Consumer-driven content promotion plays a crucial role in establishing positive brand recognition and reputation.

Businesses can further engage consumers by launching online DIY platforms, enabling users to either upload their custom designs or select from pre-existing templates for personalized packaging. This not only increases consumer engagement and loyalty but also opens additional revenue streams for companies.

5.2Visual Creation of Jingdezhen Ceramic Packaging in the Context of New Generation Life

Incorporating traditional Chinese ceramic elements into packaging design represents a novel approach that blends aesthetic sensibilities from different eras. This method, through the innovative application of modern graphic design, revitalizes

traditional motifs and symbols with contemporary flair, effectively showcasing the distinct national cultural heritage and consequently, enhancing market visibility.

The integration of Jingdezhen ceramic packaging with experiential elements significantly enriches consumer recollection. Robert Brunner, in his book, introduced the concept of the "user experience supply chain," emphasizing that every interaction between the consumer and the product forms part of an extensive user experience continuum. This perspective underscores the necessity for brand designs to meticulously consider each touchpoint as an integral component of the overall brand experience. Unique packaging designs, especially, are more likely to make a lasting impression on consumers.

In today's context, a consumer's interaction with a product extends beyond the item itself to encompass the surrounding social and cultural milieu. Various factors, including consumers' psychological states, value systems, behavioral norms, and preferences, both influence and constrain their purchasing behaviors. Consumers also strive to cultivate specific emotional ambiances and environmental effects that resonate with their individual experiences.

As the new generation gradually emerges as the dominant consumer demographic, their distinct aesthetic preferences and lifestyle requirements become pivotal in product selection. The aesthetic leanings of these consumers often gravitate towards simplicity, novelty, naturalness, fashion, quality, and inventiveness, placing greater emphasis on product quality and experiential value. Overly intricate or burdensome designs tend to be met with disfavor. Hence, Jingdezhen ceramic packaging designs should underscore simplicity, excellence, and creativity to foster a sense of visual novelty, stylishness, and sophistication.

The evolving lifestyles and consumption attitudes of the new generation increasingly prioritize quality of life and environmental sustainability. Accordingly, Jingdezhen ceramic packaging designs should reflect a commitment to enhancing the quality of life and advocating for environmental stewardship, endeavoring to merge product experiences with eco-conscious and health-oriented values.

Furthermore, the modalities and channels through which the new generation of consumers engage with and perceive packaging are crucial. With the rise of mobile internet, this demographic increasingly relies on social media for product information

and decision-making, signaling a shift towards more intelligent, dynamic, and functionally integrated packaging solutions.

Incorporating intelligent, dynamic, and functionally integrated forms into Jingdezhen ceramic packaging design is crucial for enhancing the user experience, augmenting the aesthetic appeal, and boosting the practical value of the packaging. This approach not only promotes ceramic product sales but also aids in brand enhancement.

Intelligence enhances the user experience by leveraging technology for intuitive interaction with packaging. For instance, smart design elements can enable packaging to automatically respond to user actions, allowing for easy access with a simple touch. Furthermore, integrating interactive features can make packaging more engaging and fun, such as incorporating auditory feedback that complements visual aspects. The sound produced by tapping on high-quality glaze, for example, can indicate its finesse and enrich the sensory appreciation of the product.

Dynamics add life and interest to packaging design. By employing dynamic effects, designers can increase the visual appeal of packaging, which, in turn, can foster greater trust and affinity towards the product. Engaging and moderate dynamic designs tend to captivate consumers more effectively.

Interaction design merges product functionality with simplified usage steps, making the user experience more seamless and integrated. Jingdezhen ceramics, celebrated for their vibrant glazes, diverse shapes, elegant motifs, intricate decorations, and deep-rooted Chinese cultural significance, transcend into exquisite art pieces that invoke a profound aesthetic experience. Jean Latreille remarked on the potent influence of visual, especially moving visual, cultures in shaping emotions and impacting expression and value systems.

Technological advancements have expanded the potential for enhancing visual effects dynamically. For example, incorporating quick-response (QR) codes on packaging facilitates smart shopping experiences and strengthens brand messaging. Additionally, the advent of virtual technology presents significant opportunities for evolving ceramic visuals. The RFID system’s anti-counterfeiting feature addresses market pricing issues by embedding a unique product identification number (ID) in the label, ensuring authenticity and safeguarding brand integrity.

6.Integration of local culture and green design into ceramic packaging

Incorporating local culture and green design into ceramic packaging is an interesting and challenging task that can add unique charm to a product while conveying environmental and sustainable values. Firstly, learn about the local culture of your location, including traditional customs, art, symbols, and folktales. Choose a cultural theme that is relevant to the ceramic product in order to incorporate it into the packaging design. Use symbols and motifs from the local culture in the packaging design. These can be traditional patterns, local flora and fauna, historical figures or specific geographical features. These motifs can be used for borders, backgrounds or decorative elements of the packaging. Consider using color that are symbolic of the indigenous culture. Each color may have a unique cultural meaning, ensure that the color choice fits with the cultural theme. Create a packaging story to incorporate elements of the native culture. This story could be a legend about the legend behind the product or a story related to the native culture to evoke consumer interest.

Embrace the use of sustainable materials like biodegradable plastics, recycled paper, or bamboo in your packaging designs to underscore your commitment to environmental stewardship. Aligning with green design principles not only enhances sustainability but also conveys a strong eco-friendly message.

Streamline your packaging structure to minimize material usage. A refined design approach reduces waste without compromising aesthetic appeal, offering a sleek yet responsible packaging solution.

Encourage the reuse of packaging by designing versatile ceramic jars or boxes that consumers can repurpose. This strategy diminishes the reliance on single-use packaging and promotes a circular economy.

Forge partnerships with local artisans for packaging production. This not only bolsters the local economy but also infuses your packaging with distinct craftsmanship, adding a unique touch.

Adopt eco-friendly printing methods and inks to lessen the environmental impact of harmful chemicals. This practice not only safeguards the environment but also boosts the eco-credentials of your packaging.

Innovate with multi-functional packaging designs that serve additional purposes, such as display stands, vases, or tableware, thereby enriching the consumer experience and adding value to your product.

Educate consumers about the local culture and environmental considerations through your packaging. Providing such information enhances product appreciation and raises awareness about sustainability efforts.

Leverage local cultural events by introducing specially designed packaging. Customizing packaging for festivals or significant events can captivate consumers' interest and broaden your market appeal.

As shown in the picture 80 this is a ceramic packaging designed by the author himself, through the study of the local cultural elements of the ceramic jar product itself, the pattern of the landscape painting and the embossed pattern on the bottle were extracted and applied to the box. A piece of decorative pattern is embellished by integrating the traditional elements of ceramic landscape. The shape of the mountain is also depicted around the bottle through the carving process to echo the theme. To achieve the integration of the product and packaging to convey the product's own culture. Starting from the green design concept.

The color of the box retains the original color of the bamboo, with only the white of the ceramic jar inlaid as the base color, and the landscape pattern drawn on top as the highlight of our design. The lining material and the external carrying bag are made of biodegradable materials that can be decomposed under home composting conditions. A ceramic packaging that blends local culture with green design can give a unique local flavor to the product, while conveying environmental values and appealing to consumers who care about cultural heritage and sustainability. In addition, this packaging design also helps to build connections with local communities and support local crafts and artists.

Figure 80 Design example
Source: Photography by Ye Li, 2023

6.1Value extension of packaging of Jingdezhen ceramics

The heritage of Jingdezhen's traditional ceramic culture necessitates not only a medium but also a platform for perpetuating traditional values. As the outer shell of ceramic products, packaging serves as an excellent medium for this heritage, positioning ceramic enterprises as platforms for the dissemination and display of traditional culture. These enterprises bear a significant responsibility for cultural continuity. Fundamentally, the development of Jingdezhen's ceramic enterprises hinges on the economic benefits generated by their products. Ceramic packaging plays a crucial role in boosting sales and, consequently, economic gains. Therefore, in designing Jingdezhen ceramics packaging, a focus on innovating within the current market is essential to alter the present state of affairs. Addressing and innovating upon the existing challenges in Jingdezhen's ceramic packaging is vital to enhance its competitiveness and appeal in the sales process. This, in turn, will enable Jingdezhen ceramic enterprises to capture a larger market share in a competitive environment. A higher market share not only broadens the audience but also creates favorable conditions for the preservation and propagation of traditional ceramic culture.

Jingdezhen ceramics packaging design is able to reshape the ceramic enterprise's own brand image of a method, the same can also create brand value to the ceramic enterprise. In Jingdezhen ceramics packaging, ceramic products on the market at present in addition to the text marking enterprise, almost can't see the ceramic enterprise and any brand trace, most of the ceramic packaging just to meet the basic function. Consumers face this kind of ceramic product packaging only when there is a need to consider buying, but the consumers themselves are very selective, not because Consumer recognition a brand to buy, so the ceramic goods will be very fast to be forgotten by consumers, it is not possible to form a brand loyalty to the enterprise. So designers in the process of designing ceramic packaging inside, must be ceramic enterprise brand culture elements used in ceramic product packaging design, so that consumers in the choice of ceramic products at the same time, contact with the ceramic packaging at the same time will be good sense of the packaging and corporate brand, turn to improve the brand loyalty of the ceramic enterprise, so that consumers will later subjectively choose to have good sense of the degree of goodwill and

Loyalty to the brand to buy, such ceramic packaging in the market can also help Jingdezhen ceramic enterprises to shape their own corporate brand image, not only to occupy more ceramic market, but also at the same time to enhance their own ceramic brand enterprise economic value. Jingdezhen ceramic enterprises to establish a brand is the need for a long-term process, the same is also a continuous feedback and consolidation of the process, ceramic packaging along with the continuous development of ceramic products and updates and changes in their own, but also must be followed by ceramic products together with the ceramic enterprise brand consolidation and continuous promotion, the same is also a relatively long process of slow establishment and gradual formation of the inside.

In the mode of integration of the whole economy, Jingdezhen ceramic products if you want to occupy a place in the modern marketing of the brutal competition, then like the original only rely on Jingdezhen ceramics own excellence is far from being enough, modern life commodity packaging is like a coat on the body of a person, has a very important role, clothes if you want to win the favor of the consumer, you must stick to the consumer's Demand, ceramics is also the same, in the modern life of the material needs of the focus in the psychological needs of the transfer of time, ceramic packaging design, Jingdezhen ceramics traditional local culture design elements into the modern design concepts to performance. At the same time, it is necessary to establish the brand image of Jingdezhen ceramic enterprises, packaging as a communication carrier to consumers to disseminate ceramic culture and ceramic enterprise brand image, which inherits and carries forward the excellent ceramic culture and publicity corporate brand image has a vital role. Through the ceramic packaging as a carrier, Jingdezhen ceramic culture can be inherited and carried forward, Jingdezhen ceramic enterprise brand image has been recognized, then Jingdezhen ceramic industry will be able to get the recognition of consumers in the competitive commodity economy market and increase market share, promote the development process of Jingdezhen ceramics packaging and branding, and ultimately promote the development of Jingdezhen ceramic industry.

7.Discussion on Jingdezhen Ceramic Packaging Design

7.1 Jingdezhen Daily-use Ceramic Packaging Redesign and New Directions

Ceramics, especially daily-use ceramics, permeate all aspects of daily life. The ceramic products themselves hold a significant commercial position within the commodity economy. However, in recent years, there has been a downturn in ceramic sales. This is partly due to market economic effects and partly because outdated ceramic packaging also impacts sales. From a business development perspective, packaging is the external image of ceramic products and directly influences sales. Therefore, urgent redesigns of packaging forms are necessary. It's essential to change outdated, conservative, and homogeneous market phenomena, which profoundly affects the development of the ceramic industry.

7.1.1 Emotional Factors – Human Care, Emotional Needs

Human behavior is the neural response of things in the central brain, an unconscious act not dominated by human subjective consciousness, with human specificity and emotionality. In the early stages of societal development, people were more concerned with survival and material consumption. As society progressed and people's consumption capacity improved, they began focusing on spiritual visual enjoyment. The emotional system gradually formed on a large scale, responsible for making judgments and helping choose preferred product categories. Human emotions are determined by personal consciousness, an internal emotional induction, manifesting in external expressions of preference, a blend of abstract and concrete in philosophy, with emotional generation based on human knowledge structures. Thus, design principles increasingly lean towards subjective human experience, targeting the absence of human care in current market designs for transformation. Daily-use ceramics' vast market potential and the packaging industry's substantial development space require starting from a human care perspective.

For high-end ceramic products, packaging is a popular choice among consumers. This leads to designs prioritizing form over function, chasing superficial glamour without aligning with the product's inherent attributes. Using expensive materials to elevate product prices creates a vicious competitive cycle, compounded by consumers' comparative mentality and misconceptions about product performance. This results in

visually opulent but substantively mismatched ceramic products, prompting consumer reflection without genuinely meeting emotional consumption needs, ultimately counterproductive.

In summary, emotional consumption drives packaging form transformation. The external image of ceramic products symbolizes the brand consciousness and human reflection of corporate culture.

7.1.2 Cultural Factors – Cultural Fusion, Renewed Heritage, and Design Innovation

Geertz once said that culture is the symbolic significance manifested in the process of historical inheritance, gradually forming symbolic judgments in people's minds and developing with cultural accumulation. Culture arises with human society, a testament to human civilization, encompassing daily human activities. Initially, this shows that product producers and consumer groups are human, and the production, processing, and consumption processes are all human interactions, imbued with profound humanistic colors.

Designers, under thorough research on human psychological characteristics, aim to preserve traditional culture. Ceramic culture, with its distinct features, first involves inheriting traditional ceramic handcrafts and innovating on traditional design bases according to current design trends. However, traditional elements' chaos and garish colors still pervade the market, reflecting insufficient appreciation of beauty and outdated aesthetic concepts among nationals, influenced by old ideologies. This phenomenon's root cause is the disconnection between packaging design and cultural consumption needs. Repairing this gap involves elevating design levels. For ceramics, enriching packaging design styles can more reasonably integrate ceramic culture and propagate tradition as shown in Figure 81.

Moreover, modern culture's adoption involves packaging design blending tradition while interpreting emerging cultural developments. Design requirements must align with current consumer preferences to determine design directions, integrating new and traditional

Figure 81 Jingdezhen ceramic packaging
Source: Photography by Ye Li, 2023

7.1.3 Technological Factors – Craftsmanship and Developing Packaging Trends Focused on Human-Centric Design

Modern design is increasingly reflecting a human-centric approach. Thus, its impact is analyzed from two aspects:

(1) Specific Application of New Technologies in Design

From traditional packaging forms, it's evident that ceramic packaging initially revolved around simple bundling and straw-mat styles, evolving to paper boxes, wooden boxes, brocade boxes, bamboo boxes, or cotton linen bags, and now to corrugated paper applications. Ceramic packaging continues to seek development through exploration, with each packaging form validating the current technological advancements. With technological progress, new packaging materials like packaging

films, polyethylene foam boards, and EPE pearl cotton have enriched packaging forms and further guaranteed safety. Thus, the development of new materials for packaging must first ensure protection, both in design and functionality, without compromising the material's recyclability.

(2) Design Philosophy Guided by a Green Lifestyle

The issue of new materials' recyclability relates to green design and environmental design concepts. Material selection for external packaging is crucial; many small businesses use high-end foam materials like Xuan paper, plastic bags, or polystyrene for packaging small products. Extensive use has led to "white pollution." Such packaging not only lacks aesthetic richness but also neglects sustainable design from an environmental protection perspective. Whether these materials can be recycled and reproduced is a direction for designers today, advocating for environmentally friendly design behaviors.

7.1.4 Economic Factors – Brand Ambiguity and Enterprises Seeking Change to Establish Unique Brand Awareness

Daily-use ceramics are diverse, dominating the ceramic market and pervading daily life, complicating the formation of large brands. For small and medium-sized daily-use ceramic enterprises in Jingdezhen, the lack of brand awareness is evident as they focus on retail or factory output without high demands for product and packaging design. Most use similar shapes and packaging forms, leading to style homogenization. To win development, enterprises must seek change while ensuring product quality, not only in product changes but also in packaging innovation. Only by differentiating and establishing their brand image can they secure a place in the fiercely competitive market. All things are cyclical; it's unrealistic to expect a product to sell forever or a packaging form to remain unchanged. Viewing the development of ceramic products and packaging with a progressive mindset is essential. Unchanging packaging design can lead to consumer aesthetic fatigue, reducing purchase desire and impacting enterprise profits. Packaging design holds significant importance in the corporate VI system, crucial for brand shaping.

In summary, enterprises must break from traditional concepts for a breakthrough in ceramic product packaging, urgently requiring redesign from various angles to enhance competitiveness and economic efficiency, moving towards branding and improving brand effects.

7.2 Design Philosophy Based on Regional Cultural Presentation, Shaping Ceramic Brand Awareness

Jingdezhen boasts rich, longstanding regional culture, primarily in ceramic and architectural cultures, influencing other cultural developments. The people of Jingdezhen have long relied on the ceramic industry for livelihood, deeply ingraining ceramic culture in their concepts, highly valuing the unique regional culture. In the face of fierce market competition, more accurate integration of regional culture in ceramics enriches its cultural connotation. Ceramic packaging plays an undeniable role in establishing new design concepts and brand awareness.

The regionality is reflected in folk tales about kiln firing, production processes, taboos, and specific operations in ceramics, appearing on various ceramic packaging designs. Ceramic products feature diverse shapes, styles, decorations, carrying deep traditional Chinese culture and craftsmanship, contributing to China's socialist market economy. Ceramic packaging, considering the special attributes of ceramics, is embedded in deep ceramic cultural connotations, where design forms, material choices, and cultural factors are integrated with ceramic products. Currently, packaging forms represent a brand's spokesperson and cultural promoter, inseparable. Therefore, ceramic packaging design must incorporate specific local regional culture. Surface-functional packaging cannot become the mainstream; its impact is fleeting. Only by embedding special cultural connotations as part of the product's external packaging can the product's functional and cultural attributes be better promoted, integrating local culture and developing profound ceramic culture as shown in Figures 82.

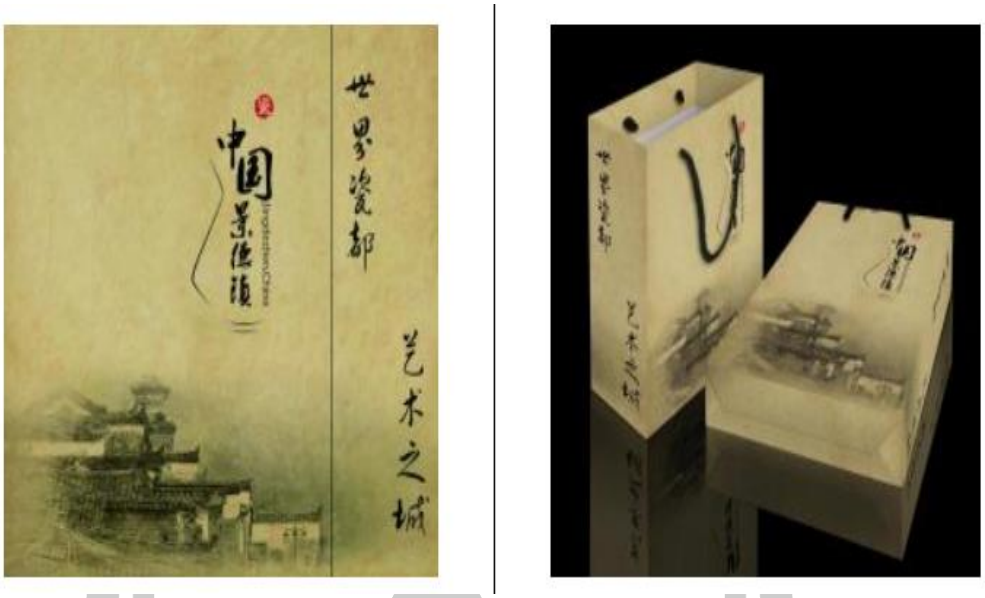


Figure 82 Jingdezhen Ceramics Packaging
Source: Photography by Ye Li, 2023

7.2.1 Folk Culture in Ceramic Packaging Design

Local customs are the unique traditional practices of a place. As the saying goes, "The local environment shapes the people," and folk culture is the cultural feature that most closely fits the local development. Jingdezhen's ceramic folk culture allows us to directly understand the production process of ceramics and thus understand the living conditions of the people in Jingdezhen and the development history of Jingdezhen culture. By understanding Jingdezhen's folk culture, we can see the development of ceramics from ignorance to civilization, from traditional to modern, from superstition to science, and from partial to comprehensive development, interpreting from multiple perspectives how Jingdezhen ceramics have adapted to the development of the times. Archaeological research on ancient ceramic shards indicates that ceramics from each dynasty have distinct characteristics and carry different, unique ceramic cultures. Hence, many archaeologists are keen on studying ancient ceramic fragments to uncover the content of ceramic folk culture. Not every folk tale can be preserved as folk culture. In ancient times, cultural transmission was mostly oral, and while some versions transmitted to the present can be verified, others cannot. However, it's certain that all folk customs have shadows of folk tales and are observed by consensus. They represent a rich entity encompassing economics, society, belief, recreation, etc., showcasing the rich and mysterious beauty of folk culture and enriching the connotation of ceramic culture.

Folk customs play a significant role in the packaging of ceramics. Packaging should not only display the regional characteristics of ceramic culture but also match the local customs, serving to promote the culture of the place. Hence, the saying "When in Rome, do as the Romans do." From ancient times to the present, folk customs subtly influence people's daily lives. Therefore, folk customs can reflect the political and economic development. From a design perspective, designs should be based on a specific cultural tradition to enrich design connotation, following the development of the times to create contemporary designs acceptable to consumers. Integrating local customs into the design can highlight the importance of regional culture in design, showcasing its unique artistic charm. When used properly, it can achieve great effects, allowing for effective promotion of corporate culture and enriching the cultural connotation of ceramic packaging, resulting in packaging designs that are easily accepted by the public.

7.3 Redesign Concept of Jingdezhen Daily-Use Ceramic Packaging

With the improvement of living standards, daily-use ceramics have become ubiquitous in people's lives, and there is a growing interest in decorative art ceramics, with some high-end consumer ceramics gradually accepted by the public. However, these art pieces that enrich home life and elevate aesthetic sensibilities haven't maximized market development. The root cause is that the products haven't aligned with specific market demands, failing to penetrate the market deeply, leading to a disconnection from consumer needs. High-end products target a small consumer group, while the mid to low-end market is cluttered, hindering the development of ceramic packaging.

The term "redesign" has been applied in various fields, meaning design recreation based on existing designs. It's not about abandoning traditional designs but relies on existing design norms for redesign. The introduction of the "redesign" concept meets the development needs of the times, aligning with consumer aesthetic trends, and is a design action that follows design trends. "Redesign" poses a challenge to designers, who must not overlook corporate culture, product functionality, or market elements for the sake of following trends. True design alignment with the product is the direction designers must aim for in "redesign."

Today, the "redesign" concept also sets new design requirements for packaging design, interpreting new functions and appearances for ceramic packaging. Packaging redesign is not only a self-improvement of packaging design but a self-improvement of the entire ceramic enterprise's development. Dewah Vennison in "Green Packaging Design" mainly discusses environmental issues of packaging, emphasizing secondary use of external packaging,

selecting materials that fit sustainable design concepts for redesign, thereby achieving energy conservation and environmental protection.

Stacey Kin Gordon in her book "Packaging Redesign" mentions redesign based on product attributes and corporate culture or customizing for high-end customers, which requires a complete break from original design patterns, infusing new design elements, or making significant changes on the existing design basis. Changes on the existing design basis involve fixing the flawed aspects of existing designs, removing poor design or packaging forms, to meet consumer expectations for new designs. Ceramic packaging "redesign" has two meanings: firstly, to improve the company's brand image, innovating original packaging to create new design images; secondly, recognizing new materials and technologies, addressing root issues of design flaws, solving current problems fundamentally, and conducting reasonable design analysis of traditional elements extraction, simplification, and generalization. Extracting the essence for design creation to cater to consumer demand, guiding consumer consumption concepts, and elevating appreciation levels for designed products.

7.3.1 The Similarities and Differences Between Traditional and Modern Packaging Materials

1. Paper Packaging Materials

Papermaking is one of China's earliest inventions. Paper materials are the most widely used in packaging, primarily processed from plant fiber materials. In ceramic packaging, paper forms are the most common, whether as outer cardboard boxes or inner straw paper linings, all aimed at reducing vibration and friction to protect the product. For instance, smaller businesses often wrap ceramics in newspaper to save costs and protect the items from breaking while also being cost-effective. Corrugated paper, with its uneven surface, has been favored by many packaging designers for its vibration damping effect and is popular for its simple operation and versatile design. While paper materials have advantages in cost savings and environmental protection, Jiangxi's humid climate, especially during the rainy season, poses a challenge for paper-packaged ceramic products, as the packaging easily becomes damp, reducing its protective effectiveness. The later introduction of cardboard boxes addressed this issue with improved moisture resistance, becoming widely used in packaging. Designers have extensively researched and improved moisture-proofing in cardboard packaging to enhance its transportation and protection capabilities as shown in Figure 83.

Figure 83 Ceramic mug packaging design
Source: Photography by Ye Li, 2023

The packaging form shown in Figure 84 is suitable for packaging individual items. Due to the load-bearing capacity of corrugated paper, it cannot achieve the packaging effect for a complete set of ceramic products. However, the frame structure it forms should not be underestimated. Moreover, it is environmentally friendly and green, facilitating the recycling and reuse of materials. Relatively speaking, the cost is also lower, but it requires a higher demand for manual craftsmanship.

Figure 84 handbag ceramic packaging
Source: Photography by Ye Li, 2023

From Figure 85, it can be seen that paper materials are still quite widely used in ceramic packaging, ranging from individual items to complete sets of products, all of which can adopt paper packaging forms. Moreover, the form of external packaging is designed around the product as a whole.

Figure 85 ceramic packaging
Source: Photography by Ye Li, 2023

2. Wooden packaging materials

Another form of packaging for Jingdezhen ceramics is the wooden box, which is processed in a high-grade manner and protects the product with its sturdy structural space, decorating the interior space to enrich the design. However, as environmental concerns have intensified, with the government advocating sustainable development strategies and people's awareness of environmental protection increasing, the use of wooden packaging materials has been restricted. The extensive use of wood materials harms forests, and domestically there has been a return to nature in search of packaging materials, such as environmentally friendly packaging products made from straw, crop straw, and other agricultural crop fibers as shown in Figure 86.

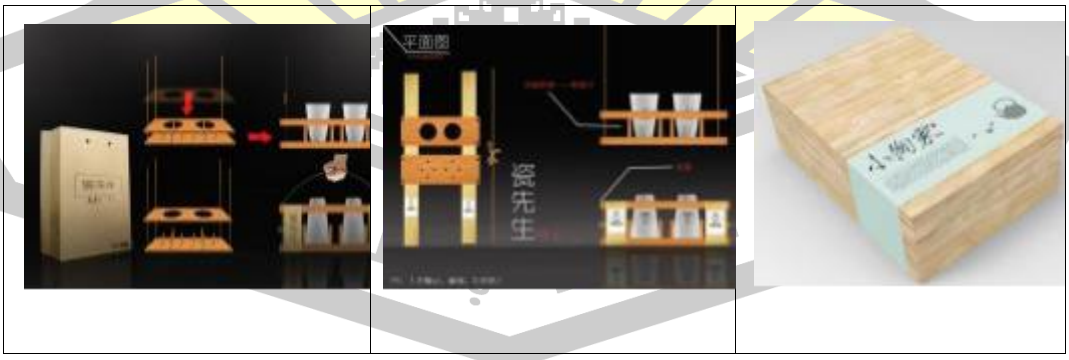


Figure 86 ceramic packaging
Source: Photography by Ye Li, 2023

3. Plastic Packaging Materials

Plastic, serving as an inner packaging material, offers good flexibility and sealing properties, making it a suitable choice for the humid air in the southern regions. However, due to the chemical composition of plastics, which has been labeled as "white pollution," there has been a trend towards reducing the use of plastic packaging materials in recent years. The stubborn indecomposability of plastics has caused severe environmental pollution. Therefore, from the perspective of green design, the use of plastic packaging forms should be limited.

4. Composite Packaging Materials

In recent years, with continuous technological advancement, emerging composite materials have been widely used, making the selection of packaging materials more diverse and the ways to obtain materials that match the product's temperament richer. For example, the emergence of new composite materials like vacuum aluminum-plated cardboard creates excellent visual texture effects. Another example is the repurposing of discarded home appliance packaging boxes, which are repressed and cut into new packaging structures, or made into cardboard forms for packaging lining, using straw mats to line the inner space for product safety.

5. Fabric Packaging Materials

In the 21st century, as the world has entered the era of high technology and considering the severity of environmental resources, governments advocate for design to follow sustainable development policies and call on designers to pay more attention to design principles that ensure long-term survival. Therefore, fabric as a packaging material has become increasingly popular among consumers, appearing in the form of cloth bags or wraps.

Fabric is widely favored for its unique functions. First, unlike plastic materials, the use of fabric does not cause environmental pollution, making it an optimal form of eco-friendly material. Second, fabric can be recycled and, even before fulfilling its packaging function, can be used for other purposes, aligning with the concept of sustainable design. Moreover, fabric can be either handmade or machine-produced, elegant and neat in appearance. "Qi Shi Jie" original handmade linen tea cup bags are designed according to the needs of ceramic shapes (as shown in Figures 87). Panda Weave. " [Qu Yi]" tea cup storage bag, cotton and linen tea set, plain cloth handmade

original fabric tea cup cover (as shown in Figures 88) perfectly combines the charm of the fabric bag with the temperament of the ceramics, providing a rustic visual pleasure. The stable color of the fabric bag further enhances the solidity of the ceramic product.

Figure 87 Fabric ceramic packaging
Source: Photography by Ye Li, 2023

Figure 88 cloth ceramic packaging
Source: Photography by Ye Li, 2023

7.3.2 Design of Graphics, Text, and Color

(1) Application of Graphics

In the design field, the application of two-dimensional elements of graphics and patterns is quite extensive. As the main information elements, they play a crucial role in defining design concepts. For instance, the use of traditional patterns versus modern patterns creates different visual design atmospheres, serving as a major element in forming design styles and influencing the visual impact and appeal of packaging design. (Refer to Figure 89) The approach to handling patterns in ceramic packaging design can be guided by the design principles of graphic design.

Figure 89 pattern study
Source: Photography by Ye Li, 2023

In graphic design, the application of elements predominantly revolves around two-dimensional materials. Patterns can be treated as backgrounds or as the main graphics in the creation, but as basic material elements, they indeed play a crucial role in creating design atmospheres and tones, supporting the theme content. By appreciating Japanese ceramic packaging design, we can contrast that Jingdezhen's ceramic packaging has not been well integrated with product performance, exhibiting visual confusion. Traditional elements are used too intricately without detailed analysis and synthesis, leading to packaging forms that are too similar, lacking a unique style for their products. Addressing these issues, the redesign of ceramic packaging must undertake targeted design reforms to elevate public aesthetics, meet consumer demands, and keep up with design trends.

1. Design of Graphics

Visual communication design is the application of visual elements on a plane, primarily focusing on human visual behavior. Graphics are one of the basic forms of expression, offering expansion and tension to design that other elements cannot compare with. By extracting information from graphics and patterns, patterned symbolic designs that accurately convey information and design concepts are created. Leading consumer consumption directions through the promotion of concepts, the patterns in ceramic design often include traditional ancient patterns such as

intertwined branches, cloud patterns, and spiral patterns. Applied to products, these patterns instantly reveal a taste of ancient elegance, representing a design style that we should inherit and preserve. (Refer to Figure 90) As representatives of traditional Chinese elements, we should discard the dross and extract the essence, combining it with the trends of modern design and following public aesthetics with new concepts and design philosophies to handle traditional elements. In two-dimensional space, the plane can be made to appear non-flat, creating a three-dimensional visual space image with patterns. Modern technological means can be used to process the visual effects of patterns. Patterns on ceramic products can be expressed using different glazes and painting techniques, selected in accordance with the product's inherent personality and combined with its attributes and functions, orienting towards the given cultural connotations. As people's understanding of design improves, design considerations extend beyond merely creating beautiful products, focusing more on human care and green design, keeping pace with policy development, and integrating certain economic, political, and cultural developments into the design.

Figure 90 pattern study
Source: Photography by Ye Li, 2023

2. Principles of Graphic Design

For daily-use ceramics, the packaging form mainly adopts the brocade box style. In designing individual products, cost considerations should be taken into account. The chosen packaging structure should not be too complicated or excessively packaged. The production of the corporate VI should be simple and elegant. The selection of standard colors for logos should coordinate with the overall corporate culture. Attention should be paid to distinguishing the primary and secondary levels of the design. Simultaneously, in the packaging design of daily-use ceramics, a combination of personalized design and traditional design principles should be formed to create

unique corporate product characteristics, thereby forming a brand effect in the fierce market competition. The principles that should be followed are as follows:

(1) Principle of Relevance

Every entity is not an isolated individual, and the elements within packaging are not separated either, nor is the intrinsic relationship between each element and the product. The so-called relevance refers to the correlation between the texture effect of packaging materials and the design content, as well as the correlation among graphics and text in the packaging work plane. Simply put, it is the intrinsic correlation between various design elements. Reasonably arranging resources within the spatial structure is an effective representation of enhancing product relevance, combining consumers' aesthetic tendencies, and perfecting design expression.

(2) Principle of Intuitiveness

Daily-use ceramics exist in people's everyday trivial lives. According to different consumer levels and concepts, the shapes and functions of daily-use products are diverse and varied, so the graphic design of packaging also shows diversity. In packaging design, the application of graphic patterns must be combined with the packaging design requirements of the product to propose specific design solutions and draft packaging plans, focusing on highlighting the product's individuality. When consumers see the product's packaging form, they should be able to clearly understand the general information of the product and make corresponding consumption choices to stimulate the desire to purchase. Therefore, the appearance design of packaging is a direct reflection of one's subjective inner consciousness.

(B) Application of Text

Design is the expression of silent visual effects, while text indeed serves as a bridge for communication with consumers. It records basic information such as the product's attributes and the company's corporate culture, playing a role in conveying information in packaging. The textual information involved in packaging design includes the company name, product function introduction, and precautions, among other records. As a medium for information conveyance, text bridges the gap between products and consumers, acting as a communicator with an extraordinary significance. It is mainly manifested in two aspects: firstly, the basic conveying function of text, and secondly, text as one of the basic elements of design. It is not only a promotional

technique but also an indispensable material for decorating packaging. Text layout design can enrich the visual presentation and decorate the page effect. From the recorded information, the text in packaging can be divided into three types.

Types: Firstly, the design of text logos; secondly, the arrangement and design of text introducing and explaining products; thirdly, the decorative aspect of text. As a basic creative element, text can undergo various style transformations and design deformations to independently achieve decorative effects.

1. Principles of Text Design

The design principles for text in design are meticulous. In layout design, text is not only a medium for information input and output but also crucial in forming a page effect. Within a design layout or workspace, the handling of text requires caution, from font style to size and color selection. In packaging design, text also serves this function. In the application of text in ceramic packaging design, the same principles apply, from choosing the font style, size, weight, color, and text-based graphic extensions, to the combination of text and graphic patterns, all requiring careful consideration by designers. In ceramic packaging, the text style can be selected based on the overall product style of the ceramics, combined with the company's culture. For instance, a standard-sized small enterprise might suit serif or sans-serif fonts, whereas a ceramic product with an ancient style might be better suited to traditional calligraphy fonts. A modern ceramic brand would match well with a minimalist font to complement the design content. Although text can serve as a visual element for creation, the primary principle of text layout is legibility, ensuring this fundamental function is not compromised. The use of bizarre or niche fonts requires caution, only to be used sparingly if product design demands, without impacting the overall design effect. Designers need to distinguish primary and secondary aspects of the design, enrich design layers and content, providing consumers with a sense of ever-increasing quality as shown in Figure 91.

Figure 91 Text pattern
Source: Photography by Ye Li, 2023

(1) Principle of Recognizability

The first design rule that text arrangement should adhere to is the recognizability of the text. It must be clear, accurately explaining and arranging information without affecting the consumer's intuitive reading. Whether serving as a medium for textual communication or as a decorative element, the fundamental function of recognition should take priority.

(2) Principle of Unifying the Concrete and the Abstract

The unification of concrete and abstract forms mainly depends on the dual attributes of text. First, text can serve as a decorative element, blending into the design; second, as a medium for information dissemination, it is directly absorbed by consumers. Therefore, when arranging text, the overall visual effect must also be considered. The design should not only focus on decoration but also on the expression of information, paying attention to both aesthetic appeal and practical functionality, following the principle of unifying the concrete and the abstract.

(3) Application of Color

In the field of design psychology, the sensitivity to color is the most acute among human senses. The eye's capture of color sensations is the quickest among sensory organs, with color reflections reaching the cerebral cortex in just 20 seconds and feedback to the corresponding central nervous system. Our lives are filled with

variously colored objects, and the colors that compose these items are too numerous and varied to quantify. The myriad colors of nature indirectly influence human life.

In ceramic packaging design, the primary goal of color extraction is to catch the eye, attracting consumer attention as the first step in marketing. Color forms a strong intuitive visual stimulus, creating emotional reactions in the visual center, influencing thought and judgment as an objective reflection of perception. This highlights the significant role color plays within the visual spectrum, an aspect that cannot be overlooked. In daily-use ceramic packaging design, the use of color can be pivotal, enhancing the overall design. In the field of visual design, color is rarely an isolated entity but is associated with text, patterns, and material textures, drawing immediate attention as the brain processes color with the shortest response time. The basic color tone in packaging elements must be carefully chosen to match the overall atmosphere for unity.

The application of color in daily-use ceramic packaging is expertly mastered, with the charm of glaze colors fully exhibited. Whether prioritizing text color, pattern color, or choosing background color tones, consideration is essential for how color combinations can better suit ceramic product packaging design. Managing the relationship between graphics, text, and color and coordinating these elements' rationality achieves final unity in the design, forming designs that consumers love and guiding consumption.

Relative to Jingdezhen's daily-use ceramic packaging, more traditional color combinations are used, preferring monochrome schemes with traditional patterns as motifs, primarily using red or yellow to signify the festivity and nobility of ceramics. Due to the popularity of underglaze red and blue-and-white in Jingdezhen, coupled with the historic luxury of porcelain, red, yellow, and blue-and-white packaging is common. This convention has led to a fixed mindset in ceramic packaging design, resulting in monotonous color use. However, new packaging styles, such as the black packaging boxes used by Den Gu Tang, marked by simple logos, are bold attempts to address the monotony and dullness in color application, refreshing consumer aesthetics and solving visual confusion in Jingdezhen ceramic packaging as shown in Figure 92.

Figure 92 ceramic color
Source: Photography by Ye Li, 2023

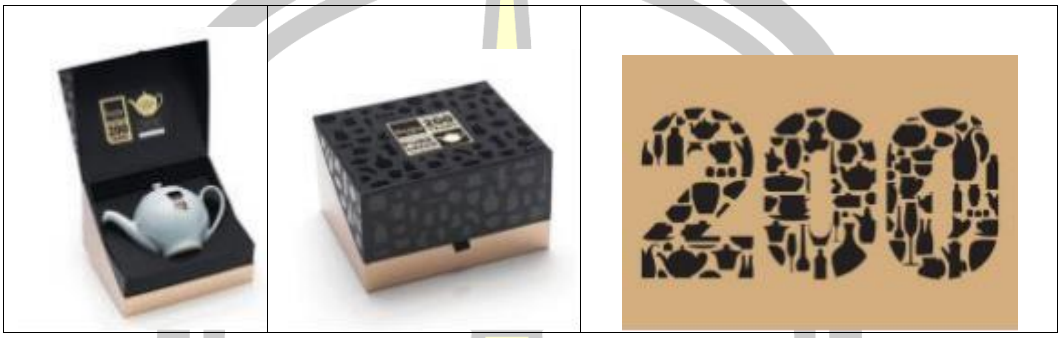
1. Principles of Color Application

The application of colors from nature, industry, and artificially adjusted colors touches every aspect of life, offering a diverse range of visual impacts and color sensations. Different colors elicit different visual responses; for example, red associates with festivities, the sun, and a warm emotional experience, while yellow conveys warmth and softness, preferred in restaurants or warning contexts. Green brings a sense of youth and the vitality of spring. Blue symbolizes freedom and expansiveness, demonstrating that the emotional experience elicited by different colors varies. Color itself is devoid of emotion; it's the context in which color appears and the natural conditions that imbue subjective emotional reflections on color, giving color its psychological significance and eliciting emotional responses. Specific principles include:

(1) Principle of Simplicity

"Less is more." Design isn't about adding more but about subtracting, simplifying information, and refining messages. Modern design increasingly pursues minimalism,

contrasting starkly with the complex designs prevalent in Jingdezhen's ceramic market and pointing towards a future direction for the packaging design of daily-use ceramics in Jingdezhen: embracing simplicity over complexity. Denby Pottery, with a 200-year



history of producing ceramic goods, created a set of bicentennial commemorative ceramic packaging to embody this principle as shown in Figure 93.

Figure 93 Bicentennial ceramic packaging
Source: Photography by Ye Li, 2023

(2) Principle of Harmony

The principle of harmony emphasizes that color selection cannot be arbitrary. Colors must complement the product's attributes and corporate culture. The choice of primary and secondary colors should not be contrasting but rather selected within a similar color range to ensure minimal differences. It's essential to coordinate the relationship among the product, consumers, and the company, taking all factors into consideration when choosing color combinations.

7.3.3 Design of Packaging Structure and Form

The exterior packaging design of daily-use ceramic products is based on the product's form. Some uniquely shaped items can be immediately recognized by their packaging structure, serving as a direct form of advertisement to consumers. Unique forms also serve as a promotional feature to attract consumers, while also embracing the concept of green design to protect the environment and conserve resources. The form should also reflect the cultural essence of the ceramic products, using the external shape to enhance the interior, combining both to create a more compelling and realistic appeal that aligns with consumer purchasing behavior and psychology. This approach helps businesses improve sales through structural design, stimulating product sales to achieve profitability goals.

In summary, the redesign of daily-use ceramic packaging should consider the following two fundamental aspects: First, the packaging's appearance should be aesthetically pleasing and carry practical significance. Second, it's crucial to consider the manufacturing process of unique shapes to ensure they are both functional and beautiful. Lastly, consideration should be given to the consumer's potential for reusing the packaging, with the value of a redesign adhering to ecological design principles, as demonstrated in the following points.

(2) Principle of Harmony

The principle of harmony dictates that color selection cannot be arbitrary. Colors must complement the product's attributes and corporate culture. Standard and secondary colors should not contrast greatly but be chosen within a close range of hues to ensure harmony among the product, consumers, and the company. This involves a comprehensive consideration of color combinations to coordinate these relationships.

7.3.3 Design of Packaging Structure and Form

The exterior design of daily-use ceramic products is based on the product's form, with some uniquely shaped items revealing their distinctive forms through the packaging structure. This direct presentation to consumers is a form of advertising. Unique forms also serve as a selling point, while packaging design should adhere to green design principles to protect the environment and conserve resources. Moreover, the design should enhance the product's cultural connotations, with external forms supporting the inner qualities, achieving a cohesive design that aligns with consumers' purchasing concepts and psychology, thus aiding companies in increasing sales.

To sum up, the redesign of packaging for daily-use ceramics should consider the following two aspects: firstly, the exterior form of the packaging should be aesthetically pleasing and meaningful; secondly, the creation of unique forms should consider both practicality and beauty, with the end-use by consumers in mind. The value of secondary design should comply with ecological design standards, which include:

1. Design Principles

(1) Based on Aesthetic Appeal

Beauty is fundamental to design. For instance, Jingdezhen's current market often employs brightly colored packaging, sometimes with jarring contrasts that can detract from visual appeal, directly affecting consumer purchasing power. Before designing packaging, research into public aesthetic preferences and analysis of well-designed product forms that have gained consumer favor is essential. Emphasizing beautiful styles lays a strong foundation for subsequent design efforts.

(2) Design Extension for Development

Packaging design should evolve over time, adapting to current design trends. Issues like plastic pollution, low-end product packaging waste, and environmental concerns from wood packaging necessitate design compliance with green and sustainable principles, minimizing unnecessary or excessive design to conserve resources and enhance environmental awareness and aesthetic appreciation.

2. Focus on Form Design

(1) Form Beautification through Streamlining

Common packaging forms are typically square or rectangular, which can feel cold and impersonal. In contrast, Chinese painting, with its emphasis on smooth and graceful lines, requires strict control over line work, advocating for lines full of vitality. This approach aligns with the Daoist concept of unity between humanity and nature. Thus, packaging design for ceramics should also strive for streamlined beauty, breaking free from rigid forms to create lively packaging that inherits traditional culture while appealing to contemporary consumer preferences.

(2) Detail Beautification Adds Collectible Value

Packaging for high-end products or those with artistic designs often has collectible value. For example, packaging for wine bottles, perfume bottles, and certain food glass containers attracts a consumer base interested in collecting. Similarly, ceramic packaging can possess collectible value. Some packages utilize brand logos in pattern transformations and employ carving techniques to create a sense of mystery, drawing consumer attention. After use, these packages can serve as storage boxes, enhancing the design's extended value. These styles not only fulfill the packaging function but

also provide a secondary use for consumers, fully embodying the concept of material reuse. For high-end gift ceramics targeting a select audience, the design must match the individual temperament of the target group, avoiding generic packaging forms. For wood packaging, consider the type of wood for categorization and incorporate carving patterns, blending craftsmanship to add value and elevate consumption class, focusing on comprehensive detail experience to heighten consumer awareness.

3. Principles of Structural Design

Packaging structure should be based on the product's form, with traditional packaging unable to accommodate unique shapes. Structure design must begin with the product, considering the practicality of the packaging and its aesthetic design. The design should achieve both functional and humanistic integration, as outlined in the following principles:

(1) Optimization Principle

Optimization involves careful resource allocation, whether to express aesthetic demands, promote functionality, or highlight corporate culture. It requires classifying and integrating these aspects to optimize design, ensuring a balanced relationship between elements to guide consumer experience effectively.

(2) Diversity Principle

Current packaging primarily focuses on product protection, often lacking integration with product content. Therefore, expanding design perspectives and embracing diverse design concepts is essential to meet functional requirements. Expansion represents a significant trend in future design, satisfying consumers' multidimensional expectations for packaging design.

Chapter V

Green Ceramic Packaging Design of Jingdezhen Local Culture

1.Ceramic packaging design and market research

In this study, combining green ceramic packaging design with local cultural elements, I carried out three ceramic packaging designs and conducted market research. Based on the results of the market research, the final design plan was derived. The first is the celadon ceramic packaging design scheme. The focus then shifts to the ceramic landscape tea set design scheme, which was developed and produced based on market research data.

1.1Celadon tea set packaging design

The combination of tenons and mortises is mainly accomplished through the interlocking of structures, achieving the raw state of the overall material. By integrating the straight tenon structure in the tenon and mortise joints, the structure of the Jingdezhen kiln celadon tea set packaging is combined with the functionality of the tea table. The four openings on the exterior of the packaging are sized to fit the bottom diameter of the Jingdezhen kiln celadon tea cups, which can not only hold the tea cups but also prevent tea from spilling due to movement, making it convenient for consumers to use. This allows for more convenient tea brewing and tasting during travel. At the same time, the heads of the straight tenons are distributed in different positions of the packaging, which can stabilize the internal products for protective purposes as shown in Figure 94.

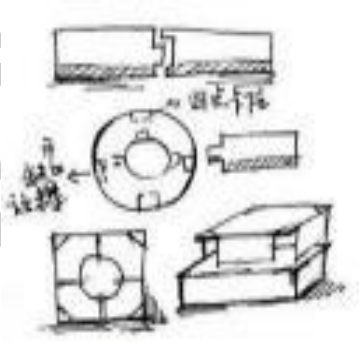


Figure 94 Multifunctional structure sketch
Source: Drawn by Ye Li, 2023

The culture of tenons and mortises is mainly used in ancient Chinese architecture. This structure, through ingenious interlocking methods, can not only withstand great pressure but also has a certain seismic resistance and self-healing ability. Integrating the tenon and mortise structure with the internal structure of the packaging and incorporating modern aesthetic characteristics for innovation can add a certain cultural interest to the packaging. The detachable assembly packaging structure mainly utilizes the "Luban's three-way lock" structure from tenon and mortise techniques. It achieves balanced force distribution by interlocking individual structures to form a whole. After removing the tea set, the internal partitions can be assembled and interlocked. Together with the external packaging, it can be transformed into a small display stand or lamp, maximizing the reuse of packaging as shown in Figure 95.

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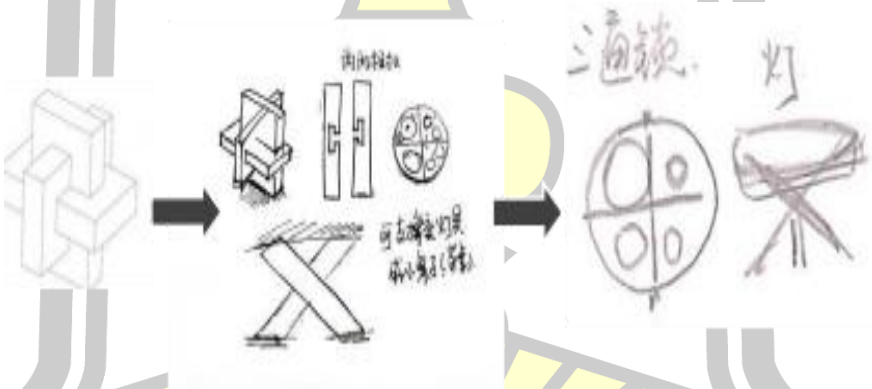


Figure 95 Detachable structure sketch
Source: Drawn by Ye Li, 2023

Celadon tea sets are fragile; therefore, the design of the packaging structure must consider the protective capabilities of the packaging for the product. A reasonable packaging structure design can effectively solve the fragility of Jingdezhen celadon tea sets. This packaging, through the coordination of straight tenons and mortise structures, can rotate the inner packaging while also changing the display of the inner decorations, interacting with consumers to create a certain level of interest. At the same time, the internal structure can be taken out for display or can be disassembled and adjusted for space autonomously.

The silver ingot tenon, a tenon and mortise structure shaped like an ancient silver ingot, mainly functions to join wood panels. Applying this to the design of the packaging structure is to achieve recombination between packages, allowing consumers to adjust the product space autonomously. Reorganizing the tenon and mortise structure can extend the functionality and detachability of the packaging, meeting the needs of products of different sizes and improving the reuse rate of the packaging. Adhering to the concept of natural environmental protection, the packaging is modularly designed through the silver ingot tenon structure in the tenons and mortises, allowing the packaging to be assembled according to different product needs, achieving the circular use of the packaging as shown in Figure 96.

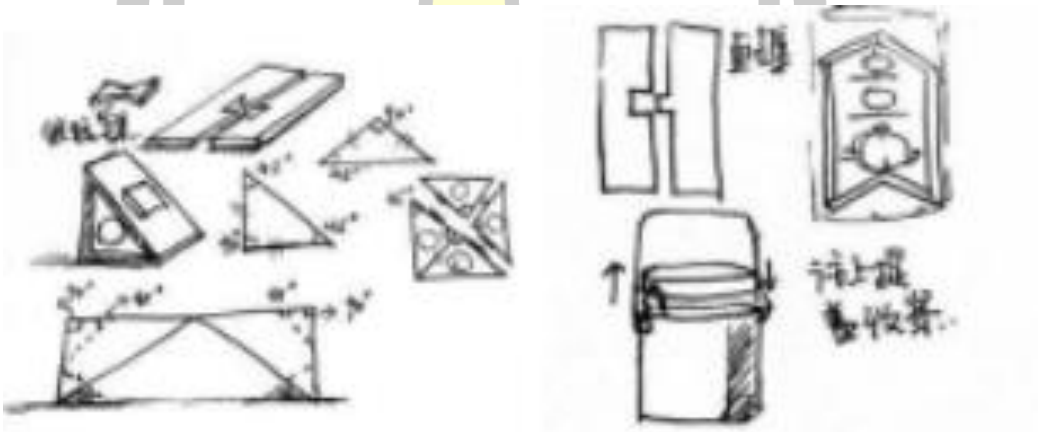


Figure 96 Structural sketch
Source: Drawn by Ye Li, 2023

The concept of a one-sheet-formed packaging box is to achieve a protective structure for product packaging through folding a single sheet of paper, without the application of adhesive. This one-sheet-formed packaging structure is more rigorously designed for product protection stability compared to conventional packaging structures. At the same time, the paper material, originating from plants in the natural ecosystem as raw materials, is easier to degrade when discarded or recycled, causing no pollution to the environment as shown in Figure 97.

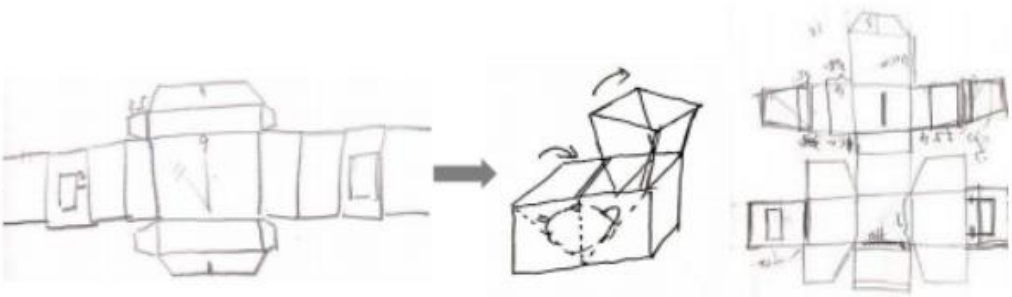


Figure 97 Structural sketch
Source: Drawn by Ye Li, 2023

The traditional production process of Jingdezhen kiln ceramics, such as "clay mining, clay washing, base powder applying, blank drawing, glazing, and kiln firing," is hand-drawn into illustrations as the overall decoration of the packaging (as shown in Figure 98). By carving on the packaging box through line drawing, a more three-dimensional decorative effect is achieved, allowing consumers to vividly approach Jingdezhen kiln culture and understand the traditional production craftsmanship of Jingdezhen kiln celadon while using the product. This creates interaction between the packaging and the consumer, sparking interest in the culture of Jingdezhen kiln celadon.

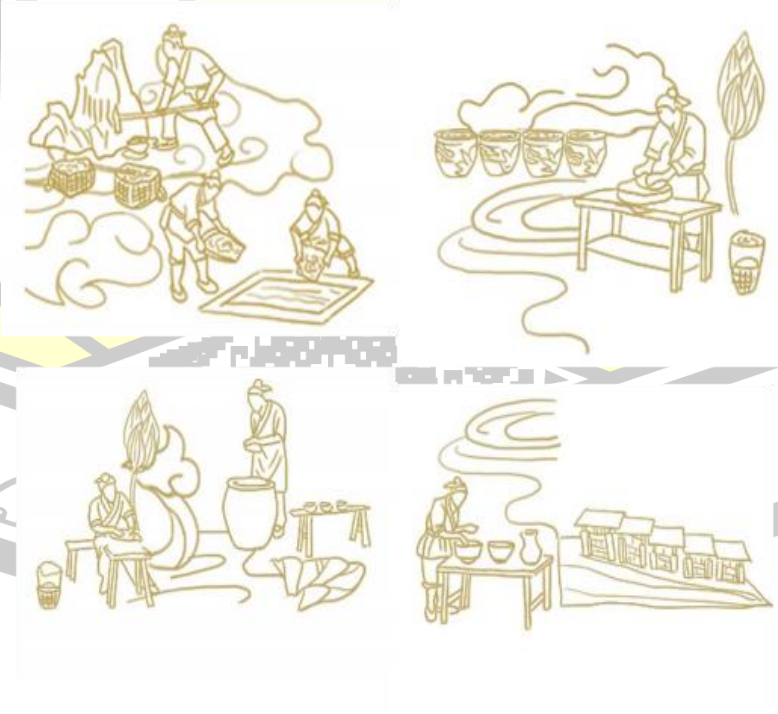


Figure 98 Packaging graphic decoration design
Source: Drawn by Ye Li, 2023

The external shape of the packaging primarily adopts a square form, with the internal protective structure mainly utilizing a straight tenon joint structure (as shown in Figure 99-100). By securing the central product inside with four points of the straight tenon heads, it not only separates the internal space of the packaging but also provides protection and stability. The outer cover of the packaging has its four corners cut out, complemented with bamboo weaving material, which can be used for tea filtration. During travel, the packaging can be transformed into a temporary tea table. Additionally, bamboo weaving has a certain degree of elasticity and toughness, offering some level of protection to the product. In terms of opening the structure, there is a wooden tenon on each side of the packaging. When both sides are pulled open to the cut corner, the cover can be unlatched. Then, by pushing from both sides to the middle until the ends align, it can be locked. The decoration of the packaging showcases the traditional production process of Jingdezhen Kiln through carving, allowing consumers to understand the cultural and historical background of Jingdezhen Kiln while using the product.

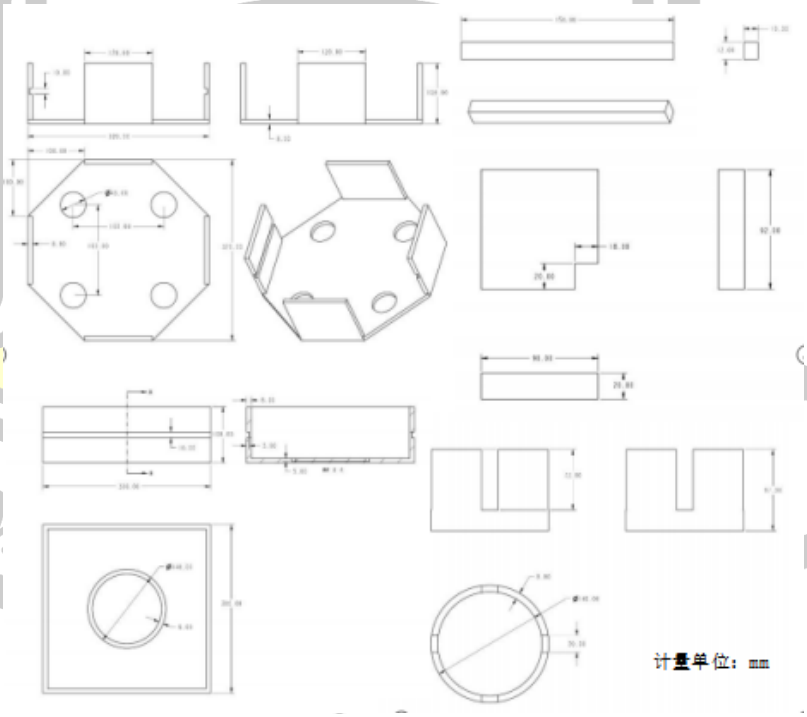


Figure 99 Multifunctional tea set packaging design and size chart
Source: Drawn by Ye Li, 2023

Figure 100 Tea set packaging design
Source: Drawn by Ye Li, 2023

1.2 Packaging design market research

By conducting market research with the product effect images of the designed celadon packaging and landscape tea set, the final ceramic packaging design was determined based on the data from the market research.

1.2.1 Market Research Report

Project Name: Market Research on Celadon Packaging and Landscape Ceramic Packaging

1.2.2Research Objective:

The purpose of this market research is to understand consumer acceptance, preferences, and demands for celadon packaging and landscape ceramic packaging, providing decision-making basis for the final packaging design.

1.2.3Research Methods:

1. Online surveys: Distribute online questionnaires via social media and professional forums to collect opinions from consumers of different ages, genders, professions, and regions.

2. In-depth interviews: Conduct one-on-one interviews with industry experts and potential consumers.

3. Competitive analysis: Analyze the packaging designs of existing celadon and landscape ceramic products on the market and their market performance.

1.2.4Research Period:

December 1, 2023 - December 31, 2023

1.2.5Sample Size:

A total of 500 questionnaires collected, 20 people interviewed in-depth, and 10 brands analyzed for competition.

1.2.6Main Findings:

1. Consumer Preferences: The vast majority of consumers prefer packaging designs that are simple, eco-friendly, and culturally distinctive. 70% of respondents indicated that traditional elements and craftsmanship on packaging significantly increase their willingness to purchase.

2. Functional Demands: Consumers generally pay attention to the packaging's protective and practical aspects. Stability is a crucial criterion for evaluating the quality of packaging design, especially for fragile ceramic products.

3. Environmental Awareness: 85% of respondents believe packaging materials should be recyclable or degradable, reflecting a strong environmental consciousness.

4. Market Competition Analysis: Competitive analysis shows a general lack of innovation in celadon and landscape ceramic packaging designs on the market, indicating significant room for design improvement.

5. Innovation Points: Through in-depth interviews, it was found that consumers look forward to seeing traditional cultural elements integrated with modern aesthetics, as well as designs that offer interactivity and reusability.

1.2.6 Conclusions and Recommendations:

1. Design Direction: It is recommended that celadon and landscape ceramic packaging designs incorporate more Chinese traditional cultural elements while adhering to modern minimalist aesthetic trends.

2. Material Selection: Priority should be given to environmentally friendly and sustainable packaging materials, such as recycled paper and biodegradable plastics.

3. Functional Design: Enhance the protective and practical design aspects of the packaging, such as shock and moisture resistance.

4. Innovative Highlights: Explore the added value of packaging, such as designs that can be repurposed as home decor or for other uses, to increase consumer interest.

In summary, the design of celadon and landscape ceramic packaging needs to follow the trend of environmental protection, combine traditional culture with modern aesthetics, and enhance the market competitiveness of the products through innovative design.

1.3 Research results on celadon packaging and landscape ceramic packaging

Through a multiple-choice online poll of 500 participants, 369 chose the landscape ceramic packaging design, while only 216 selected the celadon ceramic packaging design, as shown in Figure 101. Based on the research results, the landscape ceramic packaging design was chosen for detailed analysis and physical production.

Figure 101 Research results
Source: Drawn by Ye Li, 2023

2. Jingdezhen ceramic tea set and packaging structure creative correlation analysis

2.1 Introduction of elemental features in packaging structure design

Cultural aesthetics. Different periods of Jingdezhen porcelain pattern decoration, container shape, color technology and so on all contain different times of aesthetic concepts and aesthetic characteristics. Through the Jingdezhen cultural history of familiar understanding and combined with their own thinking and design logic of the existing Jingdezhen ceramic packaging needs to carry out the extraction of cultural elements, analysis, and reconstruction. Will enhance the cultural connotation of Jingdezhen ceramic tea packaging through packaging design. Make Jingdezhen ceramic history and culture better inheritance, carry forward. In the logo form design will be integrated into the Jingdezhen ceramic landscape painting decorative features, in the logo color selection will also be selected using the original color of Jingdezhen ceramic pigments. In the decorative design of Jingdezhen production process characteristics into the form of illustration for decoration.

packaging structure. According to the Jingdezhen ceramic cultural and historical research and the current market research found that Yue Jingdezhen ceramic containers tea bowl shape is basically a large form, in order to facilitate the use of the product in the carry, in the design of Jingdezhen ceramic tea and packaging structure need to be found in the design of the point of fit, according to the Jingdezhen ceramic tea type, from the security of Jingdezhen ceramic tea packaging structure, science, packaging form and form of fun! The packaging form and shape of the interesting and innovative design.

In analyzing the packaging needs for Jingdezhen ceramic tea sets in contemporary times, the importance of green and environmental sustainability is increasingly emphasized. In the selection of materials for design, rice husk composite boards and polyethylene foam, specifically EPE pearl cotton, are chosen for their eco-friendly properties.

Firstly, in choosing materials for packaging boxes, rice husk composite boards are considered. When compared with conventional industrial packaging wood panels, these composite panels meet the general usage requirements for packaging boards. Rice, being extensively cultivated across the country, results in a significant annual production of rice husks, surpassing current demands. Utilizing rice husks for composite boards not only addresses the issue of husk waste in many regions but also

helps alleviate the demand-supply imbalance in the domestic timber market. This approach has profound social significance.

Secondly, polyethylene foam, or EPE pearl cotton, offers unique benefits not found in traditional foam plastics, including high resilience and excellent impact resistance. It also provides effective water and moisture barrier properties, good flexibility, and is environmentally friendly due to its recyclability. It stands as an ideal replacement for traditional packaging materials.

To understand the cushioning differences between these materials, an experimental study was conducted to compare the elastic deformation and cushioning coefficients of EPS and EPE materials. Dynamic testing was performed using a DY-2 impact tester on EPS (11kg/m³) and EPE (22kg/m³) specimens with varying thicknesses (24mm, 26mm, 28mm) and sizes (150*150mm, 200*200mm, 240*240mm).

During the experiments, specimen groups were selected to measure their residual thickness after being impacted for one minute, aiming to compare their elastic deformation. The residual thicknesses of EPE and EPS were measured with vernier calipers post-impact, and the data was analyzed according to a specific formula to assess their cushioning properties.

The elastic deformation rate of pearl cotton is smaller than that of polystyrene plastic, the deformation difference between before and after the experiments was 2 mm, and after the third experiment the data basically did not change and reached the limit value, while polystyrene had a larger deformation after the first time, and lost its elasticity after the third experiment, and the final impact volume was 7 mm larger than that of pearl cotton in comparison with the original thickness.

Through the comparison of experimental data, we can find that the elasticity of pearl cotton deformation rate is less than polystyrene, pearl cotton's elasticity recovery is better, polystyrene recovery is slow and easy to change, durability is not enough, it is likely to be subjected to a large number of natural materials, the cost of packaging will be relatively low, and in the production of packaging will not affect the environment, the quality of the environment, in the use of consumers, its packaging materials will not be hazardous to human beings.

2.2Tea set packaging structure design

The local structural design of the box is mainly for the design of the joints between different surfaces of the box in square shape. In the design of wooden furniture, the commonly used joints are: mortise and tenon joint, round nail joint, wood screw joint, glue joint and connector joint, which can be completely applied to the design of packaging box. No matter what kind of joining method is used, it is to make the appearance or function of the product more perfect and save the production cost of the product.

The joining of wooden panels is a unique discipline that can be described as both technical and artistic. Most of the wooden panels are connected by inlays, which are more environmentally friendly and rustic. The design of the joints is a very important aspect of wooden products. There are many different types of joints for wooden panels, some of which use metal parts, edge banding or adhesives, while others use only wooden elements. The characteristics of the joints, their flexibility, strength and adhesion are determined by the properties of the materials used to join them.

Glue is an efficient method of joining wood panels when both sides of the joint are edge-grained. A properly glued joint can be as strong as a single piece of wood. On the end faces, however, gluing is ineffective. Tongue and groove and metal joints are good ways to join boxes. In addition, the box can also use a variety of mechanical fasteners, the simplest are small hardware and screws, glue and screws and other auxiliary accessories can be used at the same time as shown in Figure 81, for a variety of mortise-and-tenon joints, depending on the processing properties of the straw-based composite material used in the box, from which to choose the three types of joints as shown in Figure 102 At the same time, the lid and the lower box are mainly joined by metal connectors; secondly, the glued joints are also reflected in the different elevation joints of the box. The main partial structural design sketches.

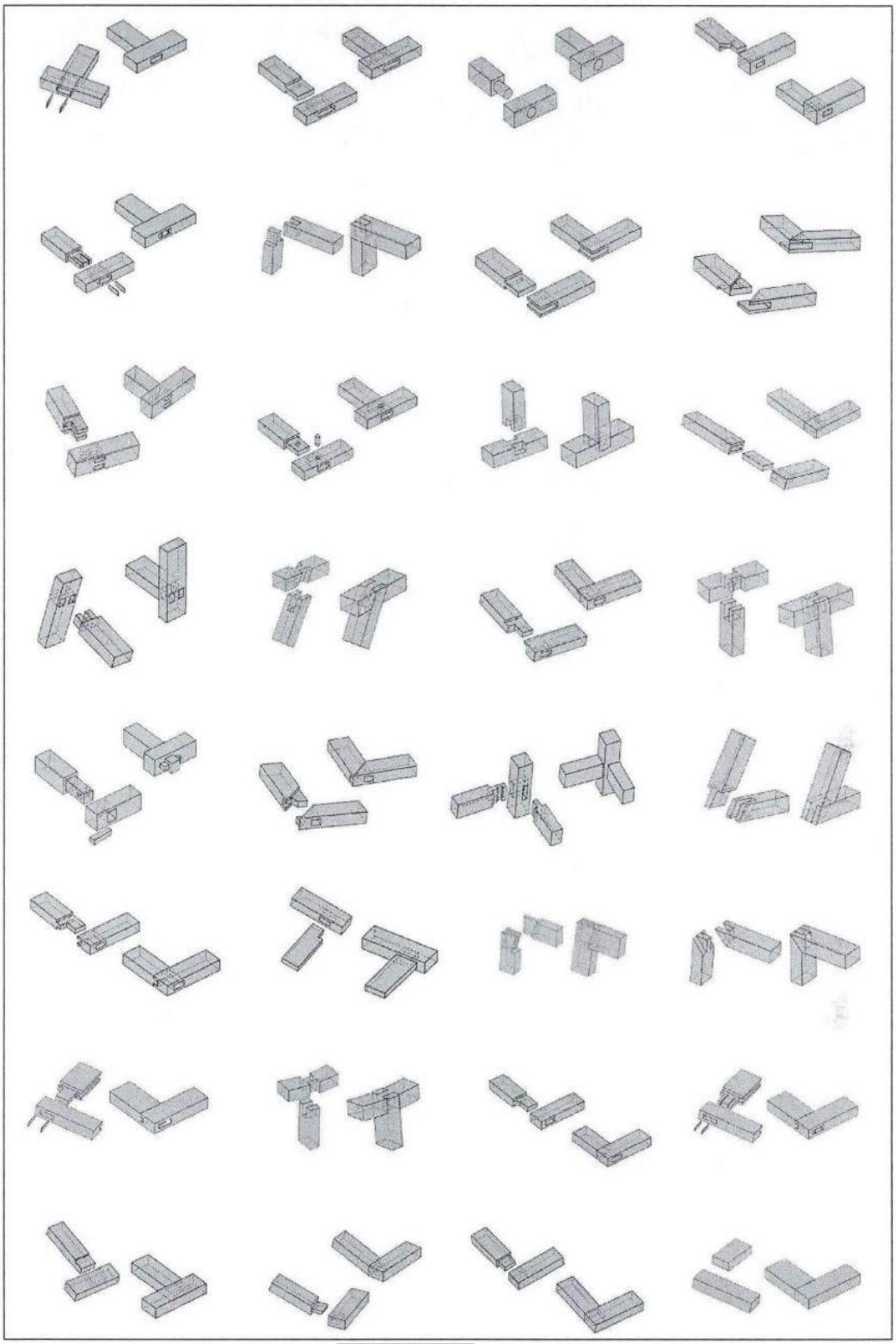


Figure 102 Structure of mortise and tenon joint
Source: Drawn by Ye Li, 2023

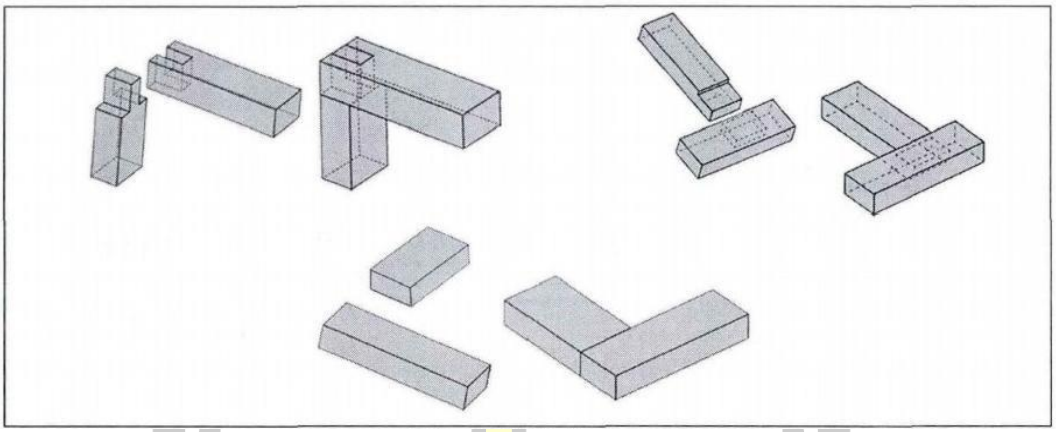
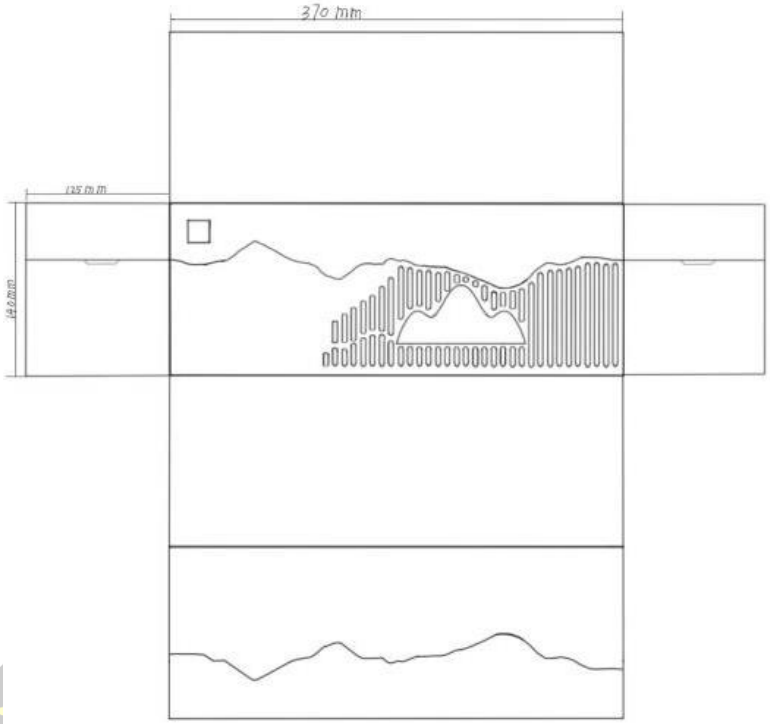
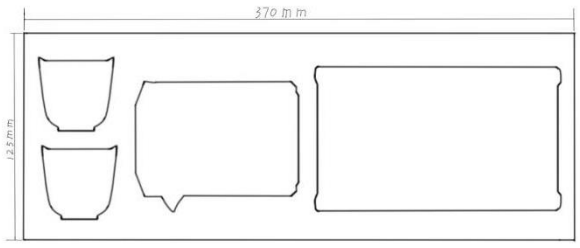


Figure 103 Selected mortise and tenon joints
Source: Drawn by Ye Li, 2023





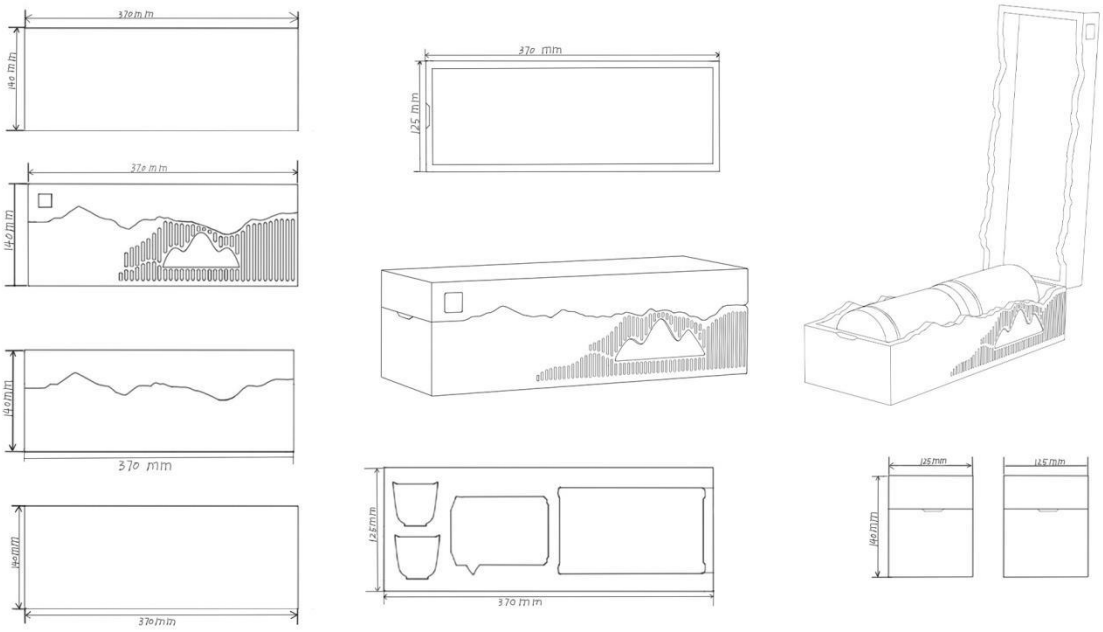


Figure 104 Sketch of the box body design of the packaging box
Source: Drawn by Ye Li, 2023

Through the design sketch in Figure 103, it can be seen that the structural modelling design of the box is based on the theoretical and practical principles of packaging design, and according to the requirements for the realization of the various parts of the packaging modelling structure and the processing properties of the composite strawboard material, the external modelling structure of the composite strawboard box is designed by making appropriate use of mortise and tenon joints or metal joints and other structural joining methods of the box shown in Figure 103 to Figure 104.

3.Jingdezhen ceramic tea set packaging visual design plan

The brand logo is a vital essence of any enterprise. A simple, clear, and highly recognizable logo not only promotes the enterprise but also conveys its brand culture effectively. The logo design for "Porcelain Art Workshop" draws inspiration from traditional seals and decorations. It arranges the brand name "Porcelain Art Workshop" into a seal-like form through innovative breakdown and recombination of structure. The strokes within the logo echo the rhythm and grace of the traditional Chinese "Wan" pattern, imbuing the design with auspicious symbolism. The word "art" is presented in traditional Chinese characters, where each complex stroke is a distillation of the rich essence of traditional Chinese culture. The fusion of Chinese

and English elements in the logo introduces a contemporary flair, aligning with international design standards. This blend of tradition and modernity, deep significance with simplicity, not only caters to the aesthetic preferences of the youth but also serves as an optimal representation of traditional culture. It ensures the logo's market visibility and facilitates promotional efforts shown in Figure 105.

In terms of color, a primarily red palette is chosen to impart a sense of nobility and to elevate the product's perceived value, enabling consumers to instinctively grasp the brand culture and corporate strength of "Porcelain Arts Square" through its color scheme. The packaging employs a monochromatic printing process, minimizing ink usage as a gesture towards environmental conservation and also reducing printing costs. Furthermore, monochromatic printing bolsters the packaging's impact.

The logo's implementation on bags and labels involves a direct embossing technique on the packaging material's surface. This method not only conserves the logo's seal-like appearance but also underscores the logo's integral role in representing the enterprise's identity shown in Figure 106.

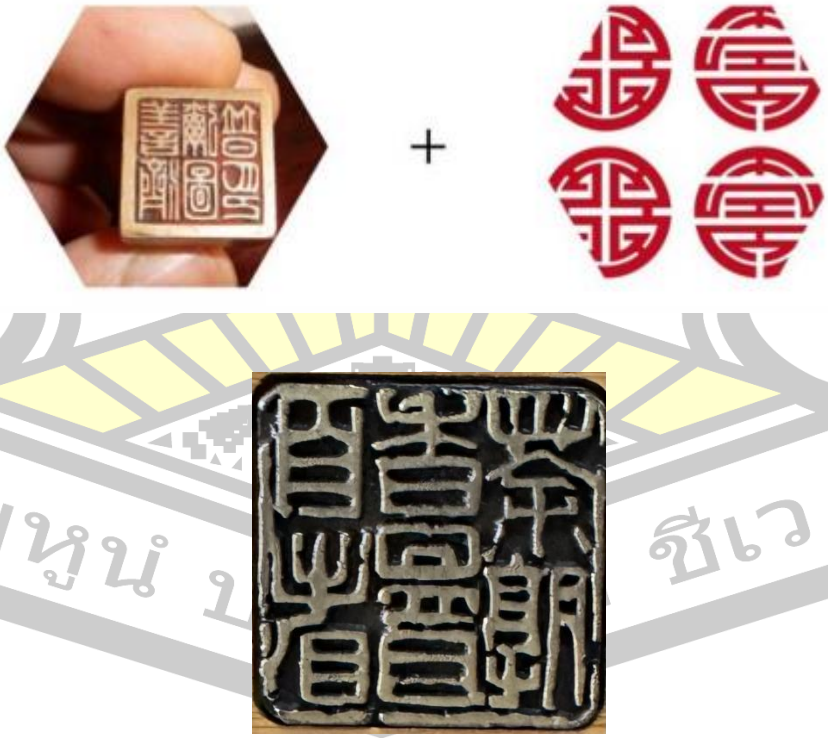


Figure 105 Inspiration for Logo Design Sketch of the box body design of the packaging box
Source: Drawn by Ye Li, 2023

Figure 106 Porcelain workshop logo design finalized
Source: Drawn by Ye Li, 2023

Extracting the elements of decorative patterns for packaging boxes is a challenging and innovative task. In the process, we drew on the exemplary ceramic art of China's famous Jingdezhen, with ceramic motifs, traditional craftsmanship and regional characteristics as the core design elements. The goal was to fully demonstrate the unique charm of Jingdezhen ceramics and make it the finishing touch to enhance the charm of the product.

We have extracted representative motifs from Jingdezhen ceramics, such as lotus, peony and batfish. These motifs are presented in simple and clear lines and forms, which not only retain the flavor of traditional art, but also have a modern aesthetic. In the design process, symmetry, repetition and gradation are used to organically integrate these elements to form the decorative patterns on the surface of the box. This unique design style makes the packaging more visually appealing while highlighting the quality of the product.

Secondly, we have cleverly integrated the production techniques of Jingdezhen ceramics, such as overglaze color, underglaze color and carving, into the packaging design. This approach makes the packaging design not only rich in visual effect, but also has a deep historical and cultural heritage. The clever combination of overglaze and underglaze color presents rich color layers and gives people a visual feast. The application of carving technology gives the packaging a unique texture, allowing people to experience the artistic enjoyment.

Finally, we incorporate the regional characteristics of Jingdezhen in our packaging design. As the birthplace of China's ceramics, Jingdezhen has a long history and rich ceramic culture. We cleverly integrate these cultural elements into the packaging design to make the packaging more regional characteristics and cultural connotations.

This not only helps to enhance the product brand image, but also allows consumers to enjoy the product at the same time, feel the cultural charm of Jingdezhen ceramics.

Through in-depth research and skilled use of Jingdezhen ceramics, we have integrated ceramic decorations, traditional craftsmanship and regional characteristics into packaging design, giving it a unique artistic charm. This not only helps to enhance the quality and image of the product, but also allows consumers to feel the profoundness of China's ceramic art during the purchase process. We are committed to presenting consumers with a visual and cultural feast, inheriting and promoting the unique charm of Jingdezhen ceramics as shown in Figure 107.

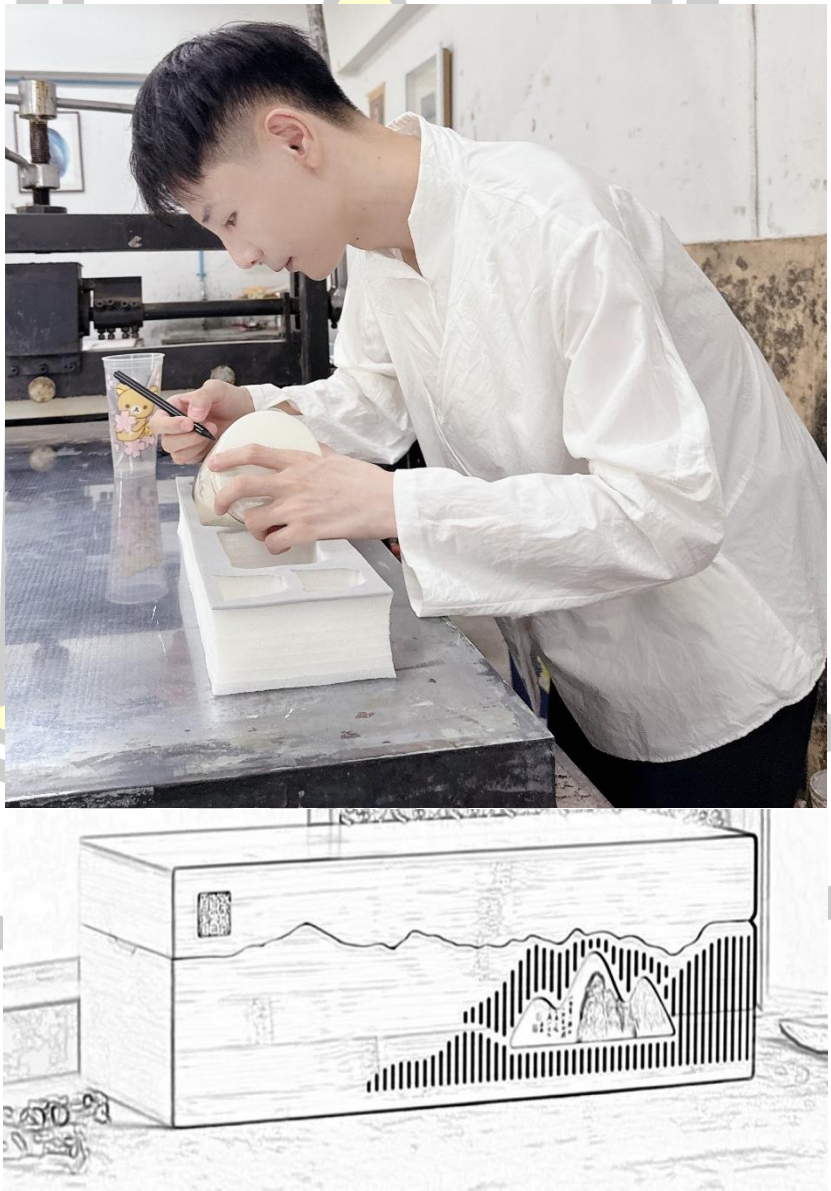


Figure 107 Packaging pattern extraction

Source: Drawn by Ye Li, 2023

In terms of color design, we mainly use the color of the planks themselves as the main color, and this tone gives a sense of elegance and environmental protection. The elegant tone not only reflects our respect for the natural environment, but also demonstrates our heritage of traditional craftsmanship. On this basis, we cleverly matched grey, white and other plain color, making the whole package design rich in traditional charm without losing the modern atmosphere.

In the design of the package, we focus on local embellishment, using ceramic patterns to decorate. These ceramic patterns not only enhance the classiness of the package, making it look more noble and elegant, but also enhance the quality of the package, making it more delicate and refined. This design concept has enabled us to successfully strike the right balance between tradition and modernity.

In addition, we also pay attention to the details in the design process of the packaging. For example, we used elements such as wood texture and ceramic texture to make the packaging closer to nature and reflect our emphasis on environmental protection. At the same time, we also gave the packaging a modern and stylish look through minimalist lines and shapes.

To sum up, our packaging design has been carefully planned and matched in terms of color, pattern and texture, aiming to create a packaging image that is both traditional and modern. This design concept not only enhances the sense of quality of the product, but also allows people to feel our persistent pursuit of environmental protection, tradition and quality while using the product as shown in Figure 108.

Figure 108 Packaging pattern generation
Source: Drawn by Ye Li, 2023

3.1 Realization of packaging box design

The appearance design of the composite straw board tea set packaging box incorporates specific graphic languages and color schemes. To achieve a refined process in its construction, it's crucial to start by cleansing the box's surface of any dust, oil, and other contaminants. Sanding the exterior of the box is a critical preparatory step for the varnishing process. Applying varnish and executing craft decorations demands meticulous attention, involving repeated hand strokes to coat the box's surface uniformly. The material prepared for application must be smoothly integrated into the lacquer surface of the box, emphasizing uniformity and aesthetics while minimizing imperfections. This careful process ensures that the box not only serves its protective function but also enhances the overall presentation and value of the tea set.

3.2Production steps

After completing the production of rice husk composite panels, the next step is to cut them. Cutting process should be based on the actual demand to determine the size of the plate. During the production of rice husk composite panels, we have fully considered a variety of application scenarios, so when cutting to ensure that the size of the plate meets the preset requirements.

Firstly, based on the design plan, the required sheet size is determined. This includes length, width and thickness in three directions. Length and width determine the surface area of the sheet, which directly affects its use; thickness is related to the stability and durability of the sheet. In the actual cutting process, make sure the dimensions are accurate so as not to affect the subsequent use. Select the appropriate cutting tools. For different thicknesses of rice husk composite panels, you can choose to use tools such as cutting, sawing or laser cutting. When choosing tools, consider their precision and efficiency, while ensuring that the cutting process will not cause damage to the plate.

Next, the actual cutting operation is performed. During the cutting process, operators should follow safety procedures to ensure the safety of themselves and others. At the same time, care should be taken to keep the cutting line neat and avoid burrs and jagged cuts to ensure the beauty and practicality of the sheet.

Finally, the cut rice husk composite panels are accepted. Check whether the size, shape and surface quality of the board meet the requirements. If there are any substandard products, the problem should be identified, the cause analyzed, and corresponding measures should be taken to deal with it. In the process of cutting the rice husk composite board into the required size, we should pay attention to the dimensional accuracy, sheet quality and safety. Through reasonable cutting, the rice husk composite panels can better meet the needs of various application scenarios and give full play to its advantages of environmental protection, energy saving and sustainable development as shown in Figure 109.

Figure 109 Cutting of rice husk boards
Source: Drawn by Ye Li, 2023

In China's traditional wood craft, the mortise and tenon technique is a unique technique that allows for the skilled joining of wood to form a solid and beautiful structure. Mortise and tenon technology is not only used in furniture making, but also widely used in the production of various wooden products, including packaging boxes. Today, let's learn how to make a rice husk box using mortise and tenon joinery.

Firstly, we need to prepare some basic tools, such as saws, rulers, pencils, scribes and so on. Then, divide the cut rice husk boards according to the designed size and shape, and scratch out the corresponding mortise and tenon structure. In this process, make sure that the thickness of the rice husk boards is uniform for the subsequent splicing work. Next, we can start the mortise and tenon splicing. According to the design, the rice husk boards are spliced according to the mortise and tenon structure to form the basic shape of the box. In this process, pay attention to maintain the stability of the mortise and tenon structure to ensure that the spliced box can withstand a certain amount of weight Finally, the box is assembled, checking whether the various components are tightly connected to ensure its stability.

The rice husk board packaging box made by using mortise and tenon technique not only has high practicality, but also has unique artistic value. This kind of box is suitable for various occasions, such as holiday gifts, business gifts, etc. It can reflect the concept of environmental protection and also show the charm of our traditional wood craft. In the future development, we hope that mortise and tenon technology can be applied in more fields, adding more beauty and creativity to people's life as shown in Figure 110.

Figure 110 Patchwork Box
Source: Photography by Ye Li, 2023

To enhance the packaging box's surface preparation: Initially, a thorough examination of the box's construction and texture is imperative. This includes identifying any metal connectors on the packaging that must be carefully dismantled, as illustrated in Figure 111. This step ensures a clean and unobstructed surface for

subsequent treatments, emphasizing attention to detail and precision in the preparation phase to achieve an optimal outcome in the packaging process.

Figure 111 Wooden Box
Source: Photography by Ye Li, 2023

Sanding: first of all, use 400 mesh water-soluble sandpaper on the box to do pre-processing, sanding should be carried out along the grain, and then were replaced with 600 mesh, 800 mesh, 1000 mesh, 2000 mesh sanding, until the wooden box smooth and delicate until, as shown in Figure 112.

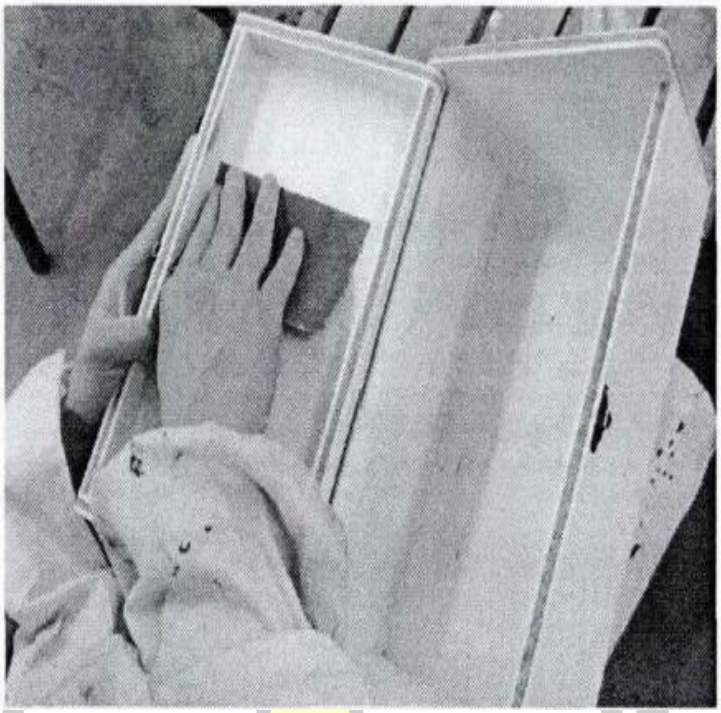


Figure 112 Sanding
Source: Photography by Ye Li, 2023

Scrape putty: sanding process found to fill (loophole) places, to find the right shape and size of wooden strips. Fill, be careful to fill, because fill is not good, will open the board out of cracks, it will be abandoned, leading directly to the wooden box cannot be done, even after the wooden box will be deformed, fill and then take 2000 mesh water-soluble sandpaper sanding, sanding to be careful, should not be too fast, too big, fill the place to be sanded smooth, such as Figure 113 Shown.

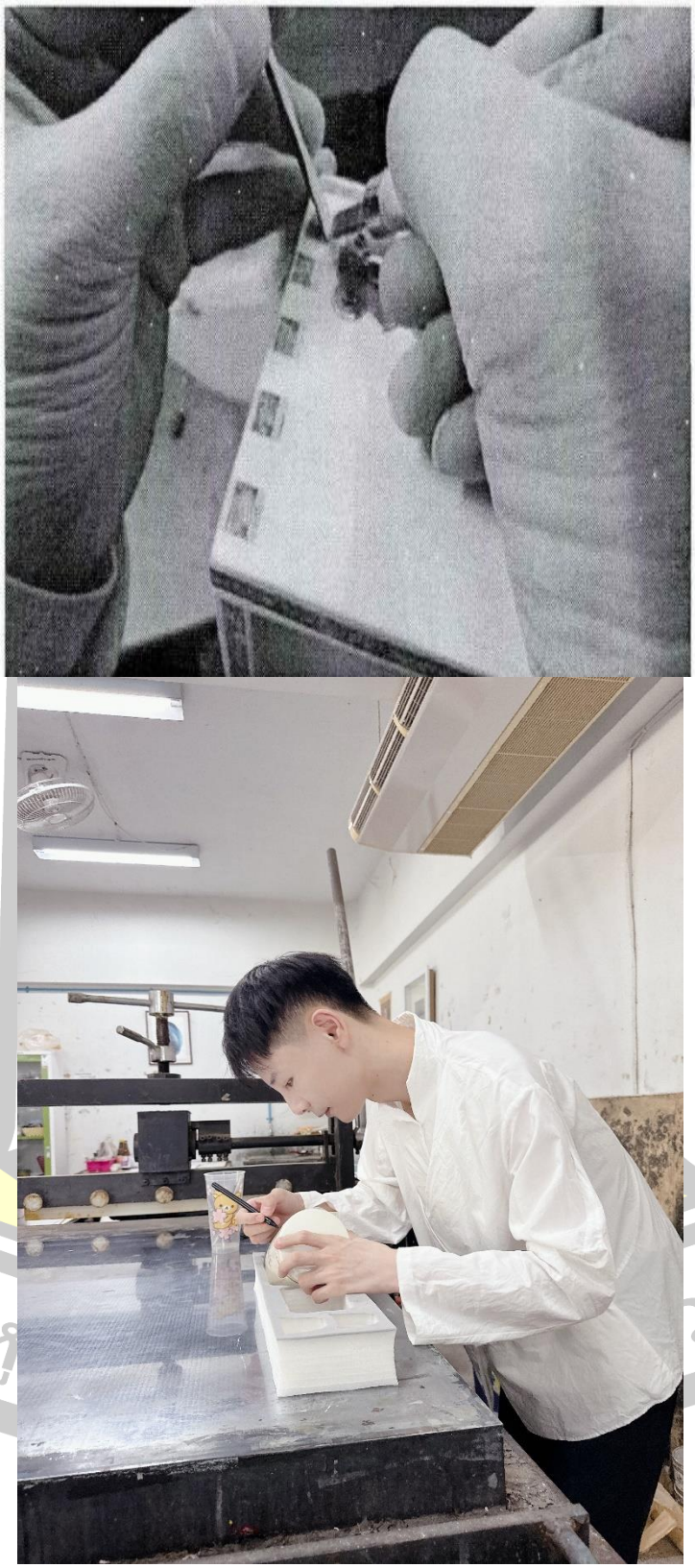


Figure 113 Filling
Source: Photography by Ye Li, 2023

Brush varnish: this step three boxes can be done at the same time. As the wood of the box is easy to absorb paint, so we should brush it thinly, and then brush the second layer after it dries, so as to avoid too much moisture absorbed by the wood and lead to the deformation of the wooden box humidity. This step requires 3 coats of varnish on the inside and outside to seal the wood against moisture. A total of 5 coats of varnish are required to complete the final result, as shown in Figure 114.

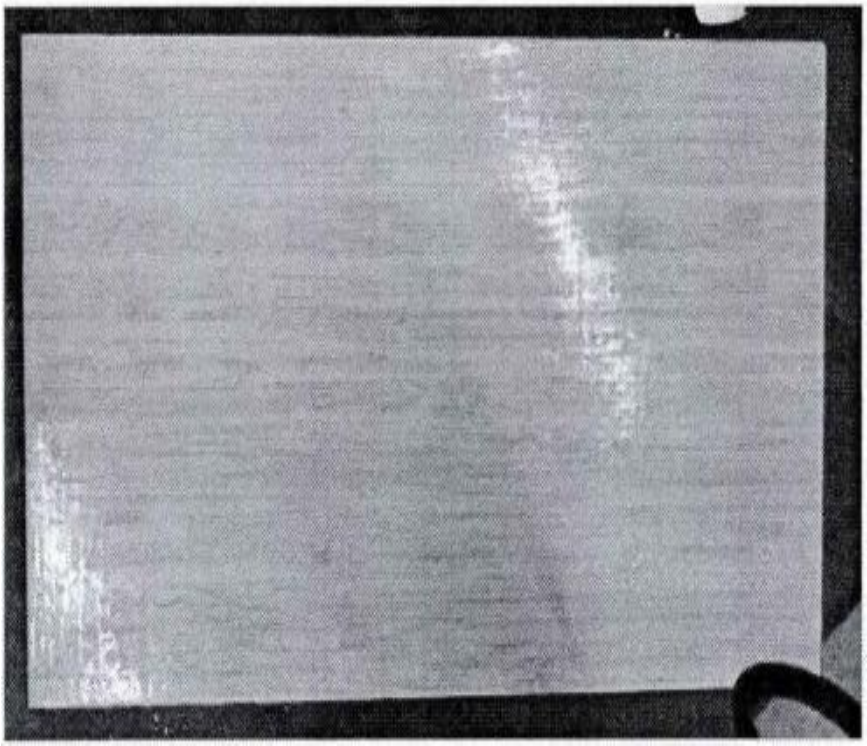


Figure 114 clear coat effect
Source: Photography by Ye Li, 2023

Before proceeding to the next step, make sure that the varnish is completely dry. During the process of varnish drying, we need to prepare some necessary tools and materials, such as copy paper, manuscript paper, ball-point pen, and special blade for carving. When the varnish is dry, we can start to put the pattern. This process involves sticking the copy paper and manuscript paper on the surface of the box respectively, and then using a biro to gently trace the pattern onto the box. During this process, please pay attention to keep the strength even to avoid the situation of different thickness of the lines. After completing the pattern placement, we need to tear off the copy paper and manuscript paper. This process should be done carefully so as not to damage the already depicted pattern. After tearing off, we can clearly see the pattern on the box. Next, use the special blade for engraving to carve along the contours of

the pattern. During this process, make sure that the blade is moderately strong, neither too light nor too heavy. Too light will result in an inconspicuous engraving effect, while too heavy may damage the box. At the same time, it is important to maintain the stability of the blade to avoid shaking during the engraving process. With the gradual emergence of the contour, we can see the sketch relationship on the box is gradually presented. This process requires patience and care, and once there are mistakes, you can use the engraving blade to correct them. Finally, when we have completed the entire sketch relationship, we can make appropriate retouching and optimization of the work. This process can use some tiny tools, such as brushes and fine pens, to adjust the lines and add details. After the above steps, a beautiful piece of sketching work will be completed. Throughout the process, we need to pay attention to keep our tools clean and maintained to prolong their service life. At the same time, continue to accumulate experience and exercise skills in order to make our work more outstanding. As shown in Figure 115.

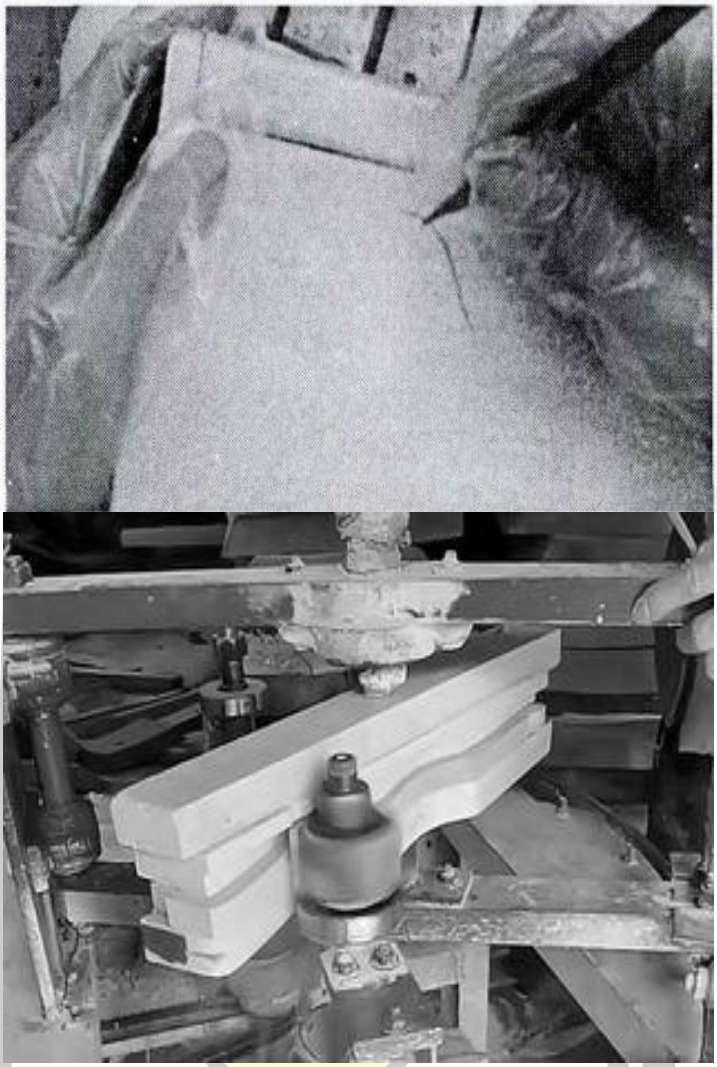


Figure 115 Cast engraving
Source: Photography by Ye Li, 2023

Ceramic art in China has a long history, its unique charm and exquisite skills loved by people in the mountain shape of the ceramic piece of paste porcelain process, craftsmen will be fired ceramic piece cleverly inlaid on the top of the outer packaging box, giving the box a unique visual effect and artistic value. First of all, we have to understand the production process of ceramic piece. Ceramic pieces are made from high-quality porcelain clay through careful screening, grinding, blending, molding, drying, firing and other processes. Each step of the process requires the rigorous attitude and rich experience of the craftsmen. After firing, the ceramic pieces have a hard texture, bright color and different patterns, laying the foundation for the subsequent paste porcelain process.

Next, there is the porcelain pasting session. Based on the design drawings, the craftsmen select the appropriate ceramic pieces and stick them one by one onto the box with a special glue. This process requires a great deal of patience and skill, as the shapes, sizes, color and textures of the ceramic pieces need to be carefully matched to ensure that the overall effect is aesthetically pleasing and harmonious. During this process, the craftsmen give full play to their creativity, making each piece a unique work of art. Once the paste is finished, it needs to be retouched and polished. Craftsmen should use fine sandpaper to gently polish the joints between the ceramic pieces to make them smoother and flatter. At the same time, a layer of luster can also be applied to the ceramic piece to make it more brilliant. After finishing and polishing the ceramic piece veneer works, presenting a natural, elegant beauty. Finally, there is the acceptance of the finished product. Craftsmen will strictly check each piece of work to ensure that the paste porcelain solid, clear patterns, color matching harmony, beautiful shape. Only works that meet the high standards can be considered as qualified ceramic veneer works of art. The mountain-shaped ceramic piece paste porcelain craft perfectly combines the traditional charm of China's ceramic art with modern aesthetics, making these boxes a unique cultural gift. In the gift of family and friends or business occasions, such ceramic paste porcelain works not only means a good blessing, but also the treasure of China's traditional culture, highlighting the unique artistic flavor as shown in Figure 116.

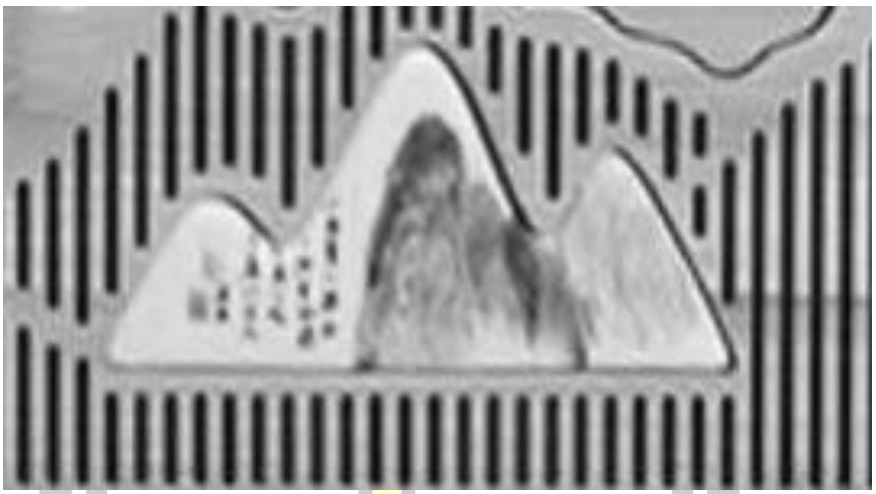


Figure 116 Applying porcelain tiles
Source: Photography by Ye Li, 2023

3.3Showcase of works

Rice husk panels are developed into green ceramic packaging, which is environmentally friendly and promotes ceramic culture. The process of making rice husk board includes collection, processing, preparation, surface treatment and molding which is treated with high temperature and pressure to provide good performance. The green ceramic packaging design focuses on shape, structure, environmentally friendly materials and easy degradation to reduce environmental impact. This will help reduce the environmental burden of the ceramic industry, enhance the brand image of Jingdezhen ceramic culture, and promote the green transformation of the industry. The government and enterprises should increase investment in research and development, cultivate the industrial chain, strengthen publicity, improve consumer awareness and promote market demand. Deepen the application of rice husk board, promote ceramic culture, and promote the green transformation and sustainable development of China's ceramic industry as shown in Figure 117.

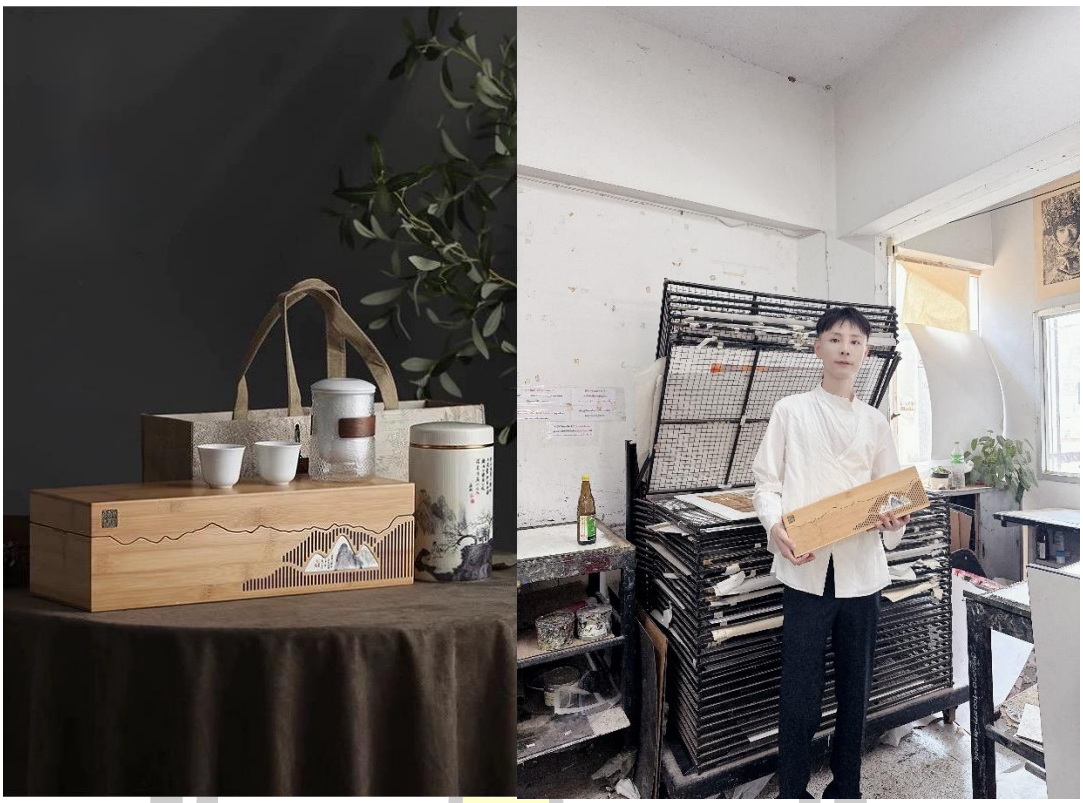


Figure 117 Summary and conclusions
Source: Photography by Ye Li, 2023

By exploring the importance of Jingdezhen ceramic packaging design in the perspective of sustainable development and the close connection with local culture, this paper provides an in-depth analysis of the integration of green packaging and traditional ceramic culture, which provides useful thinking and guidance for the sustainable development of Jingdezhen ceramic industry. In conclusion, green packaging not only reflects the social responsibility of enterprises in terms of environmental protection, but also injects new vitality into the inheritance of traditional ceramic culture.

In the global environmental problems are more and more prominent today, green packaging has become the common concern of all walks of life. Jingdezhen ceramics as a representative of traditional culture, its packaging design should not only have market competitiveness, but also should be sustainable oriented, to reduce the burden on the environment as the goal, while taking into account the cultural heritage and innovation. Through the introduction of environmentally friendly materials, reduce packaging waste, promote renewable energy and other ways, Jingdezhen ceramics

packaging design can win more consumers for the enterprise, set up a brand image, to achieve a win-win situation of economic and social benefits.

At the same time, packaging design is also a carrier of local cultural heritage. Traditional ceramic culture is a valuable treasure of the Chinese nation, and packaging as the external expression of ceramics, carrying cultural symbols and values. By integrating traditional ceramic elements into packaging design, not only can consumers feel a strong cultural atmosphere when buying products, but also help to stimulate people's knowledge of and interest in traditional culture. This combination of cultural heritage and innovation in packaging design helps to expand the market influence of Jingdezhen ceramics, making it more competitive in the domestic and international markets.

In short, the integration of green packaging and local culture in Jingdezhen ceramic packaging design is not only to adapt to the needs of modern sustainable development, but also for the continuation of traditional cultural treasures. In the future development, Jingdezhen ceramic enterprises should continue to innovate in packaging design, the concept of environmental protection and local culture into it, in order to achieve sustainable development and cultural heritage of the dual objectives. Through such efforts, Jingdezhen ceramic packaging design will bring broader market prospects for enterprises, but also for the protection of the earth's homeland and inheritance of human civilization to make a positive contribution.

Chapter VI

Conclusion discussion and suggestions

1. Conclusion

In the exploration of packaging design within the Jingdezhen ceramic industry, amidst rising global environmental concerns, the pursuit of sustainability, ecological consciousness, and the harmonious coexistence of tradition and innovation has become imperative. Jingdezhen ceramics, embodying the rich tapestry of Chinese heritage, must encapsulate both environmental stewardship and cultural perpetuation in its packaging design. This chapter delves into the critical role of sustainable development in Jingdezhen ceramic packaging and its intrinsic link to local culture, offering insights for the industry's forward momentum.

1.1. Green Packaging: A Mandate for Environmental Stewardship and Sustainable Evolution

The spotlight on green packaging intensifies as environmental issues take center stage globally. For Jingdezhen ceramics, a beacon of cultural heritage, packaging designs must resonate with contemporary eco-friendly directives. Green packaging is characterized not just by its low environmental impact and utilization of sustainable materials but also by a design philosophy rooted in the principles of sustainability.

In adopting materials that are both recyclable and biodegradable, Jingdezhen's ceramic packaging can significantly reduce the ecological footprint of its production processes. A design ethos that champions minimalism and functionality simultaneously reduce excess waste. This approach not only aligns with the eco-conscious predilections of modern consumers but also aids in sculpting a reputable brand image conducive to both economic gain and societal value.

1.2 Local Culture: A Harmonious Blend of Tradition and Novelty

Packaging, the tangible envelope of commodities, serves as a conduit for cultural expression. The storied tradition of ceramic culture represents a valuable cultural asset, making the packaging a crucial medium for cultural symbology and values. Integrating elements emblematic of traditional ceramics such as the iconic blue and white patterns, diverse glazes, and intricate designs into Jingdezhen’s packaging not

only endows consumers with a culturally immersive purchasing experience but also fosters appreciation and understanding of this rich heritage.

Yet, cultural fidelity does not equate to stagnation. Innovation must meld with tradition, marrying traditional aesthetics with contemporary design sensibilities to elevate Jingdezhen's ceramic packaging designs to new heights of market appeal. For example, modern interpretations of classic patterns or the application of cutting-edge technologies in packaging design can rejuvenate traditional motifs, making ceramic products more aesthetically compelling.

1.3 Merging Green Packaging with Local Culture: Jingdezhen's Ceramic Industry's Visionary Path

The confluence of green packaging and local cultural elements is a strategic evolution for Jingdezhen's ceramic packaging design, bolstering product competitiveness while invigorating traditional culture's legacy. Moving forward, Jingdezhen's ceramic enterprises should persist in innovating packaging designs that embrace both eco-sustainability and cultural richness.

Enterprises need to elevate environmental consciousness, choosing sustainable materials and processes to mitigate pollution and resource consumption. Embracing simplicity and pragmatism in design reduces waste, crafting a greener brand persona.

Delving into the depths of local cultural heritage, blending traditional motifs with modern design principles, creates packaging that captivates and educates, bridging past and present.

Moreover, fostering collaborations with designers and research bodies, both domestically and internationally, propels the innovation and diversification of Jingdezhen's ceramic packaging. Embracing advanced design ideologies and technologies elevates the sector's standards and competitiveness.

In essence, the integration of green initiatives and cultural homage in Jingdezhen's ceramic packaging design carves a path that aligns with sustainable development goals while celebrating the heritage's vibrancy. As Jingdezhen ventures into this explorative realm, blending environmental ethics with cultural pride, it contributes profoundly to the sustainable and cultural renaissance of the ceramic industry.

2.Discussion

This article explores the pivotal role of Jingdezhen ceramic packaging design within the spheres of sustainable development and cultural heritage, underscoring the synergy between eco-friendly packaging and traditional cultural motifs. By embracing green packaging solutions, the Jingdezhen ceramic sector not only champions environmental stewardship and social responsibility but also breathes new life into ancient cultural expressions, crafting a harmonious fusion of economic viability and cultural richness.

Amid escalating global environmental challenges, green packaging transcends its role as a marker of corporate responsibility, emerging as a strategic imperative to align with market expectations and ensure sustainable practices. Jingdezhen's ceramic industry, heeding the global call for sustainability, has adopted environmentally benign materials, minimized packaging excess, and pursued additional eco-conscious strategies. These initiatives not only bolster the industry's image but also resonate with eco-aware consumers, bolstering ceramic sales as shown in Figure 118.

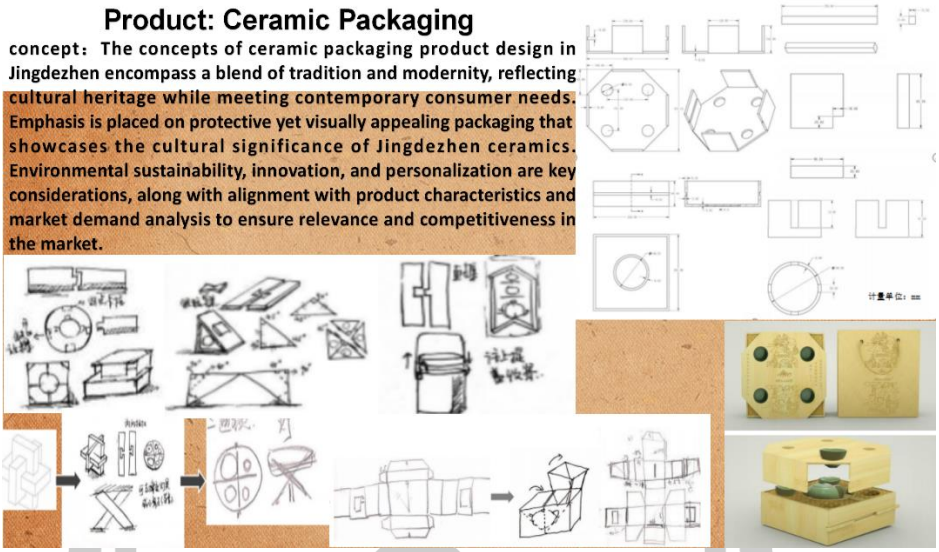


Figure 118 Concept Design
Source: Drawn by Ye Li, 2023

Furthermore, the infusion of traditional cultural elements into packaging design transforms these vessels into ambassadors of cultural legacy, enriching the Jingdezhen ceramics' identity. This melding of heritage and modernity through design ignites consumer fascination with the rich tapestry of ceramic culture. Such innovative approaches to packaging not only underscore the distinctiveness of Jingdezhen ceramics but also secure a competitive edge in the marketplace.

Looking ahead, the Jingdezhen ceramic industry is encouraged to maintain a laser focus on cutting-edge packaging design, weaving environmental principles and local cultural narratives into its fabric. Collaborating with environmental bodies, conducting thorough market analysis, and leveraging consumer insights can sharpen market acumen and amplify product appeal. Moreover, a proactive stance on exploring novel, sustainable packaging solutions will further diminish the environmental footprint, supporting not just the longevity of business operations but also enriching the cultural heritage narrative.

In essence, the intertwining of sustainability and cultural stewardship through Jingdezhen ceramic packaging design not only opens new horizons for business growth but also offers meaningful contributions to societal and environmental well-being. With a commitment to ongoing innovation, cooperation, and exploration, the Jingdezhen ceramic industry stands on the cusp of a brighter, greener future in packaging design.

3 Suggestion

1. Promoting Green Packaging Standardization: Encourage the Jingdezhen ceramics industry to participate in and promote the formulation and adherence to green packaging standards. Collaborate with industry associations and relevant organizations to jointly establish green packaging standards within the industry, ensuring that enterprises meet collectively recognized standards for sustainable development.

2. Conducting Packaging Design Competitions: Organize packaging design competitions to attract the participation of more innovative designers. This approach can unearth novel and unique packaging design concepts, stimulate the creativity of design teams, and provide diverse sustainable packaging options for businesses.

3. Establishing a Sustainable Supply Chain: Establish close partnerships with suppliers, jointly committed to building a sustainable supply chain. Ensure that every link from raw material procurement to packaging production complies with environmental standards, thereby enhancing the sustainability of the entire industry chain.

4. Advocating Packaging Recycling Programs: Promote packaging recycling programs and encourage consumer participation. Collaborate with local governments, community organizations, and others to establish packaging recycling points, and formulate incentive mechanisms to encourage consumers to actively recycle and handle packaging materials.

5. Strengthening Brand Storytelling and Cultural Communication: Enhance the communication of brand stories and local culture on packaging. Through narrative designs on labels and packaging, convey the history and cultural significance of Jingdezhen ceramics to consumers, deepening their emotional connection to the products and increasing brand loyalty.

6. Collaborating with Educational Institutions: Establish partnerships with educational institutions in the fields of design, art, and environmental conservation. By providing internship opportunities, collaborative projects, and other means, attract young design talents to engage in green packaging design and promote the injection of innovative thinking.

7. Regular Evaluation and Reporting: Regularly assess the implementation effectiveness of green packaging design and transparently report to society. This helps build the credibility of the enterprise while inspiring other industries to engage in the practice of green packaging design.

By integrating these suggestions, the Jingdezhen ceramics industry can establish a more comprehensive and systematic sustainable development system, achieving overall improvements in environmental protection, social responsibility, and cultural heritage preservation. This will better position the Jingdezhen ceramics industry to adapt to the trends of the times, protect local cultural heritage, and secure a sustainable future.

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