Research on Application of Ceramic Materials in Public Art Environment

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Abstract. The goal of this paper includes three aspects. First, we want to study the current situation of the use of materials in public art. Second, we want to explore the advantages and disadvantages of ceramic materials. Third, we want to study the utilization of ceramic materials. For this propose, we discuss the application scheme of ceramic materials in public art, and try to understand the influence of ceramics on public art. Then, we consider the relationship of ceramic materials in public art with modern science and technology. According to the application principles and forms of ceramics, the application of ceramic materials in public art is analyzed to confirm the contribution and availability of ceramic materials to public art.

1. Introduction
In public art creation, the understanding, cognition and ability to control materials are the key to public art aesthetics. The color, morphology, strength, specific gravity, brightness, ductility, shrinkage, oxidation resistance, and corrosion resistance of different materials all have an important impact on the shape and theme of the work. With the popularization of public art concepts and knowledge in recent years, people have gradually put forward new ideas and needs for public spaces and the environment. Public art is not only just a concept in terms of aesthetics and sociology, but also a comprehensive art that combines various elements. The "natural publicity" and "ecological design concept" of ceramic materials are the key points connecting public art and ceramics.

2. Application Status of Ceramic Materials in Public Art Environment
Ceramics have the characteristics of natural environmental protection and affinity, which meets people's spiritual needs and aesthetic appeal. Ceramics are also in line with people's emotion of calling for "nature, ecology, and humanity", and connects the relationship between people, environment and society. As a carrier that fully embodies humanistic characteristics, ceramics have unparalleled advantages in natural properties such as plasticity, compression, corrosion resistance, heat resistance, and sunlight resistance. The application of ceramic materials in public space environment not only enriches people's visual experience, but also embodies cultural value and social significance.

The ceramics intervene in the public art environment, which enhances the intimacy of the space environment. On the one hand, it provides a better space for thinking in the broad sense of public art; on the other hand, it also brings a broader display space for ceramic materials. However, in the public art environment, the application range of ceramic materials is not large compared to metals, alloys,
stones and other materials. Although it has unparalleled advantages, it also has obvious shortcomings, which are limited by materials, processes and places, and functions. Such as the manufacturing process of ceramics is complex, and the ceramics are easy to shrink and deform, meanwhile, it is difficult to grasp the final effect, and it is also fragile.

3. Characteristics of ceramic materials

With the development of ceramic art towards diversification, the involvement of ceramic materials in public art is an inevitable result of social development. An in-depth understanding of ceramic materials can prompt the scientific way to take advantage of ceramic materials and reduce its limitations. Clay, alumina and kaolin are the main components of ceramic materials. Porcelain clay becomes pottery when it is burnt to 700 degrees, and it is porcelainized when it is burnt to 1230 degrees. Then, the sound is crisp, and the nature is stable, and the texture is hard. It has anti-fouling, waterproof, plasticity, environmental protection ecology and performance stability. In addition, the antibacterial and anti-noise properties of ceramics also meet modern environmental protection requirements. These basic properties are determined by the mud and glaze of the ceramic material.

Adding fiber materials to the mud can increase its toughness. The better the toughness, the less likely it is to break. In materials science, toughness refers to the resistance of a material to fracture when subjected to force. In ceramics, toughness is the ability of the mud to resist external forces. The better the toughness, the less likely it is to deform when stressed. The toughness of traditional mud depends on the proportion of clay contained in the mud. The main component of clay is silicon dioxide (more than 70%), as well as magnesium oxide, calcium carbonate and a small amount of aluminum oxide (about 14%-18%). High clay content means good toughness, while low clay content means poor toughness. The toughness of the clay itself and the fibrous material will be enhanced when the fibrous material added to the clay. It can make the work more resistant to compression and elongation, and it will be stronger when fired and not easy to deform.

Different mud materials have different mud properties and give people different feelings. Many potters regard mud as a creative partner. French potter Georges Jeancls Mosse said, "Clay has memory, and all actions you apply to it will be reflected. Clay also has its own temper." The final result of the work is the result of the joint creation of the artist and the clay.

The ceramic glaze is of glass nature, which is based on minerals such as feldspar, kaolin, mica, quartz, etc. The color-determining colorants are copper, iron, cobalt, manganese, titanium, gold and other metal oxides. Different forming methods and firing temperatures will also produce different effects. The glaze will gradually melt during the firing process for several hours. The glaze can be divided into high-temperature glaze (about 1300 degrees), medium-temperature glaze (about 1200 degrees) and low-temperature glaze (about 1000 degrees) according to the firing temperature. When the temperature of the kiln reaches the agreed temperature value, the elements in the glaze will be changed into liquid state, and the glaze and mud will become one, forming a sealed protective layer on the outer surface. The heat causes chemical changes in the raw material molecules in the glaze. The crystal structure in the raw material is destroyed, and then transformed into an invisible, randomly combined glassy structure. This invisible structure will be gradually shaped during the kiln's temperature drop, hardened and condensed on the outer surface of the green body, forming a glassy protective film.

4. Combination of ceramic materials and modern technology

4.1. Combined with screen printing technology

Screen printing belongs to the stencil printing category, which is listed as four major printing techniques together with offset printing, letterpress printing, and gravure printing. Screen printing is the most widely used printing process in stencil printing. It uses a silk screen as a printing plate and a screen frame as a support body. The screen plate is tightly stretched on the screen frame at a certain angle and tension, and is made by the photochemical effect. Compared with other printing, it has less investment, low cost and wide application range.
The combination of ceramic materials and screen printing technology is more common. The use of digital technology has greatly improved the speed and accuracy of production, and changed the design concepts of contemporary architecture and environmental art. Digital technology and printing technology have widely influenced the design of environmental public art. For example, Robert Rauschenberg, who is an outstanding American contemporary artist, has applied screen printing to ceramic tiles for the first time in the 1980s. This provides a new form of expression for ceramic art creation.

At present, Germany and Japan already have decals that can burn both low temperatures around 750°C and 1340°C. The Norwegian artist Oie Lislerud, who is good at the creation of architectural tile murals, directly combines digital photography technology, computer and ceramic screen printing on the tiles. He processed the photos through computer software and used screen printing technology to make decals. His mural work "The Gate of China" shows the theme of "people, nature, environment" and constitutes a unique landscape of "World Ceramic Culture Square". He endowed ordinary tiles with rich cultural information and became a carrier of cultural traditions, not only retaining the structural beauty and geometric beauty of the building itself, but also endowing the architectural space and artistic expression.

4.2. Combining with 3D printing technology

3D technology is a rapid prototyping technology that creates a physical model in a cumulative manner of powder materials. Since the advent of the first 3D printer in the 1980s, the types of printing materials, molding principles, and application fields have been rapidly developed. Ceramic 3D printing is a combination of ceramics and digital technology. Based on the three-dimensional model files of ceramic works, the ceramic materials are layered through a 3D printer to make ceramics. The 3D ceramic printing process has a direct molding method and an indirect molding method. Using laser direct molding, this method has fast molding and high accuracy. However, it also has several drawbacks, such as large consumption, high hardware requirements and high cost, which make it not conducive to large-scale promotion. The indirect molding is to wrap the mud powder with polymer materials and print it by machine. Heating the polymer material to make it melt and bond to shape, and finally through firing and other processes. The cost is low, but the subsequent process is complicated, time-consuming and the accuracy is poor.

Dutch artist Oliver Van Herpt uses a ceramic 3D printer to create the works, and his representative work is co-created with sound artists. The use of sound waves generated by music to shape the work. The method is to place a speaker at the bottom of the ceramic 3D printer. The speaker will fluctuate when the sound appears, causing the printing table to vibrate, and the diluted mud will be vibrated by the sound wave to create a specific three-dimensional work. The creative concept stems from the ripple effect of the ceramic 3D printer during the printing process. He turned a natural phenomenon into a pottery work. The work successfully combines an unexpected phenomenon with science and technology, and uses a physical phenomenon to carry out creative activities to give music a real shape.

5. Conclusion

The limitation of ceramic materials in public art restricts its development in the public art environment in terms of shape, size and installation. The combination of ceramic materials and modern technology is determined by the characteristics of ceramic materials and the development trend of public art, and it can be regarded as an inevitable result of the development of public art history. It not only makes ceramic material gain strengths and weaknesses in public art, but also broadens the scope of public art, and the diversity of materials, forms, and contents. The development and transformation of the combination of ceramic materials and modern science and technology has promoted the development of ceramics in public art. In the future development, we not only need to explore the possibility of combining ceramics with modern science and technology, but also need to in-depth study of the spirituality of ceramic materials. This will make it more meaningful and valuable.
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