# Inspiration from the History of Chinese and Hungarian Building Ceramics Manufacturing Technology to Industrial Smoke Control

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**Abstract: Chinese and Hungarian architectural ceramics manufacturing technology is of the same origin, and both have certain influence in the world. In particular, Zsolnay, a Hungarian architectural ceramics brand, has made breakthroughs and innovations in the production process of products in the inheritance of more than 100 years, forming a unique architectural ceramics manufacturing technology. It can effectively reduce the concentration of flue gas particulate matter and sulfur dioxide produced in production. The historical experience of the development of building ceramic manufacturing technology in China and Hungary is of enlightenment to the current industrial smoke control.**

**Key words: building ceramic production technology; historical relevance; smoke control; enlightenment**
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In recent years, China's atmospheric environment has been plagued by haze, which has become worse year by year and has a great impact on people's health. One of the main reasons for haze is that industrial smoke management is not in place, leading to visible particulate matter (also known as PM2.5) in the smoke and sulfur dioxide concentration exceeds the standard, causing air pollution.[1] At present, the treatment effect of industrial waste gas in China is not ideal, especially the treatment efficiency needs to be improved.[2] How to control industrial flue gas and reduce the content of harmful substances in flue gas has become a difficult problem for China and other countries.

China has a long history of building ceramics manufacturing. The smoke produced by the firing process of Chinese building ceramics also contains a large number of particulate matter and sulfur dioxide, similar to the main harmful substances of industrial smoke. However, after years of technological innovation, the kiln did not produce industrial flue gas with high concentration of pollutants in the production without additional desulfurization facilities.

Hungarian architectural ceramics production technology in Europe and even the world has a certain influence. Its production technology was derived from the traditional Chinese porcelain production technology and further developed and innovated according to the unique soil and mineral resources of Hungary, forming unique ceramic products in the inheritance of more than 100 years. Researching the history of Chinese and Hungarian building ceramics manufacturing technology, and summarizing the historical experience of smoke

control in building ceramics manufacturing technology of the two countries, which has an enlightening effect on the current industrial smoke control.

## HISTORICAL CONNECTION BETWEEN CHINESE AND HUNGARIAN CERAMIC MANUFACTURING TECHNIQUES

### The incoming of Chinese ceramics

The historical connection between China and Hungary is closely related to the opening of the land and sea silk Roads. Starting from Chang 'an, the ancient capital of Han and Tang dynasties in China, the "Ancient Silk Road", a trade road stretching nearly ten thousand kilometers, connected China and Ancient Rome.[3] However, the overland transport conditions could not satisfy the transport condition of fragile porcelain, so the overland Silk Road only played a role of communication between China and Eastern European countries. Since the 8th century, with the development of ancient maritime industry, the low cost, high safety and high product integrity rate of shipping enabled Chinese porcelain to reach countries along the route for sale in good condition, thus the Sea Silk Road, also known as the "Ceramic Road", was established.

The "Ceramic Road" introduced a steady stream of export porcelain and imperceptible Chinese culture to the countries along the Eurasian continent at that time.The large influx of porcelain and the exchange of Chinese culture provided the accumulation of original samples and experience reserve for the study of porcelain making technology in Hungary. It can be said that the "ceramic road" is the foundation for the development of Hungarian ceramic making technology.

### The type of Chinese porcelain that affects Hungarian ceramics

China has a long history of ceramic culture, such as the white porcelain and the green porcelain of the Sui and Tang dynasties, the blue and white porcelain, glaze red porcelain, bucket color and colorful porcelain of the Yuan and Ming dynasties are representative types of Chinese ceramics. Given that China has a wide variety of ceramics spread in Europe through the silk road, before to research the historical association between China and the Hungarian ceramic production process, it is important to make clear what kind of Chinese porcelain in Hungary is to combine innovation for the study sample.

From the historical process of the development of "ceramic road", the export of Chinese ceramics can be divided into three stages. The first stage is from the late Tang and Five Dynasties to the early Song Dynasty. With the opening of the Silk Road, Chinese porcelain began to be exported to Central and West Asia and other Islamic regions as early as the Tang Dynasty.[4] Due to the lack of early shipping technique, the export of Chinese porcelain did not reach eastern Europe, so that the main types of porcelain from the late Tang dynasty to the early Song Dynasty were not the types that influenced the Hungarian ceramic craft. The second stage of The export of Chinese ceramics was from Song and Yuan dynasties to the early Ming Dynasty. The export porcelain of Song and Yuan dynasties was exported to more countries than before, including all countries in Northeast Asia and Southeast Asia, most countries in South and West Asia, countries on the east coast of Africa and inland Zimbabwe.[5] During this period, China's main export routes covered more areas than before, and the expansion was concentrated in the Indian Ocean region, but still did not touch Hungary. The third stage is from the middle and late Ming Dynasty to the early Qing Dynasty. During more than 200 years, it was the golden age of Chinese porcelain export. The main types of porcelain exported during this period were blue and white porcelain and coloured glazed porcelain.[6] At that time, in order to prevent a large outflow of silver and save money, some countries began to learn Chinese ceramic making techniques and competed in imitation. According to the Zsolnay Museum in Hungary, the first white glazed porcelain was successfully fired in Europe in March 1709, while the first porcelain was successfully fired in Hungary in 1826. This also proves that during this period, blue and white porcelain and colored glazed porcelain became the main samples of imitation Chinese

ceramics in Europe. Since the craft of coloured glaze was imported from the Western Asia, it was deeply valued by ancient Chinese emperors and craftsmen through the study, practice and exploration by missionaries. Therefore, coloured glaze soon became part of the traditional utensils of the Chinese nation.[7] Compared with blue and white porcelain, coloured glazed porcelain, as an imported product from the Western Asia, is less difficult to imitate. Thus it can be seen that the sample of Hungarian imitation ceramic production process is based on the production process of coloured glazed porcelain.

## BREAKTHROUGHS AND INNOVATIONS IN HUNGARIAN ARCHITECTURAL CERAMICS

The most representative building ceramics in Hungary are mainly made from Zsolnay ceramics factory. Zsolnay ceramics factory takes architectural ceramics as its main business, absorbs the firing process of Chinese glazed ceramics, and learns the manufacturing process of Chinese glazed tile architectural finishes to produce architectural finishes.[8,9] It can be said that Zsolnay porcelain factory represents the highest level and innovation of flue gas control in the existing Hungarian architectural ceramic production process, which is of great research value.

Zsolnay takes its name from founder Zsolnay. Known for its unique glazes and hand coloring techniques, it has a history of 160 years. It carries the tradition and particularity of the Hungarian nation, but also has the characteristics of constantly innovating the old. The Matthias Church in Budapest and the Hungarian Parliament building are all decorated with ceramic tiles and other architectural finishes produced by Zsolnay.

In 1886, Zsolnay Porcelain Factory changed the furnace to tunnel kiln, abandoned the wheel kiln, and added the flue gas collection system and dry dust removal system to solve the key problems, such as improper temperature control in the open furnace when the traditional colored glaze was fired. The temperature difference in the furnace was large, which could easily lead to insufficient pigment dissolution and a large number of particles and industrial smoke. The industrial flue gas is treated by wet desulfurization. At the same time, the reform of glaze raw materials, integration of local rich pyrite, so that the dissolution of glaze combustion more fully, developed both beautiful and high temperature resistance, frost resistance, acid resistance and other characteristics of building ceramic materials.[10] This technique of fully dissolving and burning the glaze reduces the content of sulfur dioxide exhaust gas and particulate matter produced by pyrite ore. This is precisely the innovation of founder Zsolnay according to local conditions, the fusion of local rich pyrite, to create eosin ceramic finish manufacturing process.

## COMMONNESS AND CHARACTERISTICS OF SMOKE CONTROL OF BUILDING CERAMIC IN CHINA AND HUNGARY

Based on the continuous development of Chinese and Hungarian architectural ceramics, although both countries have made improvements according to their own characteristics, there are still some experience to learn. Through the historical comparison of smoke control in the manufacturing process of building ceramics in the two countries, the similarities and differences between the two are discovered, and the advantages of smoke control are easier to be found.

The main properties of Chinese and Hungarian architectural ceramics are moisture-proof, cold-resistant, wear-resistant and pollution-resistant, and the main raw materials used are ores rich in sulfur dioxide and aluminum oxide. Therefore, desulfurization treatment after combustion is essential to the production process. In order to reduce air pollution in closed kilns and protect the health of kiln workers, China and Hungary both have adopted limestone-gypsum desulfurization technology. Its working principle is: the limestone powder is added to water to make slurry, and then the solid sodium hydroxide is pumped into the absorber by multi-stage pumps and sprayed evenly in the flue. Make it fully react with industrial flue gas, the sulfur dioxide contained in the flue gas reacts with calcium carbonate to generate calcium sulfate, and finally

crystallizes to form dihydrate gypsum. After dehydration treatment, it can also be sold as a chemical product.10 This kind of flue gas treatment technology has been applied in some thermal power plants in the United States, Germany and so on.

## INSPIRATION OF BUILDING CERAMICS MANUFACTURING TECHNOLOGY TO INDUSTRIAL SMOKE CONTROL

China and Hungary are the two leading countries in the world in terms of building ceramic production technology, and they both have unique treatment methods for the harmful smoke in the production of building ceramic industry. Based on the historical correlation research of the manufacturing process of Chinese and Hungarian building ceramic materials, the following two enlightenment for the current industrial smoke control are proposed:

First, based on the inspiration of learning, Hungarian architectural ceramic materials and production techniques come from China, but have their own unique innovation. The manufacturing technology of building ceramics in both countries is unique in the treatment of industrial flue gas. Whether it is in the sufficient degree of raw material combustion, the design structure of the furnace or the treatment of the flue gas, it can be learned and used for reference.

Second, based on the inspiration of improving economic benefits, the manufacturing process of Chinese and Hungarian building ceramics is different from simple flue gas desulfurization treatment. In addition to reducing particulate matter and sulfur dioxide, hazardous materials are processed and refined to produce additional chemical products. This way makes full use of resources and increases industrial output value and economic benefits. This kind of environmental protection, economic flue gas treatment way also provides the enlightenment to improve the economic benefit for industrial flue gas treatment.

## Author Declaration

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