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Design Analysis and Research of Hydraulic Ecological Glass with Controllable Light Transmittance Function Based on Green Building Concept

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Abstract This paper analyzes the related concepts of green buildings and hydraulic ecological glass, and explains in detail the market competitiveness of hydraulic ecological glass in green buildings. Finally, it analyzes the concept of hydraulic ecological glass design, and summarizes the universality and importance of hydraulic ecological glass in green buildings and modern housing. Through the analysis and application of green building design concept in housing and environment, it is concluded that hydraulic ecological glass has good market competitiveness, and its promotion will have a better impact on the whole green building.

Key words Green buildings, Ecological glass, Building materials

1 Introduction

In the context of economic globalization, China's national economy is growing faster and faster. On this basis, great changes have taken place in people's quality of life and pursuit of life. With the sustained and rapid development of the construction industry and the profound changes in people's consumption level and concept, people pay more and more attention to decoration and construction, the safety of building materials and the urban human settlements. In order to achieve sustainable development, China needs to fully save energy and use science and technology to reduce the resource effect of basic projects. Green building materials are an important representative of the sustainable development of China's economy, energy and infrastructure. In the actual engineering construction, strengthening the use of green building materials is the key to promoting the vigorous development of the construction industry and active construction. These advanced green buildings gradually come to the fore, showing significant advantages different from traditional buildings. Hollow glass windows have the advantages of thermal insulation and noise reduction, but if we want to fully meet people's needs for privacy, we still need to add curtains outside the hollow glass windows, but it is followed by a series of problems, for example, the curtains are easy to stain and the curtains are more troublesome to clean. The multi-functional hydraulic ecological glass studied in this project has built-in transparent film and opaque film in the insulating glass, automatic reel, and remotely controlled built-in curtains to achieve the effect of shading, which highly meets the privacy needs of customers. Instead of adding curtains outside the insulating glass window, it can better solve the problems encountered by the external curtains. At the same time, TiO_2/SiO_2 composite film technology is used to improve the hydrophilicity of glass, so that the glass can achieve hollow self-cleaning function. On the other hand, it promotes the larger-scale application of insulating glass.

2 Development of green buildings and glass building materials

2.1 Development status of green buildings With the rapid development of science and technology and economy, all fields are full of vitality. In the field of construction, with the comprehensive and rapid development, it has brought great pressure on the environment and resources, so the concept of green building came into being. At present, green building in China has stepped into a new platform, but because a large part of the green materials used in our country are only solar energy and natural materials, there is still a lot of space in the field of green building materials worth exploring. Green building design is the center and trend in the field of architecture in China in the future. The relevant arguments mentioned in the *14th Five-Year Plan for Building Energy Saving and Green Building Development* promulgated by the Ministry of Housing and Construction can well verify this point of view.

2.2 Development status of glass building materials China's glass industry mainly touches on building materials, petrochemical, real estate industries, *etc.*, but its core area is in the real estate industry. Since 2016, the net new production capacity of glass building materials has been strictly controlled by the state, coupled with the relatively depressed real estate industry in recent years, glass capacity needs to be reduced. Due to the close relationship between glass building materials and real estate, the demand and development of glass has shown a stable trend for a long time. Although there has been a great development from the emergence of glass to today, some of the traditional glass with one-sided pursuit of performance has been gradually eliminated by the market. Therefore, with today's technological progress, the transformation of traditional glass has become a new trend. At the same time, against the backdrop of green buildings, the development of

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new ecological glass is the core of glass development in our country. At present and in the long run, the design, research and development of ecological glass in glass building materials is one of the hotspots in China's future building materials market.

3 Market analysis of hydraulic ecological glass in green buildings

3.1 Concept of ecological glass Compared with the traditional glass industry, from the beginning of preparation to application, and even to the whole process of recycling of ecological glass, the materials used have less impact on the ecological environment and lower energy consumption. And the recycling space is larger, so it can better realize the concept of harmonious coexistence of human and ecological environment.

In the current ecological glass, nano-scale photocatalyst silica and silica thin film materials are used on the surface of self-cleaning glass. Because of their lipophilicity, hydrophilicity and photocatalysis[1], the glass surface can spontaneously decompose dirty substances in the sunlight such as organic matter attached to the surface.

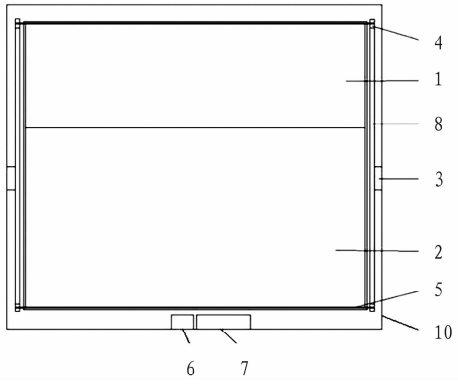
3.2 Market demand and future prospect of ecological glass In terms of total resources, China is a large country with vast territory and rich resources, and many important resources are in the forefront of the world. However, in the environment of a large population base, China has become a "small country with resources", and its per capita resources are even lower than the world level. On the social road of sustainable development, the development of ecological building materials has been recognized by more and more researchers at home and abroad. As a new type of environmental protection glass, ecological glass has been widely used in curtain walls of high-rise buildings, automobile glass, hospital doors and windows and other areas[2]. Based on the powerful function of ecological glass, many foreign glass companies compete to occupy the market of the technology. At present, in China, many universities, glass enterprises and R & D institutions in Beijing, Shanghai, Henan and Hubei are making great efforts to develop relevant ecological glass products, break through the technical blockade, and create ecological glass with Chinese characteristics according to China's national conditions and resource characteristics. In the future, this technology can not only be used in glass, but also may be extended to other building materials products, so that the development of environmental protection, the concept of green buildings will be continuously implemented.

4 Design principle of hydraulic ecological glass

4.1 Controllable light transmission technology Multi-functional hydraulic controllable light transmission glass is developed around a kind of hydraulic ecological glass with controllable light transmission function. A liquid crystal dimming film is sandwiched between two layers of glass by technical means. Liquid crystal dimming film is a new type of functional optoelectronic film, which can be quickly switched between transparent and frosted appearance states by the control of applied voltage[3]; when the liquid crystal dimming film is electrified, the light can freely pass through the ordered liquid crystal molecules, and the glass is transparent; after the power is cut off, the liquid crystal molecules become scattered disorderly, and the glass is transparent but opaque[4]. When the light penetrates freely, the light transmittance of the glass can be artificially adjusted to realize the fast and random switching between light transmission and shading function.

4.2 Glass self-cleaning technology The multi-functional hollow glass adopts hydraulic manufacturing method to improve the hydrophilicity of the glass surface and enhance the hollow self-cleaning function of the glass. Glass is an extremely hydrophilic material, the glass surface will have a lot of water stains after rain, and water stains adhere to the glass surface when they come into contact with particles such as oil and dust in the air. This will affect the visibility and light transmittance of the glass, and bring a lot of inconvenience to people's work and life, so we decide to use TiO_2/SiO_2 composite film technology to solve this technical problem.

4.3 Built-in curtain technology Through a series of ways such as the built-in transparent film and opaque film in the insulating glass and the installation of automatic reel, it can control the built-in reel with the help of the remote control to achieve the function of shading and replace the way of adding curtains outside the insulating glass window. With built-in curtains, it can highly satisfy customers' needs for different glass transmittance and privacy day and night. And it better solves a series of problems encountered by the external curtains, for example, it is easy to stain, and there is a need of extra cleaning and so on. This kind of hydraulic ecological glass not only fully retains the original function of heat insulation and noise reduction, but also effectively reduces the difficulty of cleaning the inner and outer surface of the glass, and realizes the function of controllable light transmission (Fig. 1 -2).

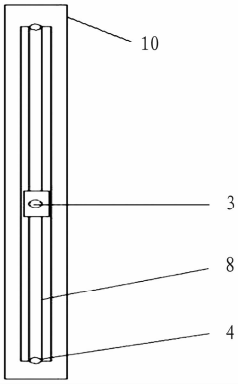


Note: 1. transparent film, 2. opaque film, 3. electric motor, 4. axle, 5. reel, 6. battery, 7. signal receiver controller, 8. rubber crawler, 9. remote control, 10. hollow glass window.

Fig. 1 Schematic diagram of multi-functional glass structure

5 Conclusion

In recent years, with the continuous improvement of people's environmental awareness, people's requirements for materials in various industries in life are increasing, and the building materials industry is no exception. At present, because of the advantages of sound insulation and thermal insulation, hollow glass windows have been more and more used in the building materials market, but the glass does not have the function of shading, so it needs to



Note: 3. electric motor, 4. axle, 8. rubber crawler, 10. hollow glass window.

Fig. 2 Side view of multi-functional hollow glass

add curtains to the window. It also brings some problems, such as the difficulty in cleaning and maintenance of curtain. The hydraulic ecological glass with controllable light transmission function studied in the project achieves the function of shading through a series of ways in which the transparent film and opaque film are built into the insulating glass, which solves the problems encountered by adding the external curtains and promotes the large-scale use of insulating glass.

In the context of building a sustainable society, the construction field actively promotes the concept of energy saving and environmental protection. Green buildings can reduce the load of buildings on the environment, provide human beings with safe, healthy and comfortable living space, and achieve harmony between buildings and people and the environment. The hydraulic ecological glass with controllable light transmission function based on the concept of green buildings not only solves the problem that it is difficult to clean up when adding external curtains, but also improves people's living comfort. It has made strides for the ecological development of green building materials.

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ing and breeding in accordance with the requirements of "high quality varieties, large-scale production, breeding facilities, standardized management, institutionalized epidemic prevention, and harmless manure treatment". Focusing on the high-quality, high-efficiency, green and healthy development requirements of Tan sheep industry, related parties should carry out research on Tan sheep gene identification technology and demonstration of characteristic high-quality Tan sheep meat production technology, establish and improve product classification and grading standards and management methods, and innovate Tan sheep product quality control and traceability management technologies. Besides, it is recommended to strengthen the changes of grain to feed, increase the development and utilization of unconventional forage resources, and improve the level of mechanized storage and feeding, establish and improve the collaborative innovation mechanism of production, learning, research, and promotion, and establish a market-oriented service mechanism. In addition, it is recommended to strengthen professional services such as forage processing and distribution, epidemic prevention and control, and technical training, and provide farmers with standardized farming services before, during and after production, and promote the well connection between small and medium farmers and the development of modern agriculture, so as to realize the efficiency and quality of industry and resources, and the high-quality development of "Yanchi Tan Sheep" brand.

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