

Influence of the New Technology of Foamed Concrete on the Industrial Upgrading Policy of China

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Abstract: This paper introduces the development of China's foamed concrete industry and its relationship with the industrial upgrading policy, and describes ten new technologies of foamed concrete related to the industrial upgrading policy. It also analyzes the impact of these technological advances on the relevant national industrial upgrading policies and market development, and puts forward suggestions for the development of the industry.

Keywords: Development; Foamed Concrete; Industrial Upgrading; New Technology; Policy

1. The development of foamed concrete industry in China

Foamed concrete is a commonly used inorganic energy saving material of building. It has many advantages such as lightweight, porous, fireproof, thermal insulation, energy saving, sound insulation, environmental protection, economy, utilizing waste and durability. The foamed concrete industry in China is mainly divided into two categories: Cast-in-place foamed concrete and foamed concrete products ^[1].

The development of foamed concrete in China is closely related to the industrial upgrading policy. Although the production and application technology of early foamed concrete had been introduced from the Soviet Union since 1960s, its development was relatively slow. Since 1990s, with the increasing emphasis on energy saving and emission reduction, relevant industrial policies had been continuously released, and foamed concrete had been developing rapidly, and gradually became a common inorganic energy-saving building material. Especially in 2011-2013, due to the prohibition of the use of flammable external wall insulation materials by various ministries and commissions of the country, foamed concrete obtained an excellent development opportunity, and became a hot thermal insulation building material with a rapid development. However, with the change of policy and market since 2014, the sales volume of foamed concrete thermal insulation materials had declined sharply, and the market shrunk rapidly. The industry and enterprises were facing tremendous pressure of survival ^[2]. Since then, the foamed concrete industry has gone through a process of transformation and upgrading, adjusting its structure and diversified development, and revitalized itself. It has adapted to the industrial upgrading policy of China with various new technologies, and has come out of a stable development path. In recent years, China's foamed concrete industry has entered a stage of steady development. The average annual growth rate is about 15~20%, higher than most of building materials ^[3]. In 2021, the total output of foamed concrete in China was estimated to be about 65 million m³, ranking first in the world.



Fig.1 Foamed concrete

In recent years, with the upgrading of the national infrastructure industry, foamed concrete has been chosen by the market as a high-quality upgrading substitute for traditional civil engineering materials. The application of cast-in-place foamed concrete has been growing steadily, especially in road and bridge engineering and backfilling works. China's foamed concrete products continuously improve the quality and launch new products for a high market recognition. They have won the support of many industrial and municipal policies in many provinces and cities, and have strong competitiveness in inorganic building insulation products. In addition, with “the Belt and Road” international development strategy, China's foamed concrete products and technologies continue to go abroad and have been applied to more and more overseas construction projects in recent years.

China's foamed concrete industry has been constantly researching new technologies and developing new products, so as to achieve the goal of diversification of raw materials, high performance products, diversified application and intelligent equipment. It continues to fit and influence China's industrial upgrading policies.

2. New foamed concrete technologies related to the industrial upgrading policy

According to the outline of the national "14th five year plan", China's current and future industrial upgrading policies on buildings and building materials are centered on green, low-carbon, energy saving and high efficiency. And the development direction of new technology of foamed concrete is also strictly consistent with these core points. Ten new foamed concrete technologies related to the industrial upgrading policy are shown in Table 1.

Table 1 New foamed concrete technologies.

Name	Technical characteristics	Technical advantages
High performance foamed concrete self-insulation block	It uses foamed concrete with high strength and low thermal conductivity to produce self-insulation block.	self-insulation, high cost performance
Polystyrene granule foamed concrete	It is a composite material made of polystyrene granule with volume fraction greater than 20% and foamed concrete ^[4] .	excellent heat insulation and crack resistance
Ceramsite foamed concrete	It can be made by adding ceramsite to foamed concrete in a special way ^[5] .	excellent strength and crack resistance
Applied technology of composite wall of foamed concrete with steel net shuttering and light steel keel	It uses steel net fixed on the steel support structure to replace the traditional cast-in-place wall formwork, and then the concrete foam slurry is specially poured into the cavity of the wall.	excellent crack resistance, high construction efficiency, versatility
Foamed concrete composite wall panels and roof panels	The foamed concrete core material with a dry density of about 200~500kg/m ³ is combined with the panel and the steel frame or skeleton to build the composite wall panel and roof panel.	fast assembling speed, strong earthquake resistance, high cost performance
Foamed concrete prefabricated buildings	It has two types: the concrete structure prefabricated building of foamed concrete part and common concrete structure component, the steel structure prefabricated building of foamed concrete part and light steel roof truss.	high construction efficiency, lightweight building, integration of structure and function
Solid waste foamed concrete	It adds more than 50% of solid waste such as construction waste, industrial solid waste, sludge and straw into foamed concrete.	massive use of solid waste, low cost
Gypsum-based foamed concrete	It uses gypsum, especially industrial by-product gypsum, to produce foamed concrete ^[6] .	massive use of by-product gypsum, low cost
Intelligent integrated production equipment of cast-in-place foamed concrete	It can monitor and control the changes of raw materials, slurry, foam, wet density and environmental parameters in every link.	high productivity, energy conservation, intelligent control
3D printing foamed concrete technology	It uses physical foaming slurry to 3D print complex foamed concrete products and buildings.	high productivity, intelligent control, diversification

3. The influence of new technology on China's industrial upgrading policy

The new foamed concrete technologies introduced above not only improve the technical level of the whole industry, but also gain market recognition and has broad prospects for development. Their impact on China's building materials market and industry upgrade policies cannot be ignored.

New technology and new products such as high performance foamed concrete self-insulation block, polystyrene granule foamed concrete and ceramsite foamed concrete not only optimizes the lightweight and high strength properties of the material, but also greatly improves the thermal insulation and durability, as well as its safety and environmental protection performance, and greatly improves the market competitiveness. These technological advances have led the development direction of industrial upgrading of building materials with light weight and high strength, and provided buildings with better green energy-saving materials, which make it easier for buildings to achieve energy conservation and low carbon. So the industrial upgrading policy of building materials industry will be promoted to make substantial progress in the direction of high performance, green energy conservation and low carbon.

The emergence of new technologies, such as applied technology of composite wall of foamed concrete with steel net shuttering and light steel keel, foamed concrete composite wall panels and roof panels and foamed concrete prefabricated buildings, has added new technical plans and design concepts for fabricated houses and steel structure buildings in China. They not only enrich the form of housing industry, but also provides applicable building systems for the vast rural areas. They provide new ideas and new starting points for the upgrade policy of housing industry in China. In addition, these new technologies have successfully entered the international market and have an important positive impact on the international development policies of relevant industries.

At present, China's building materials industry attaches great importance to recycled building materials, but the reuse efficiency of resources is low and there are few types, so the industrial upgrading policy is lack. New technologies of solid waste foamed concrete and gypsum-based foamed concrete focus on raw materials and lead the resource recycling trend of building materials industry with the leading solid waste consumption. These new technologies can drive the upgrading and improvement of industrial policies for recycled building materials, and promote the progress of solid waste recycling technology and the expansion of the market.

As a traditional material industry, upgrade policy of building materials is generally extensive and less high-grade, precision and advanced. However, the intelligent integrated production equipment of cast-in-place foamed concrete and 3D printing foamed concrete technology represent the intelligent, efficient, refined and high-end manufacturing technology of building materials industry. They are not only in line with China's action program for implementing the manufacturing power strategy, but also can promote the upgrade policy of building materials industry to tilt towards precision manufacturing technology, and promote China's building materials manufacturing industry to seize the international high-end market.

The development direction of foamed concrete industry should be guided by policies and the market. According to the spirit of the central leaders' speech, the "14th Five-Year" plan, and the related industrial policies promulgated by the relevant ministries and commissions of the state, and combining the market demand and the characteristics of the materials, the industry should explore the application of new technologies and products of foamed concrete in energy saving and low-carbon buildings, utilization of renewable resources, prefabricated building, green building and city construction. Moreover, it should constantly maintain technological progress and make foamed concrete the representative of green energy saving, high-quality and safety materials in the building materials industry, that is of great significance and influence to the upgrade policies of China's construction and building materials industry. In addition, the new direction of industrial upgrading led by the new technologies of foamed concrete can not only represent the industrial upgrading direction of the entire concrete industry, but also the whole building materials industry and construction industry, and it also has a positive impact on the upgrading of China's new materials research and application.

References

- [1] Development status and prospect of foamed concrete in China——2020 industry development report by foamed concrete branch [J]. China Concrete, 2021(10): 18-22.
- [2] 2017 foamed concrete industry development report [J]. China Concrete, 2018(02): 26-37.
- [3] 2019 foamed concrete industry development report of China [J]. China Concrete, 2020(05): 18-26.
- [4] Chen ZC, Li YQ, Hu SK, et al. Development status of polystyrene granule foamed concrete in China [J]. China Concrete, 2018(04): 26-28.
- [5] Chen ZC, Li YQ, Hu SK, et al. Development status of ceramsite foamed concrete in China [J]. Construction Wall Innovation & Building Energy-Saving, 2017(10):33-35.
- [6] Han L, Hu SK, Chen ZC et al. Research status of gypsum based foamed concrete [J]. Construction Wall Innovation & Building Energy-Saving, 2019(09): 66-68.