

## A New Fiber Reinforced Composite Material Properties and Engineering Application

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**Keywords:** Fibre reinforced, Composite material, Energy conservation

**Abstract.** External thermal insulation technology for building external wall has gradually been one important technology of the construction energy conservation. A new fibre reinforced composite material is made up of cement, flyash, silicon ash, the inflation polystyrene pellet and the admixture, after the experiment examination and the engineering application, the effect of thermal insulation is good, the performance of fire proof is excellent, high durability and low cost, good property of sound absorption. Solved the quality problem exist in the traditional building outer wall thermal insulation system such as the thermal insulation layer fall off, split, seep and so on. The new material can product standardize in factory, increase the construction efficiency; in favor of the construction industrialization and could promote construction business sustainable development.

### Introduction

In our country 80% construction energy is consumed in the use process of building, enhance the construction thermal insulation and the heat preservation capability is one of important means to realize construction energy conservation. External thermal insulation technology can obviously reduce the heat transfer, eliminate the hot bridge, to prevent the inner wall condensation, maintain the indoor environment comfortable, prolong the building service life, has gradually been the mainstream technology of construction thermal insulation and the heat preservation. At present the domestic main technology is Polystyrene board add thin plastering to build outside wall and keep warm, the construction nodes seep easily. There are some other problems: the wet working procedure is complex, consume man-hour; the difference between materials' performance is remarkable, there are a lot of questions exist in building quality, building durability, fire-proof and so on. In recent years there were a lot of serious fire events for the thermal insulation and the heat preservation materials in our big cities, so the specialist of related fields attach more importance to the thermal insulation materials' fireproof performance.

Our country's experts have studied for a long time to the construction external thermal insulation material and it's engineering application, such as Yuqing Bao [1] studied on the fireproof structure of building external thermal insulation system, University of Science and Technology of China's Jinhua Sun[2] has researched the urban high-rise construction serious fire's prevention and control, Zhe Li, Zhenli Huang, Yonghong Guo, Baixiang Zhang and so on has conducted the research to the fibre reinforced composite materials, and applied for the patented technology.

To change existing state of external thermal insulation material, one kind of new fibre reinforced composite material was developed and achieve a good effect through the engineering application. This material fireproof performance is outstanding, the durability is good, it's intensity is high; Solved the quality problem exist in the traditional building outer wall thermal insulation system such as the thermal insulation layer fall off, split, seep and so on. The new material can product

standardize in factory, increase the construction efficiency; in favor of the construction industrialization; this board have not the waste gas, solid waste and the noise, industrial pollution in the process of product, it could promote construction business sustainable development.

### New material main performance index

**Main constituents of new fibre reinforced material.** New fibre reinforced material main constituents include the cement, the flyash, the silicon ash, the inflation polystyrene pellet, the polypropylene textile fiber, the admixture and so on, according to the allocated proportion mix, add water and agitate, the high and low surface layer strengthens with the fibre reinforced. Formation through the trundle, then curing, cutting, superficial hatred water treatment and so on to form board, it has high intensity, energy conservation, anti-aging, heat preservation heat characteristic, can widely used in all kinds of construction include new construction and existing outer wall system, does not need design the fire protection isolation strip again; the compound wall structure heat insulation, sound-insulated effect are good. This system anti-impulse, reduces the load of construction and enhances the building earthquake resistance performance. Promotes our country building outer wall to keep warm technical level; enhances the outer wall structure quality and the construction efficiency, to provide a better choice for construction energy conservation.

**Main engineering properties.** The fiber reinforced board has fireproof performance, the combustion level is A1, conforms to the fireproof integrity; even if in the long time high temperature environment it could not burn; The product thermal conductivity is not higher than  $0.08\text{W/m} \cdot \text{k}$ , meet the construction demand; does not easy to smash in transportation, lightweight and high strength, the density is no more than  $260\text{kg/m}^3$ , may achieve the outer wall heat preservation board request. The fibre reinforced board uses the polymer mortar glue the wall, and with the bolt auxiliary anchor, the froth strip sealing, with specially makes of PVC expansion strip trap, plasters the mortar on some surface need to make smooth, at last uses weatherability sealant to pointing, forms the complete outer wall system. Because uses the PVC expansion strip pointing board seam, it is helpful to prevent the dehiscence, Gaul in plaster question, enhances the building overall life effectively, save the maintenance cost of building in the later period. Fiber reinforced board major technical indicators as Table 1

**Table 1.** Fiber reinforced board major technical indicators

Serial number	Item	Testing Results
1	thermal conductivity $\text{W}/(\text{m} \cdot \text{K})$	0.063
2	Dry density $\text{kg/m}^3$	243
3	compression strength MPa	0.49
4	tensile strength MPa	0.19
5	softening coefficient	0.67
6	water absorption %	9
7	burning performance	A1
8	safety performance	AQ1

The composite board system's superiority contrasts the traditional outside wall system:

Firstly, keep warm and weathering resistance properties is good: the whole heat preservation effect is good, the thermal conductivity is small, the good flame-resistant performance, have not condensation point, the durability is good, the system constructs easily. Secondly, high reliability

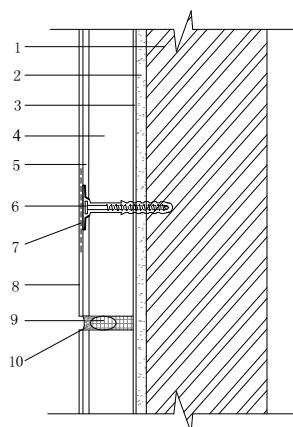
and safe, the structure is simple, need not worry about the board flake off; the board itself is light and reduced construction wall's load, simultaneously reduced the load of base, remarkable anti-impact properties. In the reconstruct of existing building wall, does not need more word on the wall surface then directly to construct again; it has advantages of dry work circumstances, construct convenience, and environmental protection. In the end, construct nodes and node components detail is perfect. Can realize the building energy conservation, the decoration integration, product factory, the product quality is stable, the construction is simple, the cycle is short, the efficiency is high, reduce site wet work and so on.

**Manufacturing technique.** Technique of production as follows: Raw material inspection - measurement ingredient - agitation – precompression and formation - compaction and trimming - outward appearance examination - maintenance - half-finished product intensity examination - end product inspection. The quality control manifests from raw material enters the plant to product leaving the plant each link. Raw material must conform to the standard, strictly according to the mixture ratio, controls the speed of dry material and the water and the mixing time. In the procedure of rolling, control thickness error. Get rid of unqualified part of half-finished product in the formation and examination half-finished product size deviation. The curing room must control the maintenance environment -the temperature and the humidity, the product's location should be solid and smooth, dry, to ventilate and prevent erosion of medium or rain water.

### **New composite materials engineering application**

The fiber reinforced composite board surface can paint or paste face brick according to the design requirements, artistic and neat. The application scope is wide; the comprehensive construction cost is lower. The difficulty craft of installs lies in it must guarantee the wall board installment reliable and the waterproof node construct. The basic plane of structure wall need clean up and clean, examines the wall surface smoothness and the verticality. Use chisels picks out the out-of-tolerance part or patches smoothly with the polymer cement mortar. Construction program: design and sets up the surface- clean up basic surface - measurement and lay out – the board cutting - glue and plug bolt fixed - cutting division seam - polish - mix the polymer mortar - glue grid cloth – structure seam processing - make up the hole and repair - clean and other.

For example, Changshu Changjian group Co., Ltd office reconstruct, this project list by Ministry of Housing and Urban-Rural Development of the People's Republic of China as the 2010 science and technology project plan - science and technology demonstration engineering project. The total floor space is 8638.01 square meters, frame structure, seven floors and one basement; the total investment is 10,688,700 Yuan. Carried on scene test for the outer wall hot working performance, this time examines the building west wall in the 7th floor northwest corner room, heat transfer coefficient is  $0.75\text{W}/(\text{m}^2 \cdot \text{K})$ ; the west wall in the 6th floor northwest corner room heat transfer coefficient is  $0.76\text{W}/(\text{m}^2 \cdot \text{K})$ . The building outer wall heat transfer coefficient value conforms to "Public building Energy conservation Design standard" GB50189-2005.



1 wall structure, 2 cement mortar layer, 3 mortar glue, 4 composite board, 5 fibre reinforced layer 6 bolt, 7 reinforced net, 8 face brick, 9 Polyethylene foam, 10 sealant

**Fig. 1.** The fiber reinforced composite board heat preservation board external thermal insulation system constructional node

This project achieves the public building outer wall energy conservation design standard 65% of Jiangsu Province; this outer wall keeps warm and through system examination, the site hot working test, the results conform to the energy conservation related standards of country and Jiangsu Province, this product quality is stable; The committee common consent this project through approval.

## Conclusions

The fibre reinforced composite board has the good performance of fireproof, thermal insulation, higher intensity. The product uses the assembly line continuous production, the craft is reasonable, the mechanized degree is high, so the product quality is stable. Through engineering examination and site test, the major technique performance meets the related standard requirement. The product basic construction craft has been a set of complete systems, is advantageous in reduces the wall surface crack and seep questions, the engineering practice effect is good.

This fibre reinforced composite material has significant social effects. Increases the house indoor usable areas, protects the farming areas, protects the ecological environment; Enhances the construction energy conservation effects obviously, meets people's comfort life need, promotes outer wall thermal insulation system's innovation and the construction energy conservation development; The building energy conservation will make the biggest contribution to reduce the carbon emissions for our country urban construction.

## References

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10.4028/www.scientific.net/AMR.399-401

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10.4028/www.scientific.net/AMR.399-401.1294