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New Energy Saving Functional Construction Material

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Through performance experiments validate the new energy-saving eco-friendly materials can effectively improve indoor air quality and energy efficiency, it will become an important research direction in the field of building energy efficiency. In the development of this class of functional materials, the need for several of the phase change material having a different phase transition temperature of organic synthesis, to prevent the occurrence of phase change microcapsules super cooling phenomena in order to enhance the usefulness of the functional materials, Meanwhile, the study of functional materials is still not mature enough, especially in the phase change material properties of attenuation performance requires further study.

1. Introduction

In recent years, the global building energy-saving technology has been rapid development. Improve indoor air quality has also made a series of progress and made a series of improvement measures, but in building energy efficiency and improve indoor air quality, the building energy efficiency design often worsen indoor air quality for the price, resulting in a construction-related diseases (Building Related Illness, BRI) and sick Building Syndrome (Sick Building Syndrome, SBS); while at the same time improving indoor air quality, often resulting in the loss of indoor energy (such as increasing the fresh air, etc.) (Mysen et al., 2005).
In order to resolve this contradiction theme, this paper presents nano microencapsulated phase change materials used in construction as a novel functional material, the main component of nano-titanium dioxide (TiO2) and micro-encapsulated phase change materials. Functional building materials at the nano TiO2 photocatalysis, kill the virus, a new technique to eliminate VOC and inorganic toxic gases are emerging in recent years. Studies have shown that: Nano TiO2 can decompose indoors most of the VOC, and VOC reaction product of environmental pollution, can effectively improve the indoor air quality in outdoor air barrier into the case, reducing the air-conditioning system energy consumption; Meanwhile, micro-encapsulated phase change material through the phase transition, the molecular structure of matter occurs rapidly changing state at a constant temperature endothermic or exothermic, when the outside temperature changes can effectively maintain the stability of indoor thermal environment, reducing energy consumption, achieve the purpose of building energy efficiency. After these two-materials technology processed composite to form nano-functional microencapsulated phase change materials, making it also has to improve indoor air quality and energy-saving features.

2. Review analysis of general energy saving materials

2.1 Gypsum Building Materials

Gypsum building materials has four characteristics: calcined gypsum consumption is relatively low, a quarter of cement, lime-third do so with gypsum building materials can greatly save energy; gypsum building materials than concrete, bricks are more economical materials; gypsum building materials can be recycled, not prone to construction waste; gypsum nontoxic, have good heat resistance, fire resistance.

2.2 Waste Plant Fiber

Lesson waste plant fiber is a renewable resource with multiple uses, mainly referring to crop straw, bamboo waste, waste wood materials. As a large agricultural country, China's crop stalks and other plant waste fiber

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resources are very rich. Plant fiber has good performance, has great potential in the development and application of environmental performance of energy-saving building materials in.

2.3 Foam Glass Building Materials

Foam glass is a new type of building materials, set environmental protection, flame retardant, sound absorption, thermal insulation, moisture barrier in one. Its source is discarded bottle glass fragments or color flat belonging to reuse waste materials. Foam glass products have very significant environmental benefits and the production process is not easy to produce waste.

2.4 Membrane Materials

Composite membrane material with good transparency, high mechanical strength, low density, fire, durability, excellent thermal insulation properties and resistance to ultraviolet light, is a new type of environmentally friendly energy-saving building materials. Membrane materials for natural light transmittance is very high, can reach 20, you can save a lot of electricity for lighting. Membrane material has a low absorption rate and high light reflectivity and low thermal conductivity, largely organized solar radiation into the room, reducing heat conduction, has good thermal insulation properties. Chemically stable membrane material, will not cause harm to human and environmental pollution, as a green building material in the developed world has a good application (Pacheco et al., 1993)

3. Application mode of energy saving materials

3.1 Energy Saving Functional Materials

Weihai natural environment does not exist in nature, having to save energy decoration materials, cabbage, and pipe insulation and so can be divided in a range of building materials, energy-saving features of such energy saving wood flooring, energy saving coating materials, energy saving and environmental protection chemical building materials. Use energy-saving building materials can not only get good decorative effect, but also the characteristics of the material itself has a mailbox can avoid wastage of resources (Song, 2018).

3.2 Energy Saving Building Envelope Material

Envelope system bear in construction -% energy saving task is to achieve energy saving targets key factor in the construction process should give priority to the use of having the desired transmittance and thermal insulation glass material, or use of solar energy that can take full advantage of new glass materials effectively save energy. For example, choose to use solar panels as roofing materials in large construction projects, because the construction of the roof lighting area is relatively large, you can get a good generation.

3.3 Energy Saving Windows and Glass Curtain Wall Material

A large proportion of the application area is the development trend of China's construction curtain wall industry in recent years, but in actual construction projects, we not just focus on the application form to enhance the proportion of curtain walls, doors and windows of the problem but also give enough attention. Windows, doors and glass walls are the main form of the building envelope, the building indoor and outdoor heat exchange is very sensitive conduction. Data show that the doors and windows of building works part due to air infiltration energy consumption accounts for about 25% overall building energy consumption., Energy accounts for about 27 percent of the building's energy consumption by thermal losses doors, windows and walls of the total energy consumption has exceeded the amount of construction, operation and maintenance 50% of total energy consumption, higher than the 5 to 7 times the wall heat loss values. Thus, to take measures against the doors and windows to avoid excessive energy waste sites is a key part of the overall energy construction projects to get the effect. In the process of selection of building materials, we should focus on highlighting the important position of doors and windows and glass walls, choose the appropriate doors and windows and glass curtain wall of energy saving materials at least be able to save 40% of energy.

3.4 Energy Saving Wall Material

Architectural engineering end-use feature is the wall design and application of fundamental constraints materials, design should pay particular attention to the wall when not appear too obvious bump. Indoor fire rating given to compliance with building enough attention to the intensity of the problem, and then again on the basis of a comparative analysis of various wall materials, choose to use energy-saving material with good insulation properties, and make the greatest efforts to reduce indoor heat loss degrees.

Off the wall when using the light, especially in the construction of the heat demanding, such as partition walls between the warehouse and the office conduction, and in order to achieve control to reduce unnecessary heat conduction is not required to maintain a fixed temperature of the room, priority should be given to use of new

energy-saving wall materials, such as adding insulation materials to lightweight partition, the demand for maintaining the temperature of the room walls for processing, or add insulation materials to the gypsum board walls, the maximum to avoid severe heat loss phenomenon.

4. Analysis of energy saving building materials develop trend

4.1 The Prices of Energy-saving Building Materials is Decreasing

Currently, the building energy consumption has become China's largest energy products, promote the use of energy-saving building materials is an effective measure to reduce building energy consumption. With the popularity of low-carbon energy-saving and environmental protection, energy saving building materials to high-quality performance by the developers favor the procurement of raw materials industry and market development began to accelerate the rhythm, energy saving building materials prices decreased for the future expansion of the building materials market conditions (Jaakkola, 1991).

4.2 Environmental Performance of Energy-saving Building Materials is Increasing

Along with the improvement of energy efficiency standards, energy saving targets new building is also rising. As representatives of energy-saving insulation material, a lot of energy-saving building materials manufacturer of polyurethane to bring the latest products exhibition. There are to improve the insulation, moisture-proof waterproof, fire retardant parameters aspects. Polyurethane foam composite panel external wall insulation system in Germany generally has a standard thermal conductivity, a thin insulation layer thickness, excellent insulation properties, but also has a good fire retardant properties. In terms of construction, to ensure the integration of building insulation composite panels and architectural ornaments once completed, to improve the speed of construction, decorative surface is also more abundant (Shang and Xu, 2012).

4.3 Use of Natural Conditions

Development of energy saving function type projects in the early planning stage should take full account of the use of natural conditions, energy-saving design. Select the project at the end of the use of energy-saving building materials, with respect to the prices of different categories of energy-saving building materials in different environments, the project should be a reasonable application of more attention. Outstanding features of energy saving building materials have been recognized, but the good materials also meet the project, the environment, for different regions, the need to develop different types of products. Characteristics for domestic projects, energy saving building materials production enterprises should also be used to explore different models according to the needs of clients and projects, categories of products in order to achieve better energy efficiency.

4.4 Higher Technical Standard in Construction Process

Development of energy saving function type projects in the early planning stage should take full account of the use of natural conditions, energy-saving design. Select the project at the end of the use of energy-saving building materials, with respect to the prices of different categories of energy-saving building materials in different environments, the project should be a reasonable application of more attention. Outstanding features of energy saving building materials have been recognized, but the good materials also meet the project, the environment, for different regions, the need to develop different types of products. Characteristics for domestic projects, energy saving building materials production enterprises should also be used to explore different models according to the needs of clients and projects, categories of products in order to achieve better energy efficiency (Li et al., 2001).

5. The Preparation of Functional Materials

5.1 Preparation Process

Studies emulsifier mixed with the phase change material, the stabilizing effect under high-speed stirrer, and stirring emulsifier, the phase change material in the form of fine droplets uniformly dispersed in the aqueous phase to form an emulsion. This system, the water as the continuous phase and the dispersed phase change material, the whole system is an oil-in-water (OPW) emulsion. Emulsification process, the phase change material is dispersed into tiny droplets, which greatly increases the interfacial area and the interface of water and oil emulsion system can be leaving in an unstable state. After adding the emulsifier, the emulsion system is in steady state. Anionic emulsifying surfactant belongs, P adsorbed on the oil-water interface, wherein the phase change material is coated to form droplets. In one aspect, the emulsifier reduces the surface tension of the droplet phase change material, and because of their negatively charged leaving droplets repel each other; the other hand, to avoid the formation of the interface membrane emulsifier droplets collide and aggregation.

Adding a certain amount of nano-TiO2 in the emulsion and continue to stir, let nanometer TiO2 surface adhesion to the emulsifier; dropping wall solution in the emulsion, adjust the pH and heat, making a crosslink polymer, continuous deposition of phase change materials droplet surface, thereby forming a phase-change material as core nano microencapsulated phase change material.

5.2 After Processing

In this study, microencapsulated phase change materials, nano-TiO2 as the basic ingredient of functional materials, functional materials will be evenly coated on a substrate with a polyester felt air filter material as the substrate, the coating application method, with a fixed Calibrating scraper, finally put it in the oven bake 120e 115h, the formation of functional materials experimental filter. The study found that during the preparation of microencapsulated phase change materials, adding nano-materials can not only increase the dispersion of nano-materials, can also increase the surface area of nano-materials, nano-TiO2 enhanced sterilization, air purification effect. Microencapsulated phase change material such that TiO2 is also more firmly adhered to the substrate. Coating method is simple, convenient and processing time is short features can save a lot of experimental time.

6. The Analysis of Performance of Functional Building Materials

6.1 Sterilization Experiments of Functional Building Materials

According to AATCC 100 requirements, selection of E. coli as the bacteria tested. Nutrient agar medium, and its composition is as follows: Peptone 5g, beef extract 3g, distilled water 1000mL, NaCl 5g. Prepared as follows:

1) Adding the above ingredients in 1000mL of distilled water, heated to boiling and promote its dissolution (the need to prevent spills), and make up the loss of water due to evaporation.

2) Correcting the pH value to 714, with flannel filter, packed in tubes HPP (103kPa, 15min).

Nano TiO2 UV light wavelength less than 393nm, and will occur in accordance with the photocatalytic hair should, thus killing the characteristics of bacteria. In order to better detect and protect the health of laboratory personnel bactericidal effect of nano-TiO2, and experiment with a dominant wavelength of 365nm UV lamp, lamp power is 8W.

After 1h ultraviolet radiation, experimental results: no ordinary building materials bactericidal capacity; bacterial survival contain only pure nano-TiO2 material was 3.05%; homemade functional materials bacterial survival of only 0.41% on; nanoparticles bactericidal effect of encapsulated phase change material is stronger than the simple nano-TiO2 7 to 8 times. Bactericidal effect is shown in Table 1.

Table 1: The bactericidal effect

Time	General material (/%)	TiO2(/%)	TiO2+PCM120gPL (/%)
0h	100	100	100
1h	100	3.05	0.41
2h	100	0	0

6.2 Air Purification Experiment of Functional Building Materials

Eliminate VOC materials using photo catalysts is a new technology emerged in recent years, because it has low energy consumption, easy operation, mild reaction conditions, and the ability to reduce secondary pollution of continuous work, etc., increasing attention has been paid. Photocatalytic reaction can be broken down most of the VOCs, currently has nearly 60 kinds of organic compounds on the photocatalytic reaction conducted research, including 43 kinds of common organic compounds in indoor environments, have achieved very significant results in this study, for example toluene were studied experimentally.

In this study, the necessary equipment: removable airtight chamber, purple lights, gas samples contain VOC's, fans, filter and other functional materials. Use ordinary bricks sealed chamber, the size of 2m * 2m * 116m (ANSIPAHAMAC-1-1988 standard), wall to wall 24, 5cm thick coated the inside of microencapsulated phase change materials, functional materials installed filters, micro-encapsulated phase change settings UV lamp (8W) between the material layer and the filter layer. Removable sealed chamber requires a good seal, the air leakage rate of less than 0.05Ph. Sealed chamber wall structure shown in Figure 1.

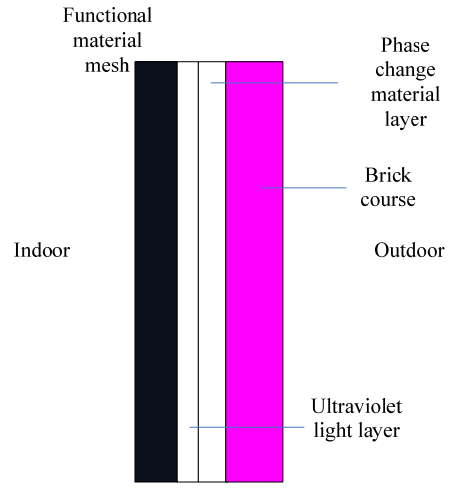

Figure 1: The wall graph

Functional materials under UV irradiation, toluene concentrations tested once every 28min, after nearly 1h, found that toluene concentration of functional materials where the filter chamber is 0.25mg/m3, the decomposition rate of about 83%; while ordinary construction the basic function of the filter material does not degrade toluene. Experiments show that the materials have a strong functional effect of the decomposition of toluene. Functional decomposition of toluene effects of building materials shown in Figure 2.

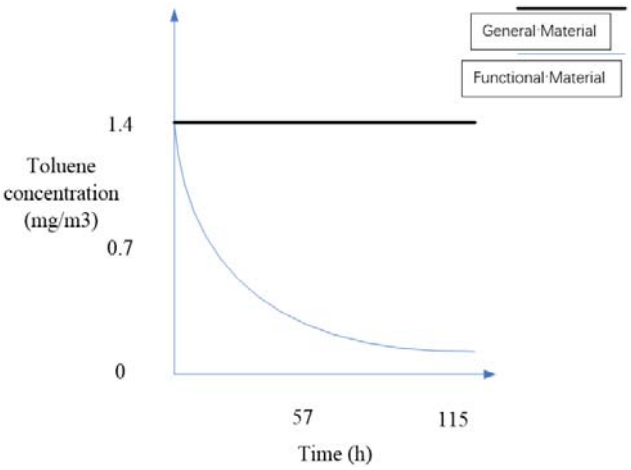

Figure 2: The contrast of toluene degradation effect

6.3 Experimental of Functional Storage of Construction Materials

1) The construction of ordinary building materials removable airtight chamber, its size, structure and on a same. Were installed in two movable sealed small indoor radiant temperature gauge, removable airtight chambers indoor temperature is adjusted to 26e, and reaches a steady state.
2) The use of a heat pump simulation Southwest summer heat and humidity environment, it is heated to a temperature 35e of the environment and reach a steady state.
3) The two removable airtight chamber while displaced to the simulation of summer heat and moisture environment, the experiment began, the use of radiation were measured temperature measurement instrument enclosed two small indoor temperature data changes, the experiment lasted 10h.
4) End of the experiment, the simulated environment may be removed from the sealed chamber to move, to prepare another experiment
The experimental data taken every 1h read once found common wall 2h former small indoor temperature rises 1 ℃, while the use of the functionality of the previous building materials small indoor temperature of 26 ℃ 3h essential to maintain constant temperature; in the first 10h, temperature chambers basically ordinary building

materials reach equilibrium with the outside ambient temperature in summer, is about 35℃, the temperature of the chamber of functional materials only 28.3 ℃ (cannot adjust the air conditioning and refrigeration temperature), its regenerative effect As shown in Figure 3.

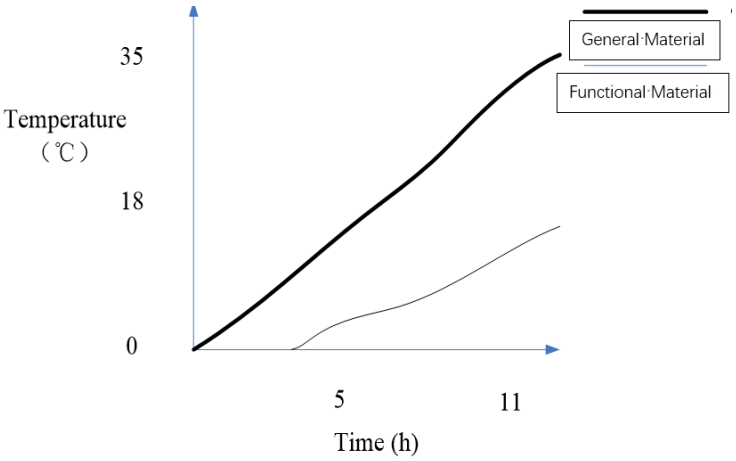

Figure 3: Comparison of heat transfer delay effect

Experimental results show that: the use of functional materials as wall enclosed chamber has good regenerative energy savings, in the hot summer Southwest, the day cannot be refrigeration air conditioning, indoor temperatures can still be kept within the lower range, thus effectively saving energy, to achieve the purpose of building energy efficiency. It also found that the use of temperature fluctuations small field of functional materials chambers conducive so that the body has a high comfort.

7. Conclusions

China is a developing country who must fully understand the necessity of the development of green buildings and promote green building technologies. Under the technology framework of the water, energy, land and materials saving and environmental protection, china must learn foreign advanced technology and experience to achieve its localization in the practical application and industrialization. This paper describes the status of building energy-saving technologies and improve indoor air quality, homemade nano-functional micro-encapsulated phase change materials, design and construction of the experimental chamber with a removable airtight conducted sterilization functional building material, indoor VOC removal and storage energy and other properties of the experiment and a certain amount of data analysis is conducted.

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