High Performance Structures and Materials (2019) 1: 1-4
Clausius Scientific Press, Canada
DOI: 10.23977/hpsm.2019.11001
ISSN 2523-644X

Research on Logistics Scheduling of Prefabricated Building Components Based on Smart Logistics

Wang Peng*

School of Economics and Management, Dalian University, No.10, Xuefu Avenue, Economic & Technical Development Zone, Dalian, Liaoning,The People's Republic of China(PRC)
**corresponding author*

Keywords: *Ai-bim, Fabricated building components, Shaped phase change building materials, Scheduling preparation*

Abstract: *The AI-BIM's fabricated building materials recombination technology is used to study the scheduling and preparation of building materials. In order to determine the thermal performance and other physical and chemical properties during the preparation and preparation of phase-change building materials, the paper constructs a AI-BIM-based assembly building component logistics scheduling platform, and adopts vacuum infiltration method to apply palmitic acid. A new type of shaped phase change material was prepared by combining eutectic with cetyl alcohol and expanded perlite. Environmental scanning electron microscopy tests show that the phase change material enters the pore structure of the perlite. The optimum eutectic content of palmitic acid and cetyl alcohol eutectic in expanded perlite is 25%. Under this impregnation, PA-H D will not undergo phase change even if it is not coated. Leak from the EP. The differential scanning calorimeter test obtained a melting point of PA-H D/EP of 41.49 ° C and a phase transition enthalpy of 122.9 J/g. Improve the thermal conductivity of the material by adding 10% graphite to PA-HD/EP. The composite phase change material can be well combined with ordinary building materials, and further prepared into a building material having a temperature regulating function. The empirical results show that the adoption of this technology can not only achieve targeted identification of physical and chemical properties of building materials, but also achieve high-precision scheduling and preparation.*

1. Introduction

Phase change energy storage is a new environmental protection and energy saving technology that utilizes the phase change latent heat of phase change materials for energy storage. The phase change material absorbs the heat (cold) of the environment during its own phase change, and releases heat (cold) to the environment when needed, thereby achieving the purpose of controlling the ambient temperature and saving energy. By adding a phase change material to ordinary building materials, a lightweight building material with a relatively high heat capacity can be produced, which is called a phase change energy storage building material. The use of phase change energy storage building materials to construct the building structure can reduce indoor temperature fluctuations, improve comfort, make building heating or air conditioning use less or less energy; can reduce the capacity of required air handling equipment, and can also make air conditioning or heating systems Use low-cost electricity at night to reduce operating costs for air conditioning or heating systems. Therefore, this material becomes a kind of building material with both thermal stability and environmental friendliness[1].

There are some special requirements for the application of phase change materials in building materials, such as low price, abundant resources, no corrosion, no toxicity, no special odor, high latent heat, low undercooling and long service life. Among them, organic phase change materials have the above advantages, but they have lower thermal conductivity and flammability than inorganic materials. In recent years, a shaped phase change material has emerged, which combines various types of heat storage materials with suitable matrix materials to maintain the original shape (solid state) before and after the phase change. The requirements for the container are very low, and the phase change storage is significantly reduced. The cost of the thermal system and some of the superior performance of the phase change material can be in direct contact with the heat transfer medium, so that the heat transfer efficiency is greatly improved. So far, the current academic and practical circles generally regard the scheduling and preparation of phase change materials as a key practical issue in the decoration of building materials[2].

Expanded perlite is a kind of white porous granular material which is formed by the instantaneous expansion of volcanic vitreous lava by high temperature roasting. It is named for its pearl fissure structure. It has light weight, non-toxic, odorless, non-corrosive, acid-resistant, alkali-resistant, heat-insulating, sound-absorbing and other properties. Expanded perlite is rich in raw materials, low in price, safe in use and convenient in construction. It can be widely used in petroleum, chemical, electric power, metallurgy and construction fields, in roof insulation, wall composite insulation, thermal pipe insulation, and cold storage. The insulation of the structure is widely used. In this study, expanded perlite is used as the skeleton of the shaped phase change material, and the phase change material is adsorbed into the microspores of the expanded perlite, which acts as a fixed phase change material so as not to leak from the matrix during the phase change. It can play a role of flame retardant, prepare a composite phase change energy storage material with high heat storage density, and use graphite to improve the thermal conductivity of the material. In view of this, this paper analyzes the transfer preparation of prefabricated building component materials represented by phase change materials based on AI-BIM technology to clarify the physical preparation process of such materials and improve the optimization rate of building materials[3].

2. Experiment

2.1 Raw Material

The pore structure of the expanded perlite was tested using a Po remaster-60 mercury intrusion tester at a test temperature of 25 ° C, a mercury density of 13.5 g/mL, and an implementation standard of ASTM D4284-03. It can be seen that the pore size is mainly distributed between 100 and 2500 nm, accounting for 76% of the total distribution, and the remaining pore size distribution is also 50 to 100 nm. The median pore diameter of the expanded perlite was 899.6 nm, the specific surface area was 8.56 m 2 /g, and the porosity was 80%.

2.2 Preparation of the Lowest Eutectic Based on Ai-Bim

The mass ratio of eutectic composition is 64.4:35.6 Weigh a certain amount of palmitic acid and cetyl alcohol, heat it in a water bath at 60 °C until it is completely melted, then stir it evenly for 6-8 hours and then cool it. A eutectic organic composite phase change material (PA-HD) of palmitic acid and cetyl alcohol.

2.3 Preparation of Shaped Phase Change Materials Based on Ai-Bim

The eutectic of PA-HD is combined with the granular expanded perlite by vacuum infiltration. First, the expanded perlite was placed in a muffle furnace and baked at 500 ° C for 1 h to remove flammable impurities and a small amount of water on the surface. Then, a certain amount of perlite particles are weighed into a vacuum container together with the solid phase change material. First, the air is pumped out with a vacuum pump, the vacuum is 0.09 MPa, and then heated to melt the PA-HD, and the vacuum is kept for 2 hours. The physical infiltration process of the PA-HD phase change material is carried out in perlite, and finally at 60°C. The composite shaped phase change material (PA-HD/EP) was obtained by drying at 60°C.

2.4 Testing and Characterization

The morphology of the sample was observed using a Quanta200 environmental scanning electron microscope (ESEM) and the AI-BIM test bench constructed in this paper; the thermal performance of the sample was analyzed by TA Q10 DSC differential scanning calorimeter at a heating rate of 5 °C/min. Melting and solidification of PA-HD/EP and PA-HD/EP/G (with a mass fraction of 10% graphite added to PA-HD/EP) using a modified K-type thermocouple with the Agi lent 34970A instrument Temperature curve. The sample was placed in a cylindrical wall heat exchange container in an amount of 2 to 3 g. The heat exchange medium is tap water, the heating temperature is 60 °C, and the cooling temperature is 20 °C.

3. Results and Discussion

3.1 Selection of Process Conditions

In the process of vacuum infiltration, the infiltration time and the infiltration temperature have a great influence on the infiltration of PAHD in perlite. The experiment investigated the influence of the infiltration time on the infiltration amount. The experimental conditions were the infiltration temperature of 60 °C and the heat treatment for 40 min. The influence of the infiltration temperature on the infiltration was the infiltration time of 20 h and the heat treatment for 40 min.

In addition to investigating the influencing factors in the infiltration process, it is also necessary to examine the effects of drying time on post-treatment. Due to the large amount of phase change material in the expanded perlite, it will flow out from some relatively large gaps during the remelting process. For this reason, the composite material is treated by drying to ensure that it does not leak from the substrate when it undergoes a melt phase transition. The experiment used a PA-HD/EP composite with an impregnation time of 10 h and an infiltration temperature of 60 °C, which was 69.7%, and dried at 60 °C (above its melting temperature of 15 °C). The relationship between the drying time and the impregnation amount of PAHD in perlite was investigated.

3.2 Differential Scanning Calorimetry

The melting point of the eutectic was measured at 45.00 °C, the phase transition enthalpy was 20.9 J/g, and the melting point of the composite phase change material was 41.49 °C, and the phase transition enthalpy was 122.9 J/g. The thermal analysis data of the composite phase change material is inconsistent with the eutectic, and the melting peak of the composite becomes wider. This is because the perlite of the network-like structure is a restricted system, the spatial motion of the organic molecules embedded therein is limited, and the organic molecules interact with other molecules, thereby exhibiting the thermodynamic properties and free accumulation. It is different. Moreover, due to the addition of expanded perlite, the overall heat transfer performance of the material is reduced, and the heat hysteresis is exhibited in the process of heat transfer, which also affects the phase transition temperature to some extent.

4. Conclusions

(1) An AI-BIM platform that can identify the physical properties and chemical shape characteristics of organic phase change materials is constructed. A new eutectic composite phase change material PA-HD/EP was prepared by filling the eutectic mixture of the organic phase change material cetyl alcohol and palmitic acid into the pore structure of the expanded perlite by vacuum infiltration.

(2) The AI-BIM model constructed above was used to analyze the scheduling preparation problem of phase change materials. The study found that the mass fraction of phase change material in PA-HD/EP can reach 58.0%, the melting point of composite phase change material is 41.49 °C, and the phase transition enthalpy value is 122.99/g. The material has good melting properties and does not chemically react with the substrate.

(3) The thermal conductivity of PA-HD/EP/G prepared by adding 10% graphite to composite PA-HD/EP is significantly enhanced. The prepared shaped composite phase change material can be applied to the field of building energy storage to regulate the rational use of energy. In addition, the AI-BIM model constructed in this paper can accurately analyze the scheduling preparation process of composite materials represented by phase change materials, which can significantly improve the precision of building materials preparation and scheduling.

Acknowledgement

This article was specially funded by Dalian University's 2019 Ph.D. Startup Fund (20182QL001) and 2019 Jinpu New District Science and Technology Project.

References

[1] Matthew Haigh,. (2018) Molecular Dynamics Study on Bonding Properties of Copper-SAM-Epoxy Resin Interface, ACI MATERIALS JOURNAL, 5,68-74

[2] Frank Collins. (2018) Synthesis of a High Fluidity High Performance Polyethersulfone Ketone Resin, International Journal of Oil Gas and ACS Applied Materials & Interfaces, 16, 89-106.

[3] Francisco Ascui. (2019) Effect of welding temperature on microstructure and properties of TLP diffusion welded joint of coiled tubing. ACTA ACUSTICA UNITED WITH ACUSTICA, 1, 119-136.