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The preparation of phase change energy storage ceramsite from waste autoclaved aerated concrete

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Abstract

During phase transition process, phase change materials (PCMs) can absorb or release a large amount of heat from the environment while maintaining its own temperature basically unchanged. The phase change energy storage material suitable for buildings was obtained from paraffin liquid and stearic acid with mass ration of 78:22, and the melting temperature can be regulated from 25℃ to 35℃. Two step encapsulation was used to prepare phase change energy storage ceramsite:①Waste aerated concrete was soaked in a mixed slurry composed of cement, white latex, steel slag powder and water;②mixed powder of building gypsum and manganese slag was coated on the particles prepared in step ①. It solves the problem of easy leakage of phase change materials and compatibility with aggregate and cement, which provides a cost-effective approach for the utilization of waste autoclaved aerated concrete.

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Keywords: Phase change energy storage material; Energy conservation; Building material; Ceramsite

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1. Introduction

With the rapid development of economy in our country, the energy consumption is increasing, and the problem of energy supply shortage and demand is becoming more and more urgent. Therefore, various governments actively encourage the development of energy-saving products, in order to reduce energy consumption and maintain the sustainable development of economy.

Phase change energy storage material[1,2,3] is a kind of self-adjusting temperature energy saving material, which can storage and release of heat automatically, in order to reduce the fluctuation range of indoor temperature within certain limits of temperature range, thus improving the indoor thermal comfort and reduce the energy consumption of air conditioning refrigeration and heating[4,5]. Implementation of phase change energy storage building materials[6,7] to save energy and promote economic sustainable development is of great significance[8,9].

In this paper, we use waste aerated concrete as the carrier and adopt vacuum adsorption and packaging technology to prepare phase change energy storage ceramsite as well as to investigate the utilization of the solid waste.

2. Materials and methods

2.1 Materials

In the preparation of PCMs, Stearic acid (phase transformation temperature, 68℃, transformation enthalpy, 196 J/g) and paraffin liquid were used. The waste autoclaved aerated concrete was used as the carrier. White latex mixed with gypsum was used for encapsulating phase change energy storage ceramsite.

2.2 Method

Three steps were used to prepare phase change energy storage ceramsite. Firstly, PCMs suitable for buildings were prepared, whose phase change temperature can be regulated from 25℃ to 35℃. Secondly, take waste autoclaved aerated concrete as carrier to absorb PCM. Thirdly, encapsulate the concrete particle to form phase change energy storage ceramsite.

3. Results and discussion

3.1 Preparation of binary composite PCMs

Stearic acid and liquid paraffin were selected as phase change materials[10]. Taking the different proportion of both materials in a beaker, mixes well in water bath at 80 ℃, the binary composite PCM was obtained. See Table 1.

Table 1. Formulation of binary PCMs..

Paraffin liquid: stearic acid （mass）	Transformation temperature （℃）	Transformation enthalpy （J/g）
50:50	40.3	431
70:30	37.5	166
75:25	32.2	143
78:22	29.3	135
80:20	25.5	129

It shows in Table 1 that the transition temperature changes with the changes in material proportioning of paraffin liquid and stearic acid. When the mass ratio of paraffin liquid and stearic acid is 78:22, the transition temperature is 29.3 ℃, and the transition enthalpy is 135 J/g correspondingly. In this case, the human body feels comfortable and