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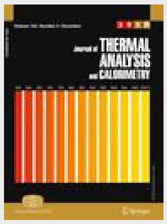

Gelled Na_2HPO_4 • $12H_2O$ with amylose-g-sodium acrylate: heat storage performance, heat capacity and heat of fusion

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摘要

Abstract A novel gelling method was studied to stabilize phase change material Na_2HPO_4 • $12H_2O$ with amylose grafted sodium acrylate. Gelled Na_2HPO_4 • $12H_2O$ shows stable heat storage performance prepared at optimized conditions: 2.7mass/mass% sodium acrylate, 0.4 mass/mass% amylose, 0.05 – 0.09 mass/mass% *N*, *N*′ -methylenebisacrylamide, 0.05 – 0.09 mass/mass% $K_2S_2O_8$ and Na_2SO_3 (mass ratio 1:1), at 50 ° C. Na_2HPO_4 • $12H_2O$ was dispersed in gel network as tiny crystals less than 0.1 mm. Melting points were in the range 35.4 ± 2 ° C. Short-term thermal cycling proves the effectiveness of the novel method for eliminating phase separation in the gelled salt. Adiabatic calorimetric measurement of heat capacities shows two phase transitions, which correspond to melting of Na_2HPO_4 • $12H_2O$ and freezable bond water in gel, respectively. Heat of fusion of pure Na_2HPO_4 • $12H_2O$ was determined as 260.9 J g^{-1}. Distribution of extra water is: free water:freezable water:nonfreezing water = 0:0.85:0.15.

Keywords

Gelling method, Na_2HPO_4 • $12H_2O$, Phase change material, Phase separation

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共 1 篇最新文献

1. Dan, W. Y. (2010) Crystal structure and solid – solid phase transition of the complex (C11H18NO)2CuCl4(s). *Journal of Thermal Analysis and Calorimetry* [CrossRef]

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Gelled $Na_2HPO_4 \cdot 12H_2O$ with amylose-g-sodium acrylate: heat storage performance, heat capacity and heat of fusion

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Keywords Gelling method · $Na_2HPO_4 \cdot 12H_2O$ · Phase change material · Phase separation

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Introduction

Phase change materials (PCMs) have been extensively studied for solar energy heating, peak-shift of electrical demand and heat recovery [1–7] since 'Sun Queen' Dr. Maria Telkes designed the first solar-heated house in 1948 [8]. These materials include the inorganic, the organic, metals or the composites, which may take action in gas–liquid, liquid–solid and solid–solid phase transitions. As is known to this field, organic PCMs usually show stable thermal energy capacities but with poor thermal conductivity and small volumetric heat storage densities. Inorganic PCMs, which are mainly salt hydrates, have no those drawbacks of organic PCMs, while often show phase separation for those most incongruent and semi-congruent melting salts [1]. Once this problem is solved, salt hydrates can be used in latent heat storage system. However, up to now only several kinds of salt hydrates PCMs are available as commercial products, among which modified $Na_2SO_4 \cdot 10H_2O$ is probably the most successful one. Thickener attapulgite, nucleator borax and habit modifier $(Na_2PO_3)_6$ are found to be the crucial additives for long-term $Na_2SO_4 \cdot 10H_2O$ latent heat storage system, which spent about 20 years to be optimized under efforts of Maria Telkes and S. B. Marks [9–12]. Perhaps it is difficult and time-consuming process to select proper thickener and especially habit modifier which limit the development of salt hydrates PCMs with various melting points.

$Na_2HPO_4 \cdot 12H_2O$ has almost the largest mass heat storage capacity among low temperature phase change materials [1]. However, when heating, it melts incongruently because of the precipitation of hepta hydrate, which leads to a quick decrease in heat stored during thermal cycling [13, 14]. Some thickeners were added to promote performance such as starch, sodium alginate, cellulose