The International Conference on Dyeing and Finishing
EXCO, Daegu, Korea, March 13, 2009

Shape-Stabilized Phase Change Materials : Frozen Gels From Polypropylene and *n*-Paraffin for Latent Heat Storage

Jong Hwan Kim, Jae Wang Ko, Tae Won Son

School of Textiles, Yeungnam University, Gyeongsan, Korea

ABSTRACT

We prepared polymer-PCM gels such as prepared frozen gel from polypropylene and n-Paraffin for thermal storage and release materials, their basic properties and possible applications especially in latent heat storage. The preparation methods are used to melting method and absorption method respectively. The composition and properties of prepared frozen gels from polypropylene and *n*-Paraffin were observed by DSC, FT-IR spectra, ARES and Elemental analysis. We can prepare frozen gels in different temperature for latent heat storage materials as controlling composition of phase change material as well as using different incorporating phase change materials. These frozen gels can be used to latent heat storage materials for several applications.

1. INTRODUCTION

All pure substances in nature are able to change their state. Solids can become liquids (ice to water) and liquids can become gases (water to vapor) but changes such as these require the addition or removal of heat. The heat that causes these changes is called latent heat. A Phase change material is a substance with a high heat of fusion which, melting and solidifying at certain temperatures, is capable of storing or releasing large amounts of energy. The advantage of a phase change material is the use of the latent heat which is available during the phase change process. A smaller amount of the heat storage capacity consists of sensible heat. As you know that the heat storage capacity depending on the temperature difference. It means that the phase change material is very useful material for capturing or releasing heat.

2. EXPERIMENTAL

The preparation methods are to be used as "melting method" and "absorption method", respectively. In melting method, the reaction mixture of two different kinds of polypropylene chip and four kinds of phase change materials such as normal Paraffin, respectively. And the reaction mixture is heating up under nitrogen gas atmosphere. In absorption method, polypropylene powder was mixed in the molten phase change materials with stirring at relatively low temperature.

The reaction mixture in the reaction container was heating up the reaction mixture to 200 ^{o}C for 2 hour. The mixing time of lab scale preparation should be provided quit long, instead of the short working time in a compounder vessel. Melting point *n*-Paraffin in this experiment is 65 ^{o}C. And melting temperature of polypropylene is around 160 ^{o}C. Used polypropylenes for melting method are chip type polypropylene with melt index (MI=0.5) and 17,37, respectively. So, the reaction mixture was heating up to 200 ^{o}C to melt down the reaction mixture, perfectly. After the reaction complete, the reaction mixture cooling down to room temperature The PP-PCM mixture in the reaction container was heating up the mixture around 60 - 80 ^{o}C for 12 hour. In here, powder shape polypropylene with melt index (MI=4.9) was used. we mixed up polypropylene powder and *n*-Paraffin, respectively. A melting method of frozen gel with 50/50 weight ratio of polypropylen-Paraffin was prepared by adding polypropylene chip and *n*-Paraffin. An absorption method of frozen gel with 70/30 weight ratio of polypropylene 4.9 *n*-Paraffin was prepared by adding polypropylene powder and normal Paraffin.

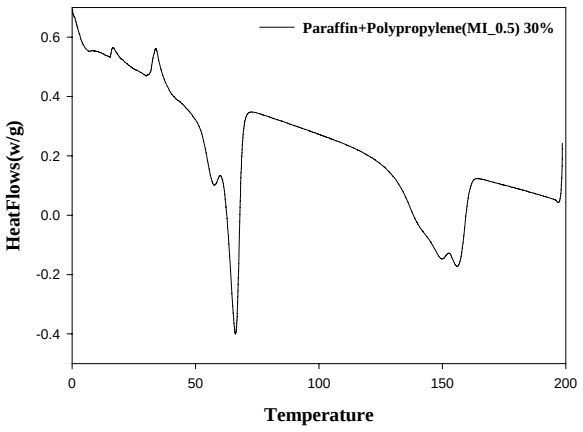

Figure 1. DSC Thermo-diagrams of PP(MI0.5) and *n*-Paraffin 30%

Thermal properties of frozen gels via melting method are measured using differential scanning calorimetry with ramping rate 5.0 K/min. And the line shows a thermogram of frozen gel from melting method using polypropylene chip and 30 weight % of normal paraffin65 as phase change material. As shown in here, we can see two melting points around 66.0 ^{o}C and 158 ^{o}C. These two melting points are associated with melting point of n-paraffin and polypropylene chip. In here, we measured heat of fusion from low temperature region that comes from normal Paraffin, because only this heat of fusion is important for latent heat energy storage for application.

3. RESULT AND DISCUSSION

The composition and properties of prepared frozen gels from polypropylene and *n*-Paraffin was observed from DSC, FT-IR spectra, ARES and Elemental analysis**.** From the experimental results, we can prepare proper frozen gels for different temperature for latent heat storage materials as controlling composition of phase change material as well as using different incorporating phase change materials. These frozen gels can be used as latent heat storage materials for several applications

REFERENCES

[1]Beginn, *Macromol. Mater. Eng.*, **2003**, 288, 245
[2]Y.G. Bryant and D.P. Colvin, *USP 4756958*, **1989** *USP 5499460*, **1996**
[3]X. Zhang et al., *J. Coll. Inter. Sci.*, **2005**, 281, 299
[4]A. Sari, *Ener. Conver. Manag.*, **2004**, 45, 2033
[5]I. Krupa and A.S. Luyt, *Polymer*, **2001**, 42, 7285