The effect of nucleating agent on supercooling in encapsulated microcapsule for building applications

Piyalak Ngernchuklin¹*, Priyagorn Pholsrimuang², Nestchanok Yongpraderm¹, Arjin Boonrung¹, Preeyaporn Chaiyasat², Amorn Chaiyasat²

¹Expert Center of Innovative Materials, Thailand Institute Scientific and Technological Research (TISTR), Klong 5, Khlong Luang, Pathum Thani 12120, Thailand
²Department of Chemistry, Faculty of Science and Technology, Rajamangala University of Technology Thanyaburi, Klong 6, Thanyaburi, Pathum Thani 12110, Thailand
*E-mail: Piyalak@tistr.or.th

Abstract: Phase change materials (PCMs) were encapsulated by polymer shell to increase heat transfer area, control the volume change and protect from the outside environment. In this research, paraffin wax (Rubitherm® 28:RT28) was encapsulated by polymer shell from poly(methyl methacrylate-co-divinylbenzene) (P(MMA-co-DVB)) by microsuspension polymerization technique. To prevent supercooling effect, the amount of nucleating agent (paraffin: Tc 55 °C at 0, 5, 10 and 15 wt% of RT28) was studied. The bulk RT28 and encapsulated RT28 were characterized by differential scanning calorimetry (DSC) to observe the crystallization temperature (Tc), thermogravimetric analysis (TGA) for degradation temperature, scanning electron microscope (SEM) for microstructure and fourier transform infrared spectrometer (FT-IR) to compare the functional group. From the results, we obtained that adding of paraffin (Tc 55 °C) at least 5 wt%, the crystallization temperatures of encapsulated RT28 (18 and 24°C) were almost the same as bulk RT28 (25°C). In addition, the latent heat of crystallization (ΔHc 182 J/g-core) of encapsulated RT28 was close to bulk RT28 (ΔHc 195 J/g-RT28). In summary, nucleating agent (paraffin; Tc 55 °C) can reduce supercooling in microcapsules. Therefore, P(MMA-co-DVB) shell encapsulated RT28 can be used as thermal energy storage material for building applications.

Keywords: Microcapsule; Microsuspension polymerization; Thermal storage material; Supercooling; Nucleating agent