World Academy of Science, Engineering and Technology
International Journal of Energy and Environmental Engineering
Vol:14, No:08, 2020

Kaolinite-Assisted Microencapsulation of Octodecane for Thermal Energy Storage

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Abstract : Phase change materials (PCMs) are widely used in latent heat thermal energy storage because of their good properties such as high energy storage density and constant heat-storage/release temperature. Microencapsulation techniques can prevent PCMs from leaking during the liquid-solid phase transition and enhance thermal properties. This technique has been widely applied in architectural materials, thermo-regulated textiles, aerospace fields, etc. One of the most important processes during the synthesis of microcapsules is to form a stable emulsion of the PCM core and reactant solution for the formation of the shell of the microcapsules. The use of surfactants is usually necessary for the formation of a stable emulsion system because of the difference in hydrophilia/lipophilicity of the PCM and the solvent. Unfortunately, the use of surfactants may cause pollution to the environment. In this study, modified kaolinite was used as an emulsion stabilizer for the microencapsulation of octodecane as PCM. Microcapsules were synthesized by phase inversion emulsification method, and the shell of polymethyl methacrylate (PMMA) was formed through free radical polymerization. The morphologies, crystalloid phase, and crystallization properties of microcapsules were investigated using scanning electron microscopy (SEM), X-ray diffractometer (XRD), and Fourier transforms infrared spectrometer (FTIR). The thermal properties and thermal stability were investigated by a differential scanning calorimeter (DSC) and a thermogravimetric analyzer (TG). The FT-IR, XRD results showed that the octodecane was well encapsulated in the PMMA shell. The SEM results showed that the microcapsules were spheres with an average size of about 50-100nm. The DSC results indicated that the latent heat of the microcapsules was 152.64kJ/kg and 164.23kJ/kg. The TG results confirmed that the microcapsules had good thermal stability due to the PMMA shell. Based on the results, it can be concluded that the modified kaolinite can be used as an emulsifier for the synthesis of PCM microcapsules, which is valid for reducing part of the possible pollution caused by the utilization of surfactants.

Keywords : kaolinite, microencapsulation, PCM, thermal energy storage
Conference Title : ICATEST 2020 : International Conference on Advanced Thermal Energy Storage Technologies
Conference Location : London, United Kingdom
Conference Dates : August 20-21, 2020