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Soybean Oil Based Phase Change Material for Thermal Energy Storage

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Abstract : In many developing countries, with the rapid economic improvements, energy shortage and environmental issues have become a serious problem. Therefore, it has become a very critical issue to improve energy usage efficiency and also protect the environment. Thermal energy storage system is an essential approach to match the thermal energy claim and supply. Thermal energy can be stored by heating, cooling or melting a material with the energy and then enhancing accessible when the procedure is reversed. The overall thermal energy storage techniques are sorted as; latent heat or sensible heat thermal energy storage technology segments. Among these methods, latent heat storage is the most effective method of collecting thermal energy. Latent heat thermal energy storage depend on the storage material, emitting or discharging heat as it undergoes a solid to liquid, solid to solid or liquid to gas phase change or vice versa. Phase change materials (PCMs) are promising materials for latent heat storage applications due to their capacities to accumulate high latent heat storage per unit volume by phase change at an almost constant temperature. Phase change materials (PCMs) are being utilized to absorb, collect and discharge thermal energy during the cycle of melting and freezing, converting from one phase to another. Phase Change Materials (PCMs) can generally be arranged into three classes: organic materials, salt hydrates and eutectics. Many kinds of organic and inorganic PCMs and their blends have been examined as latent heat storage materials. Organic PCMs are rather expensive and they have average latent heat storage per unit volume and also have low density. Most organic PCMs are combustible in nature and also have a wide range of melting point. Organic PCMs can be categorized into two major categories: non-paraffinic and paraffin materials. Paraffin materials have been extensively used, due to their high latent heat and right thermal characteristics, such as minimal super cooling, varying phase change temperature, low vapor pressure while melting, good chemical and thermal stability, and self-nucleating behavior. Ultraviolet (UV)-curing technology has been generally used because it has many advantages, such as low energy consumption , high speed, high chemical stability, room-temperature operation, low processing costs and environmental friendly. For many years, PCMs have been used for heating and cooling industrial applications including textiles, refrigerators, construction, transportation packaging for temperature-sensitive products, a few solar energy based systems, biomedical and electronic materials. In this study, UV-curable, fatty alcohol containing soybean oil based phase change materials (PCMs) were obtained and characterized. The phase transition behaviors and thermal stability of the prepared UV-cured biobased PCMs were analyzed by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). The heating process phase change enthalpy is measured between 30 and 68 J/g, and the freezing process phase change enthalpy is found between 18 and 70 J/g. The decomposition of UVcured PCMs started at 260 ºC and reached a maximum of 430 ºC.

Keywords : fatty alcohol, phase change material, thermal energy storage, UV curing
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