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The Utilization of Phase Change Material (Pcm) Composite Derived from Fatty Acids and Waste Materials as Thermal Energy Storage (Tes) Medium

S.Z. Abidin[1,2], S.S. Jamari[1], S.A.A. Ghani[1]*

[1] Faculty of Chemical & Natural Resources Engineering,
[2]Centre of Excellence for Advanced Research in Fluid Flow (CARIFF), Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia.
**Corresponding author: sumaiya@ump.edu.my*

EXTENDED ABSTRACT

Implementation of organic materials in the thermal energy storage (TES) systems has been one of the most attractive candidates in improving the heat and energy storages as well as preserving the environment. Organic PCM such as fatty acid has been discovered to have high heat capacity, good chemical stability, low or non- supercooling, non-corrosive, small volume change, low vapor pressure and low cost. However, problem associated with low thermal conductivity has become one of the major drawbacks of PCM derived from fatty acids. Therefore, in-depth researches have been conducted and PCM composite containing fillers such as nanowires, metallic, and carbon additives has been formulated to investigate the potential of these materials to improve the performance of conventional organic PCM during heating and cooling application in solar system. As they observed the thermal properties between the formulated PCM composite, PCM with carbon additives has shown the obvious advantages but the other PCM fillers properties were excellent too. Despite their good performance, in terms of economic value, it is quite pricy. From the study, the performance of PCM composite using nanowires and metallic particles was poorer compared to the carbon additives (i.e. expanded graphite, graphene oxide, and activated carbon) during heating and cooling application in solar system. Despite that, the performance is still excellent for the thermal storage and thermal conductivity of all elements but, in terms of economic value, it is quite pricy. Therefore, several solutions have been identified to enhance the thermal conductivity of the conventional PCM whilst producing cheaper PCM composite. This paper investigates the potential of waste materials i.e. metal and biochar wastes as fillers in PCM composite. In-depth characterization analyses using differential scanning calorimetry (DSC), scanning electron microscopy (SEM), Fourier transform- infra red (FTIR) and thermogravimetric analysis (TGA) were carried out to evaluate the thermochemical properties on the newly formulated PCM composite. The performance of PCM composite was evaluated using water storage system application to determine the best performance of the PCM composites. Through the analysis based on the latent heat calculation from the heating and cooling temperature profile, the results revealed that the highest content of fillers showed the best thermal storage performance with highest latent heat stored in the system. Besides that, comparison study on both fillers was investigated and biochar waste was found to give the best TES performance. Overall, this work demonstrated the possible utilization of metal and carbon wastes in the TES application as these newly synthesized materials shows promising results as a good TES material.

Keywords: Thermal energy storage (TES); Filler; Composite phase change material (PCM); Fatty acid PCM; Waste materials.

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