Phase change materials emulsions for heat exchange applications

Filippo Agresti[1], Simona Barison[1,*], Sergio Bobbo[2], Giovanni Ferrarini[2], Stefano Rossi[2], Laura Fedele[2]

[1] Institute of Condensed Matter Chemistry and Technologies for Energy (ICMATE), National Research Council (CNR), Padova (Italy)

[2] Construction Technologies Institute, National Research Council (CNR), Padova (Italy)

*Corresponding Author: simona.barison@cnr.it

Phase change material emulsions (PCMEs) have risen interest in recent years as potential heat transfer and heat storage fluids. These systems consist of a heat transfer fluid as water and an emulsified or an encapsulated PCM, which should be immiscible with the base fluid [1]. The idea is to exploit the latent heat of melting and crystallization of PCM to increase the thermal energy storage capacity of the base fluid. The continuous phase, the base fluid, confers greater thermal conductivity and lower viscosity with respect to PCM. The emulsified or encapsulated systems have also the advantage to be pumped through a heat transfer circuit independently from the state of PCM.

In this work, a 10 wt% of a commercial PCM material, RT25HC, with nominal phase change temperature at 25 °C, has been successfully emulsified in water by sonication and surfactant addition. The size of PCM droplet as well the emulsion stability was investigated over time.

Since supercooling, that is the crystallization process happening at lower temperature with respect to melting, is a typical issue in PCME development being more pronounced in nano-confined systems, the effect a nucleating agent on crystallization kinetics has been evaluated. In particular, a PCM melting at higher temperature with respect to RT25HC (RT65, melting at 65°C) was added with a concentration of 1 wt%.

The thermal conductivity, the viscosity, the density and the Cp of the emulsion were measured at various temperatures. The heat exchange performance of the PCME was investigated by means of a specifically built apparats for the measurements of the heat transfer coefficient at constant heat flux.

Acknowledgment

Authors would like to acknowledge the Project “PCM Cool” financed by CNR Italy. Moreover, authors would like to thank Mauro Scattolini for his valuable technical support in the measurements.

Significant references

1. D. Cabaleiro, F. Agresti, L. Fedele, S. Barison, C. Hermida-Merino, S. Losada-Barreiro, S. Bobbo, M.M. Pineiro, *Renewable and Sustainable Energy Reviews,* 159 (2022) 112238.