Implementation of Micro Encapsulated Phase Change Material (MEPCM) Into Fluid Based Heat Exchangers

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Fluids have been used to maintain operational temperatures for machinery for as long as machines have been developed. Over time different mediums have been explored, such as oils and waxes. These different mediums have had varying impacts on the overall system such as improving the heat capacity but at the cost and strain on the system of requiring more pumping power. Some mediums, while they provide an improvement can also damage to the system itself over time with unwanted interactions such corrosion. In this paper we will examine the implementation and suspension into the working fluid of Micro Encapsulated Phase Change Material (MEPCM) into water at different concentrations for use in a fluid-based heat exchanger. The implementation of MEPCM will provide a cost-efficient method to improve the overall efficiency of liquid heat exchangers while not dramatically increasing the cost of operation and of maintenance requirements.

Fluid based heat exchangers can only move as much energy as their working fluid can hold, in this paper we examined how the implementation of MEPCM to a common working fluid (water) can increase the specific heat capacity of the working fluid over an experienced range of temperatures, and by increasing the specific heat capacity, improve the overall system performance while not substantially increasing the cost. The comparison will be drawn between the system using water as the working fluid and the same system with the same flow rate and experienced heat flux across the cross section, but with the addition of MEPCM into the working fluid.

With the inclusion of MECPM we hope to improve the performance of the system while maintaining a reasonable cost comparison to that of water. A numerical model was evaluated comparing the system performance of that of water and to that of different percentages of MEPCM in suspension in the working fluid. The simulation was conducted with COMSOL Multiphysics which has provided us with our data points and infographics. The COMSOL model was able to show a noted improvement to the overall systems specific heat capacity as expected in our temperature range. The inclusion of MEPCM into the working fluid of heat exchanger has a direct an impact on the specific heat capacity of the system, localized heat flux, and local Nusselt number across the heat exchanger all while not restricting the flow of the working fluid. MEPCM over time presents little risk to the system while it remains in suspension as there will be no negative interaction between the MEPCM and the system while in suspension. The inclusion of MEPCM into a system working fluid was numerically shown to have a direct correlation between the heat capacity and performance of the system when compared to just water as the working fluid.