Natural convection heat transfer in a shell and helical coil heat exchanger using non-Newtonian nanofluids

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Abstract

Nanofluids have gained much attention due to excellent thermal properties. In this study, natural convection heat transfer behavior of three different types of non-Newtonian nanofluids in a shell and helical coil heat exchanger has been investigated experimentally under unsteady state conditions. Nanofluids were prepared by dispersion of Al_2O_3, Fe_2O_3 and CuO nanoparticles in an aqueous solution of carboxymethyl cellulose (CMC) (base fluid). Nanofluids of different concentrations (0.2, 0.4, 0.6, 0.8 and 1.0 wt%) were prepared by dispersing Al_2O_3, Fe_2O_3 and CuO nanoparticles in base fluid using probe sonication process. In the present study, the effect of shell-side nanofluid concentration, tube-side fluid (heating medium) temperature and flow rate parameters on heat transfer has been investigated.

Results indicated that the addition of nanofluid has intensified heat transfer as indicated by the higher temperature of nanofluid when compared to base fluid. Out of the three materials used in the study, CuO nanofluid attained the highest temperature because of its higher thermal conductivity. Heat transfer rate decreased with time continuously for all the experimental conditions. Enhancement in heat transfer initially was higher compared to later times. A maximum enhancement in heat transfer rate of 23% has been obtained initially. At longer time the enhancement is less due to the lower buoyancy forces prevailing due to lower driving force. The effect of nanofluid concentration on heat transfer rate with time exhibited different behavior compared to the effect of inlet temperature and flow rate.

References:

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