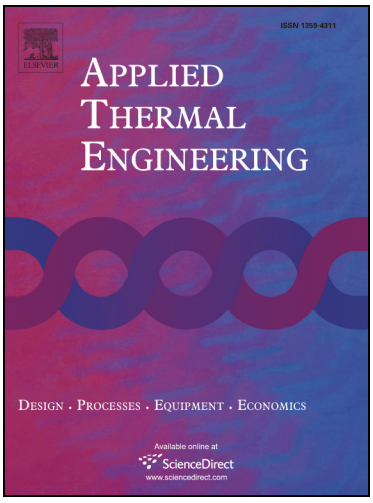

On the uses of classical or improved heat transfer correlations for the predictions of convective thermal performances of water- Al_2O_3 nanofluids.

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On the uses of classical or improved heat transfer correlations for the predictions of convective thermal performances of water-Al_2O_3 nanofluids.

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ABSTRACT: This paper reports calculations aimed at predicting the convective heat transfer enhancement evaluated in terms of the ratio of the nanofluid and base fluid heat transfer coefficients. Either usual single-phase heat transfer correlations or improved correlations involving slip velocity due to inertia, Brownian and thermophoretic diffusions are considered. In this regard, eight classical flow configurations both for laminar and turbulent forced or natural convection, are first examined. In each case, five to six commonly used models for the effective thermal conductivity and viscosity are compared for water-Al_2O_3 nanofluids, with nanoparticle volume fractions ranging from 1 % to 5 %. In order to recover anomalous convective heat transfer enhancements, we examine mainly the influences of simultaneous augmentations of thermal conductivity and dynamical viscosity. The opposite influences of these two fluid properties on the heat transfer coefficient are clearly established. In the second part of the Result section, we attempt to give a critical interpretation of the previous results by using new published improved correlations derived with the objective to show that the usual correlations are not relevant for predicting nanofluid convective heat transfer. However, most of the present results reveal that the increase in the particle volume fraction tends to deteriorate the heat transfer in comparison with the base fluid.

Keywords: Anomalous heat transfer, Forced convection, Natural convection, Correlating equations, Nanofluids thermophysical properties.

Highlights:

- Heat transfer correlations for various loading-dependent models are considered.
- Single-phase fluid does not generally lead to significant heat transfer enhancement.
- The increase in dynamic viscosity is a severe limitation in the use of nanofluids.
- Improved thermal conductivity and viscosity models result in controversial effects.