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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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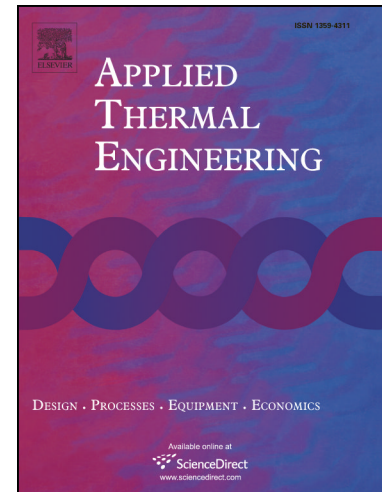
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1 **On the uses of classical or improved heat transfer correlations for the pre-**
2 **dictions of convective thermal performances of water- Al_2O_3 nanofluids.**

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5 **ABSTRACT:** This paper reports calculations aimed at predicting the convective heat transfer enhance-
6 ment evaluated in terms of the ratio of the nanofluid and base fluid heat transfer coefficients. Either usual
7 single-phase heat transfer correlations or improved correlations involving slip velocity due to inertia, Brown-
8 nian and thermophoretic diffusions are considered. In this regard, eight classical flow configurations both
9 for laminar and turbulent forced or natural convection, are first examined. In each case, five to six com-
10 monly used models for the effective thermal conductivity and viscosity are compared for water- Al_2O_3
11 nanofluids, with nanoparticle volume fractions ranging from 1 % to 5 %. In order to recover anomalous
12 convective heat transfer enhancements, we examine mainly the influences of simultaneous augmentations
13 of thermal conductivity and dynamical viscosity. The opposite influences of these two fluid properties on
14 the heat transfer coefficient are clearly established. In the second part of the Result section, we attempt to
15 give a critical interpretation of the previous results by using new published improved correlations derived
16 with the objective to show that the usual correlations are not relevant for predicting nanofluid convective
17 heat transfer. However, most of the present results reveal that the increase in the particle volume fraction
18 tends to deteriorate the heat transfer in comparison with the base fluid.
19

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

22 Highlights:

- 23
24 • Heat transfer correlations for various loading-dependent models are considered.
25
26 • Single-phase fluid does not generally lead to significant heat transfer enhancement.
27
28 • The increase in dynamic viscosity is a severe limitation in the use of nanofluids.
29
30 • Improved thermal conductivity and viscosity models result in controversial effects.
31

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