Forecasting of water thermal conductivity enhancement by adding nano-sized alumina particles

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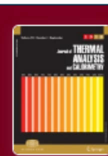

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Abstract

Operating fluids play an important role in heat transfer equipment. Water is inexpensive popular operating fluid with extensive applications, but its thermophysical properties are not good enough, especially for high temperature processes. Therefore, modification of its inherent characteristics by adding nano-sized solid particles found high popularities. Thermal conductivity is one of the most important thermophysical properties of an operating fluid in relatively all energy-based processes. Variation of thermal conductivity of nanofluids with different operating conditions is required to be understood in such processes. Therefore, the focus of this study is concentrated on modeling of thermal conductivity of water-alumina nanofluids using four different smart paradigms. Multilayer perceptron, radial basis function, cascade feedforward, and generalized regression neural networks are employed for the considered task. The best structure of these paradigms is determined, and then, their accuracies are compared using different statistical indices. Accuracy analyses confirmed that the generalized regression neural network outperforms other considered smart methodologies. It predicted more than 280 experimental datasets with excellent absolute average relative deviation = 0.71%, mean square error = 0.0006, root mean square error = 0.023 and regression coefficient (R^2) = 0.9675. In the final stage, the proposed paradigm is used for investigation of the effect of influential parameters on the thermal conductivity of water-alumina nanofluids. This type of accurate and straightforward paradigm can broaden our insight about thermal behavior of homogeneous suspension of nano-size alumina particles in water.