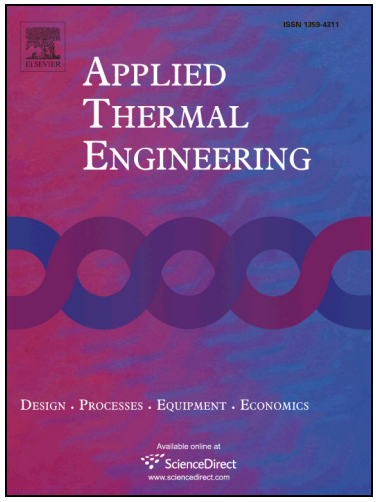

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A series of generalized correlations for predicting the thermal conductivity of composite materials packing with artificially designed filler shapes

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Abstract

Enhancement of the thermal conductivity of composite materials has become more and more common in heat exchangers by applying artificially designed fillers. In this paper, the effective thermal conductivity of composite materials is investigated based on an extensive numerical study. The effective thermal conductivity of composite materials packing with different shapes of fillers are compared under the same volume fraction, thermal conductivity ratio and the thermal conduct resistance. The results indicate that the effective thermal conductivity of composite materials decreases as the thermal conduct resistance increases and the decline ratio will gradually slow down. Different shapes of fillers have different sensitivity degree on the thermal conduct resistance. Composite materials packing with the fillers which provide a longer path for the heat flow have a higher effective thermal conductivity than other types of fillers. A series of new generalized correlations is proposed by using the method of nonlinear regression. These new generalized correlations can be used at a wide range of thermal conductivity ratio $(1 \leq \kappa \leq 1000)$, thermal conductivity resistance $(0 < R_c^* \leq 1)$ and volume fraction $(0 < \varphi \leq 0.2)$.

Keywords: Effective thermal conductivity, Composite materials, artificial designed fillers.

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