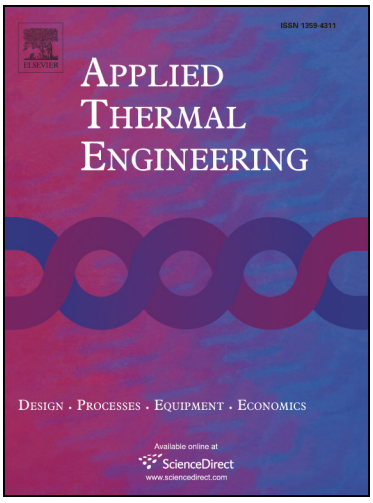

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Kelvin-cell-based metal foam heat exchanger with elliptical struts for lower energy consumption

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Abstract

Conventional Kelvin-cell-based metal foam (KMF) has triangular or circular struts. This study proposes a KMF with elliptical struts instead of such struts. Two schemes of transforming a circular strut into an elliptical strut are proposed: (1) maintaining the same circumference as the circular strut cross-section and (2) maintaining the same cross-section area as the circular strut cross-section. Five KMFs with different struts were designed. The fluid flow, heat transfer, and performance characteristics of the KMFs were numerically investigated. Two dimensionless diameters for the strut section are introduced to analyze the hydro-thermal characteristics of KMFs: λ_a, the major diameter ratio of the elliptical strut to the circular strut, and λ_b, the minor diameter ratio of the elliptical strut to the circular strut. The major axis of all struts was set parallel to the main flow direction. The pressure drop and heat transfer characteristics of KMFs are explained by the pressure drag and friction drag. As λ_b decreases from 1.000 to 0.556, the pressure drop of the KMF decreases by 44% because the pressure drag and blockage ratio decrease with λ_b. However, the decrease of λ_b results in decreases in the free stream velocity around the strut, which has a penalty on the heat transfer performance. This can be partially compensated by increasing λ_a by increasing the flow tortuosity, surface area, and separation angle. Therefore, using the scheme