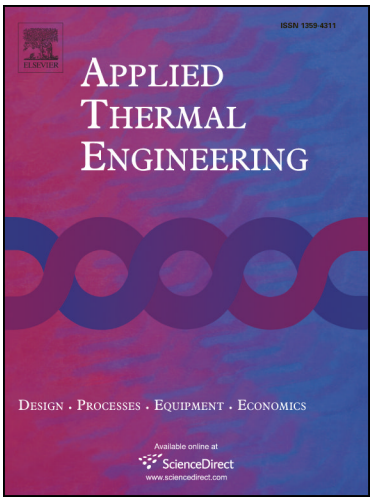

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PII: S1359-4311(16)33471-8
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2017.05.134
Reference: ATE 10448

To appear in: *Applied Thermal Engineering*

Received Date: 19 November 2016
Revised Date: 16 May 2017
Accepted Date: 20 May 2017

Please cite this article as: N.S. Effendi, K.J. Kim, Orientation Effects on Natural Convective Performance of Hybrid Fin Heat sinks, *Applied Thermal Engineering* (2017), doi: http://dx.doi.org/10.1016/j.applthermaleng.2017.05.134

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ABSTRACT

Orientation effects on thermal performances of the hybrid fin heat sinks (HFHSs) in natural convection are computationally and experimentally investigated. Hollow and solid hybrid fin heat sinks are explored as representative HFHSs and compared with a similarly-sized pin fin heat sink (PFHS). The staggered array of hollow pin fins integrated with radially-oriented plate fins and containing perforations in the vicinity of fin bases composes the hollow hybrid fin heat sink (HHFHS). The staggered array of solid pin fins with extruded radially-oriented plate fins composes the solid hybrid fin heat sink (SHFHS). CFD thermal models of the HHFHS, the SHFHS, and the PFHS are generated, experimentally-verified, and employed to investigate the orientation effects, ranging from 0 to 180 °, on their thermal performances. The results show the lowest thermal resistance, R_{th}, values for the HHFHS, the SHFHS, and the PFHS occurred at an orientation angle of 45°, less orientation dependence of the HHFHS compared with the PFHS, and consistently smaller mass-multiplied thermal resistance, $R_{th}M$, values of the HHFHS, even up to 32%, than those of the PFHS despite various orientations.

Keywords: Heat sink, Hybrid fin, Orientation, Natural convection, Thermal