

# The entropy generation analysis of a pin–fin heatsink with $\text{Fe}_3\text{O}_4$ ferrofluid coolant and considering four different pin–fin shapes (circular, square, rhumbas, and triangular) in the presence of the magnetic field

Tao Hai<sup>a, b, c</sup>, Kamal Sharma<sup>d</sup>, Abdulrazak Abdulsalam Mohammed<sup>e</sup>, Hassan Fouad<sup>f</sup>, Walla El-Shaai<sup>g</sup>

Show more

+ Add to Mendeley Share Cite

<https://doi.org/10.1016/j.jmmm.2023.170904>

[Get rights and content](#)

## Abstract

The entropy generation analysis was performed to determine the viscose and thermal irreversibilities ( $\dot{S}_{fr}$  and  $\dot{S}_{th}$ ) inside a pin–fin heatsink under the absence (WO) and presence (W) of the magnetic field considering  $Re$  of 200, 300, 400, and 500, four different pin–fin shapes, and  $\text{Fe}_3\text{O}_4$  ferrofluid coolant. The results demonstrated that  $\dot{S}_{fr}$  and  $\dot{S}_{th}$  escalates and diminishes, respectively, by increasing  $Re$  or by applying the magnetic field effects. For instance, the increase in  $Re$  from 200 to 500 escalates  $\dot{S}_{fr}$  by 86% and 80% for 4 configurations and under WO and W scenarios of the magnetic field. Besides, the highest  $\dot{S}_{fr}$  (and lowest  $\dot{S}_{th}$ ) was observed for the triangular configuration, which is nearly 12.79% (and 8.36%) and 13.89% (and 11.18%) higher than that for the circular configurations with the lowest  $\dot{S}_{fr}$  (and highest  $\dot{S}_{th}$ ) among four configurations at  $Re=200$ . Furthermore, the magnetic field escalates  $\dot{S}_{fr}$  by 41.88%, 37.19%, 37.49%, and 34.06% over the base case without the magnetic field for circular, square, rhumbas, and triangular heatsinks, respectively, at  $Re=200$ . These values diminish to 10.50%, 11.46%, 10.51%, and 7.77% as  $Re$  increases from 200 to 500. In addition,  $\dot{S}_{th}$  decreases by 21.98% (or 7.39%), 19.18% (or 6.17%), 20.95% (or 7.15%), and 14.00% (or 3.46%) under the W scenario against the WO scenario for circular, square, rhumbas, and triangular configurations, respectively, at  $Re$  of 200 (or 500).