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Numerical investigation, environmental consideration, and the use of machine learning in optimizing the dimensions of a rectangular blade between two blades in the presence of a magnetic field (Two-phase method)

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Abstract

Human life is being impacted by nanotechnology in many ways, including economics, production, and the environment. The present study has numerically investigated the laminar flow and natural convection heat transfer (NACHT) in a square enclosure filled with nanofluids (NFs), considering the entropy generation (ETG) and Be. The 2D enclosure includes two rectangular fins attached to the left hot wall and a single fin of very high temperature positioned in the middle of the enclosure. A constant magnetic field (MCF) has been applied to the enclosure. The average Nu, maximum value of stream function (MXSF), generated entropy, and Be have been examined by changing the length and thickness of the middle fin and the distance between heated fins (fin spacing). Finally, these parameters have been optimized through machine learning methods to determine the best case with the highest HT rate and lowest ETG rate. A two-phase model based on control volume has been used for NFs flow simulation. Results indicated that increasing fin length (w) increases Be and decreases the MXSF. Also, by increasing the w, the Nu and generated entropy initially decrease and then increase. Increasing the fin thickness (b) and fin spacing lead to a decrease in the MXSF. Increasing thickness for the fin increases the Nu but decreases it for larger fin spacing.Furthermore, the studied model is less harmful to the environment than existing models.