The optimisation of MHD free convection inside porous trapezoidal cavity with the wavy bottom wall using response surface method

Heat transfer by natural convection within the trapezoidal enclosure has several engineering applications, including heat exchangers, electronic devices, nuclear energy and solar collectors. As a result, this investigation includes a computational simulation of natural convection heat transfer in a wavy trapezoidal cavity using porous media with and without magnetohydrodynamics (MHD) at various wave numbers (N), amplitudes (a) and cold sides temperature (Tc) along with Rayleigh number (Ra). The dominant design of heat transfer enhancement regarding heat transfer enhancement (HTE) and energy enhancement (EE) is enhanced by 3.16–3.37 and 5–80 times, respectively as the design and operating parameters values are N = 4, a = 20 mm, Tc = 0 ◦C, and Hartmann number, Ha = 40 for various Ra. As the originality study, the optimisation investigation was carried out utilizing a unique multi-objective optimum technique to identify the ideal design for the trapezoidal cavity by evaluating the influence of the Ha, Tc, and Ra. The ideal maximum Nuave was identified at Ha = 40, Ra = 2.5 × 104 , and the smallest value of Tc = 0 ◦C (Optimum Case), whereas the lowest Nuave was identified at Ha = 0 and Ra = 5 × 102 , and the highest value of Tc = 25 ◦C (Standard Case). As a consequence, the ideal design produced a significant increase in the hydrothermal performance in respect of both the HTE = 3.16 and EE = 5.03 based on computational simulation findings, which was the main goal of the current study.