Multi-objective optimum design of porous triangular chamber using RSM

The present research enlightens the study of natural convection in an isosceles triangular shaped chamber heated from below and cooled from the sides filled with porous media. The study is conducted due to the wide use of this subject in nature and thermal industrial systems, such as in a valley. Natural convection in a chamber is numerically simulated in two dimensions using the Finite Volume Method. A wide range of Rayleigh numbers (Ra) from 102 to 5 × 103 is examined for various inclination angles (θ), heater lengths (Lh) and heater locations (Ph). It is found that the plumelike patterns for the isotherms occur at Ra = 2.5 × 103 , with two rotating large vortices breaking into multi smaller vortices as the length of the heater is increased. Additionally, for an inclination angle of 0◦, the Nusselt number records a higher value nearly 26% compared to θ = 180◦ at the highest Ra. Finally, Response Surface Methodology (RSM) is used to show that porosity (ε), aspect ratio (L/H), and Ra have a major effect on hydrothermal efficiency, which is almost equal to 1.27 at the minimum porosity (ε), the maximum values of aspect ratio (L/H) and Ra with higher desirability. This study offers a novel approach to designing an isosceles porous triangular-shaped chamber as well as practical advice.