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Mixed convection in a partially layered porous cavity with an inner rotating cylinder
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Abstract
In this study, mixed convection in a cavity that has a fluid and superposed porous medium with an adiabatic rotating cylinder is numerically investigated. The bottom horizontal wall is heated and the top horizontal wall is cooled while the remaining walls are assumed to be adiabatic. An adiabatic rotating cylinder is inserted inside the cavity. The governing equations are solved by the Galerkin weighted residual finite element method. The effects of Rayleigh number (between 103 and 106), angular rotational speed of the cylinder (between 0 and 6,000), Darcy number (between 10-5 and 10-2), cylinder sizes (between R = 0.1 and R = 0.3) and three different vertical locations of the cylinder on the fluid flow and heat transfers characteristics are numerically investigated. It is observed that the cylinder size has a profound effect on the local and averaged heat transfer. The local and averaged heat transfers generally increase and the convection is more effective in the upper half of the cavity as the Rayleigh number and Darcy number enhance. The averaged heat transfers increases with the cylinder size until Ra = 105. The averaged heat transfer increases almost linearly with the angular rotational velocity of the cylinder and the increase rate becomes higher as the cylinder size increases. The local and averaged heat transfers enhances/deteriorate as the cylinder approaches the upper/lower wall of the cavity. Copyright © Taylor & Francis Group, LLC.

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