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Control of buoyant flow and heat dissipation in a porous annular chamber using a thin baffle

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Abstract

This paper reports the numerical simulations on buoyant thermal transfer inside the finite porous cylindrical annular region with a thin circular baffle attached to inner cylinder. The main objective of this investigation is to provide a detailed impact of baffle on flow and heat transport rates due to the direct relevance of this problem to the design of heat exchangers. The side walls of annular enclosure are maintained at uniform, but different temperatures, while the top and bottom walls are insulated. The Brinkman-extended Darcy model is adopted for the momentum equations, and simulations of the governing PDEs are performed using the ADI and SLOR algorithms. The predictions from the present simulations detected that the size and position of baffle has predominant impact on buoyant flow and thermal transport characteristics. It has been detected that the thermal dissipation rates could be enhanced by positioning the baffle near the upper boundary, while increasing the baffle length leads to the reduction of thermal transport. The size and location of baffle emerges out as an important quantity in regulating the global thermal transfer through modifying the flow regimes in the annular geometry. Interestingly, the magnitude of flow circulation enhances with an increase in Rayleigh and Darcy numbers for any baffle length and position.

Keywords:
Annulus enclosure, Baffle, Porous, Darcy-Brinkman model, Finite difference method

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