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Natural convection from a horizontal annulus filled with porous medium of variable permeability

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Abstract: Natural convection from a horizontal annulus filled with porous medium of variable permeability is investigated. Two cases are considered: variation of porous permeability in the radial direction and in the tangential direction. A numerical solution is obtained using a finite volume method. The effect of the permeability variation on the flow and heat transfer of the annulus is presented in terms of velocity and temperature profiles, Nusselt number, skin friction coefficient, and pressure coefficient at both the inner and outer walls of the annulus. Stream function distribution and isotherm contours are also shown for all considered cases. The calculation for the two reference cases, namely, free-fluid case and the uniform permeability case, are also calculated and presented for comparison. All calculations are performed at the same pertinent parameters, namely, Rayleigh number, Darcy number, and Prandtl number, with an annulus radius ratio of 2.0.