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Incompressible viscous flow in a porous medium enclosed by two rotating discs

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Abstract: Rotating-disc systems are used to model the flow and heat transfer that occurs inside the cooling air systems of gas-turbine engines. In this study, the numerical solution for an axisymetrical, steady laminar flow between two rotating discs is investigated and presented. The space between the disks is filled with porous media. For this study, the Navier-Stokes equations combined with the Forchheimer-extended Darcy model and energy equation were adapted to model the flow. Results are presented in terms of the pressure difference (??), between the outlet and inlet of the rotating disc, Reynolds number (Re0), flow coefficients (??), Darcy number {Da), inertia parameter (??), geometry parameters (a/b, s/b), and Nusselt number (Nu). It is found that both the Darcy number (Da) and inertia parameter (??) have an important effect on the flow structure and the pressure difference (??). The effect of the Darcy number (Da) is significantly for values less than Da =0.01, where the pressure difference (??) increases as the Darcy number (Da) increases. The effect of the inertia parameter is significant for values more than ?? =0.001, where the pressure difference (??) decreases as the inertia parameter (??) increases. Increasing the flow coefficient (??) decreases the pressure difference (??) for both fluid and porous domain. The pressure difference (??) increases as both (a/b) and (s/b) decreases. The Nusselt number (Nu) increases as the Darcy number (Da) decreases. An increase in the thermal conductivity ratio, (ke/k f), results in an increase in the Nusselt number. Filling the rotating cavity with porous media significantly enhances the heat transfer from the walls to the fluid domain. The porous material properties, with specific values of Darcy number and inertia loss parameter, should be selected in a way that give the preferred flow and pressure difference coefficients .