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FRICTION AND HEAT TRANSFER CHARACTERISTICS OF TURBULENT FLOW IN A HELICAL VANE FITTED ANNULUS ROTATING ABOUT A PARALLEL AXIS

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ABSTRACT In this paper, turbulent helical flow in an annulus has been predicted using high Reynolds number form of k-ϵ model of turbulence. The helical flow is generated by a single helical vane insert (see figure 1)[1]. For the stationary duct, the predictions of friction factor f and Nusselt number Nu are compared with the published experimental data of Gupte and Date [1989] for two radius ratios $R^* = (R_1/R_2)$ and one vane twist parameter Y = H / D_h. Excellent agreement is found between predictions and experimental data.

The computations are further extended to the case of rotation of the annulus about an an external axis parallel to the axis of the annulus. This results in axially periodic flow and heat transfer under fully developed conditions with axial periodicity 2H. Rotation gives rise to two additional parameters characterizing the flow. These are: Radial distance eccentricity $E^* = (E/D_h)$ and Rotation number Ro = $(\Omega\, D_h^2/\mu)$. Besides, the direction of rotation $\pm\ \Omega$ also affect the f and Nu characteristics.
Computations are performed using SIMPLE algorithm on Colocated curvilinear grids. The

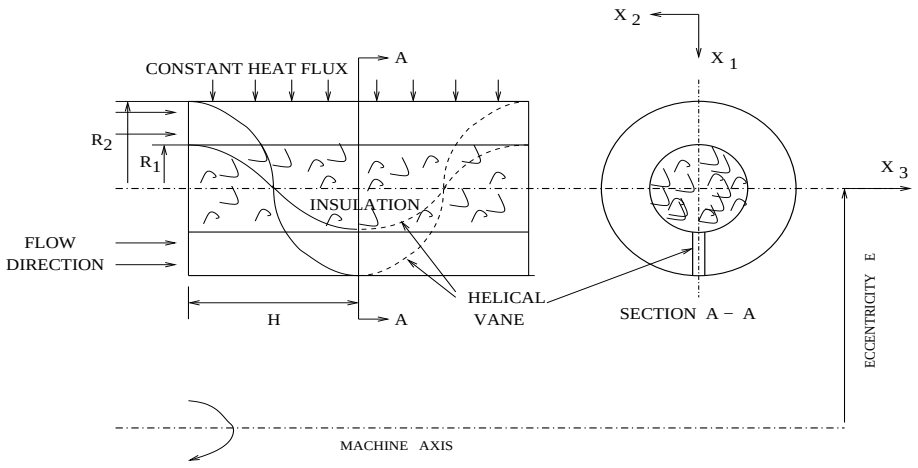

Figure 1: Annulus Fitted with Helical Vane

problem of zig-zag pressure prediction is eliminated by employing *smoothing pressure correction* strategy Date [2003]. The computed results are of relevance to cooling of high-power-density electrical rotating machines.

[1]Case of Laminar Flow in an annulus with large number of helical vanes (called Radial Fins) has been considered by McArthur and Patankar [1985]

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