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Conjugate heat transfer in porous annulus

Abstract

The effect of conductivity ratio on temperature at a solid-porous interface is one of the most important aspects in conjugate heat transfer. The present work is undertaken to investigate heat transferbehavior in a porous annular vertical cylinder having a solid wall at the inner surface. The main objective of the present study is to evaluate the effect of solid wall thickness and conductivity ratio onheat transfer characteristics of the porous medium. The inner and outer surfaces of the annulus are maintained isothermally at Th and T∞, respectively, such that Th > T∞. The increase in conductivity ratio leads to an increase in temperature at the solid-porous interface. It is noticed that the temperature variation along the porous region is almost linear for higher values of conductivity ratio and wall thickness ratio. It is found that the fluid velocity decreases with increase in wall thickness. It is observed that the Nusselt number decreases with increase in solid wall thickness. The effect of the aspect ratio is found to be negligible when porous conductivity is much higher than that of the solid wall conductivity. The attainment of the maximum Nusselt number at Ar ≈ 1 in a porous annulus does not hold good for the conjugate heat transfer problem. The variation in Nusselt number is sensitive for higher wall thickness ratio and lower conductivity ratio

Keywords

Conjugate heat transfer; Finite element method; Porous media; Vertical annular cylinde