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Numerical Study of Rayleight Number and Eccentricity Effect on Free Convection Fluid Flow and Heat Transfer of Annulus

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Abstract : Concentric and eccentric annulus is used frequently in technical and industrial applications such as nuclear reactors, thermal storage system and etc. In this paper, computational fluid dynamics (CFD) is used to investigate two dimensional free convection of laminar flow in annulus with isotherm cylinders surface and cooler inner surface. Problem studied in thirty different cases. Due to natural convection continuity and momentum equations are coupled and must be solved simultaneously. Finite volume method is used for solving governing equations. The purpose was to obtain the eccentricity effect on Nusselt number in different Rayleight numbers, so streamlines and temperature fields must be determined. Results shown that the highest Nusselt number values occurs in degree of eccentricity equal to 0.5 upward for inner cylinder and degree of eccentricity equal to 0.3 upward for outer cylinder. Side eccentricity reduces the outer cylinder Nusselt number but increases inner cylinder Nusselt number. The trend in variation of Nusselt number with respect to eccentricity remain similar in different Rayleight numbers. Correlations are included to calculate the Nusselt number of the cylinders.

Keywords : natural convection, concentric, eccentric, Nusselt number, annulus
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