STUDY OF CONVECTIVE HEAT TRANSFER AND PRESSURE DROP IN SHORT PASSAGES OF TRIANGULAR CHANNELS

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ABSTRACT

Interest in laminar flow forced convection in ducts of non-circular cross-sections has increased in recent years as a result of their wide application. In many cooling problems present today such as in nuclear reactors, high performance heat exchangers, or rock power plants, design considerations are in favour of using ducts of non-circular cross-sections. In the present investigation, experimental data is presented for isothermal pressure drop and convective heat transfer rates with out phase change under laminar flow conditions in isosceles triangular channels of different aspect ratios which are heated only from one side(bottom side).The influence of various physical properties on the heat transfer rates are presented. Water and glycerol-water mixtures have been used as coolants. The heat transfer coefficients obtained in the triangular channels are correlated in the conventional manner using Colburn J factor with Sieder-Tate correction factor. From the investigations made, it is found that the J factor is a function of $Re^{-0.825}$, $(L/D_e)^{-1.48}$ and $(1+0.015\ Gr^{1/3})^{0.26}$. Test sections of varying hydraulic diameters, namely, 5.15, 4.27 and 2.88 cm are employed in the present investigation. The Prandtl numbers are varied from 3 to 52 using glycerol-water mixture as the coolant. Empirical correlations for isosceles triangular channels of different aspect ratios heated from only one side are presented. The general correlation is expressed by the following equation.

$$J = 260\ Re^{-0.825}\ (L/D_e)^{-1.48}\ (1+0.015\ Gr^{1/3})^{0.26}$$

The increase in the experimental friction factors over theoretical friction factors in the streamline region is correlated by the equation

$$f - f_{fd} = 1.58 \times 10^{5}\ (L_h/D_e)^{-2.6}\ Re^{-1}$$

KEYWORDS: Isosceles triangular channels, Heat Transfer, Hydraulic diameter, Friction factor, Grashoff Number.