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Investigation of Heat Transfer by Natural Convection in an Open Channel

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Abstract : Experimental study of natural convection heat transfer inside smooth and rough surfaces of vertical and inclined equilateral triangular channels of different inclination angles with a uniformly heated surface are performed. The inclination angle is changed from 15º to 90º. Smooth and rough surface of average roughness (0.02 mm) are used and their effect on the heat transfer characteristics are studied. The local and average heat transfer coefficients and Nusselt number are obtained for smooth and rough channels at different heat flux values, different inclination angles and different Rayleigh numbers (Ra) 6.48 × 105 ≤ Ra ≤ 4.78 × 106. The results show that the local Nusselt number decreases with increase of axial distance from the lower end of the triangular channel to a point near the upper end of channel, and then, it slightly increases. Higher values of local Nusselt number for rough channel along the axial distance compared with the smooth channel. The average Nusselt number of rough channel is higher than that of smooth channel by about 8.1% for inclined case at θ = 45o and 10% for vertical case. The results obtained are correlated using dimensionless groups for both rough and smooth surfaces of the inclined and vertical triangular channels.

Keywords : natural heat transfer convection, constant heat flux, open channels, heat transfer
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