

CFD Investigation on Heat Transfer and Friction Characteristics of Rib Roughened Evacuated Tube Collector Solar Air Heater

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Abstract : Heat transfer and friction characteristics of evacuated tube collector solar air heater artificially roughened with periodic circular rib of uniform cross-section were investigated. The present investigation was carried out in ANSYS Fluent 15.0 to study the impact of roughness geometry parameters, i.e. relative roughness pitch (P/e) of 8 and relative roughness height (e/D_h) of 0.064 and flow parameters, i.e. Reynolds number range of 2500-8000 on Nusselt number and friction factor. RNG $k-\epsilon$ with enhanced wall treatment turbulence model was selected for analysis. The results obtained for roughened evacuated tube collector has been compared with smooth evacuated tube collector for the similar flow conditions. With the increment in Reynolds number from 2500 to 8000, Nusselt number augments while friction factor decreases. Maximum enhancement ratio of Nusselt number and friction factor was 1.71 and 2.7 respectively, obtained at Reynolds number value of 8000. The value of thermo-hydraulic performance parameter was varied between 1.18 - 1.23 for the entire range of Reynolds number, indicates the advantage to use the roughened evacuated tube collector over smooth evacuated tube collector in solar air heater.

Keywords : artificial roughness, evacuated tube collector, friction factor, Nusselt number

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