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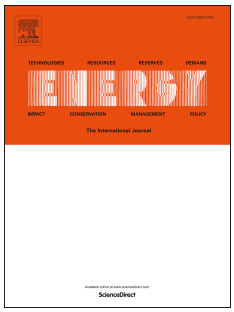

Numerical study of thermohydraulic performance of solar air heater duct equipped with novel continuous rectangular baffles with high aspect ratio

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Numerical study of thermohydraulic performance of solar air heater duct equipped with novel continuous rectangular baffles with high aspect ratio

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Abstract

Turbulent flow and convective heat transfer of air inside channel of rectangular cross-section, containing rectangular baffles with inclined upper part planted on the opposite surface of absorber plate is investigated numerically under solar air heater boundary conditions. For a fixed value of heat flux (1000 W/m^2) and the range of Reynolds number from 4000 to 18000, the effect of four baffle blockage ratios, (B_R= 0.7, 0.82, 0.92, 0.98) and four baffle-pitch spacing ratios, (P_R= 2, 4, 6, 8) in sixteen configurations on thermohydraulic behavior were confirmed.

By means of commercial CFD code Fluent 6.3, the Reynolds average Navier Stokes formulation was computed with RNG *k-ε* model to simulate the fully turbulent air flow through a baffled rectangular duct. However, the configuration of B_R= 0.7 and P_R= 2 at a Re=5000, yields the highest thermohydraulic performance factor THPF of about 0.857 , with both increment in heat transfer and friction factor, which noted to be 2.16 and 15.95 times of those of the smooth duct, respectively.

Attempts were carried out to explain the mechanisms of fluid behavior in the presence of this type of obstacles and their impact on both fields, thermal and dynamic.

Keywords: fully turbulent flow, solar air heater, rectangular baffled duct, recirculation region, Reattachment, turbulent intensity.