Akkaraphon Wanrareun 2010: A Study of Swirl Flow on Heat Transfer Coefficient Enhancement in Square Duct. Master of Engineering (Mechanical Engineering), Major Field: Mechanical Engineering, Department of Mechanical Engineering. Thesis Advisor: Associate Professor Chawalit Kittichaikarn, Ph.D. 66 pages.

This research focuses on the enhancement of heat transfer coefficient of swirl flow in a square duct using thermochromic liquid crystals. The experiment was performed in the square duct of $100 \times 100 \times 1000$ mm^3. Inside duct, thermochromic liquid crystal was sprayed on bottom wall to detect the variation of temperature on the wall surface. The heater was installed below the bottom wall of air duct to provide a constant heat flux. A 20^{o}C air flows through the 17 mm diameter injectors which were used to make the swirl flow and were set up at different angles. The angles between injector and flow direction were 45^{o}C, 60^{o}C and 90^{o}C. Also, the injectors were inclined at 30^{o}C from duct wall to generate a wake-like swirl flow and jet-like swirl flow at the distance of 1000 mm after the inlet. Computational Fluid Dynamics software was also used to simulate the flow field inside duct. Details of swirl flow therefore were revealed. The 200,000-800,000 cells of tetrahedral elements were created over the physical model of the air. The boundary conditions were set to be velocity of 2-3 m/s that refers to the Reynolds number of 13000-20000 at the inlet while the flow from injector was set to be $\dot{m}_j / \dot{m} = 0.09$ and $\dot{m}_j / \dot{m} = 0.12$. At the outlet was set to be outflow. The temperature at the bottom surface of the duct was heated by the constant heat flux method. Turbulence model was chosen as standard $k - \varepsilon$ model over the 3D-steady incompressible domain. Heat transfer coefficient was calculated from the difference of temperature distribution over heated surface and bulk air temperature. From the simulation obtained, it was found that the predicted results for the heat transfer coefficient and flow characteristics were similar to those obtained from the experiment. Moreover from the contours of surface temperature obtained, it was found that the swirl flow increased convective heat transfer coefficient of air flow in duct and the wake-like swirl flow gave a higher thermal performance than jet-like swirl flow. Thermal performance of the wake-like swirl flow was 1.39. The results obtained can be used to enhance thermal performance of the solar air heater.

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