Heat Transfer Enhancement of Flat Plate Solar Collectors for Water Heating in Iraq Climatic Conditions

*Braa Khalid Ameen,**Mustafa B. Al-Hadithi,***Obaid T. Fadhil

ABSTRACT

This work presents an experimental and numerical study to investigate the heat transfer enhancement of flat plat collector (FPC) using three types of twisted tapes (single twisted tape (ST), double twisted tape (DT) and mixed twisted tape (SDT)) which are compared with plain tube with twist ratios (TR=2). The study are considered under fully developed turbulent flow with solar radiation heat gain are changing with time. The designed FPC consists of four pipes with
1.25cm in diameter and 1mm thick are placed above the plate to act as a heat removal fluid passage ways. The system consists of two collectors, each one has (40cm x 160cm x 15cm) and connected to two tanks, each one is 20 liters. The amount of heat gain from solar radiation depends on many effective parameters are used; type of twisted tape are using, type of collectors plate metal (aluminum or copper), value of Reynolds number, amount of sun rays available at the site, number of glass covers and orientation of the collectors with respect to the south direction. From the experimental results was obtained which are demonstrate that the DT are more efficient than ST and SDT, since the heat transfer enhancement which increases the output temperature of the working fluid. The experimental study also show that the temperature of outlet water from mixed twisted tape collector is higher than the other type of plain tube collector by 10°C. The outlet water temperature of collector made from cupper is more than the collector made of aluminum about 6°C. The outlet water temperature from collector which has Reynolds number of 5000 less than 5°C for copper collector and less than 4°C for aluminum collector from the other with Re number is 10000. Increasing of the temperature of the outlet water in the collector which has two glass cover is about 4°C from one glass cover. The numerical analysis was based on finite volume numerical techniques to solve the governing partial differential equations in three dimensions, using ANSYS FLUENT commercial CFD software, to study the effect of Reynolds number and twisted tape types on the heat transfer enhancement and friction factor. The comparison between the experimental and numerical results shows a high agreement, and the maximum error was 8.3% occurred with mixed twisted tape**.**