

## **Heat Transfer Analysis of the Flat Plate Solar Thermal Collectors with Elliptical and Circular Serpentine Tubes**

### **ABSTRACT**

In this study, the heat transfer characteristics of the flat plate collectors with circular and elliptical serpentine tubes are theoretically analyzed and compared in terms of  $\dot{m}$ ,  $Re$ ,  $Nu$ ,  $h_f$ ,  $i$ ,  $FR$ ,  $Q_u$ , and  $\mu_{Th}$  under various water flow rates and the standard test conditions. The results reveal that the maximum  $\mu_{Th}$  corresponds to the elliptical serpentine design with 56% under turbulent flow, and the minimum  $\mu_{Th}$  of 47% for the circular cross-section under laminar flow. In addition, it was found that the highest useful energy gain per unit time (493.8 W) through the system is possible when  $FR$ ,  $h_f$ ,  $i$ ,  $Nu$ , and  $\dot{m}$  are maximum and vice versa. It was concluded that, at the same area, the larger contact area in the elliptical cross-section compared to the circular would improve  $FR$  and  $Q_u$  by an average of 2%. Overall, it is crucial to evaluate the thermal parameters of the thermal collector during the preliminary design stage to fabricate a highly efficient system and save time as well as initial cost.