

Performance Analysis of Modified Solar Water Heating System for Climatic Condition of Allahabad, India

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Abstract : Solar water heating is a thermodynamic process of heating water using sunlight with the help of solar water heater. Thus, solar water heater is a device used to harness solar energy. In this paper, a modified solar water heating system (MSWHS) has been proposed over flat plate collector (FPC) and Evacuated tube collector (ETC). The modifications include selection of materials other than glass, and glass wool which are conventionally used for fabricating FPC and ETC. Some modifications in design have also been proposed. Its collector is made of double layer of semi-cylindrical acrylic tubes and fibre reinforced plastic (FRP) insulation base. Water tank is made of double layer of acrylic sheet except base and north wall. FRP is used in base and north wall of the water tank. A concept of equivalent thickness has been utilised for calculating the dimensions of collector plate, acrylic tube and tank. A thermal model for the proposed design of MSWHS is developed and simulation is carried out on MATLAB for the capacity of 200L MSWHS having collector area of 1.6 m², length of acrylic tubes of 2m at an inclination angle 25° which is taken nearly equal to the latitude of the given location. Latitude of Allahabad is 24.45° N. The results show that the maximum temperature of water in tank and tube has been found to be 71.2°C and 73.3°C at 17:00hr and 16:00hr respectively in March for the climatic data of Allahabad. Theoretical performance analysis has been carried out by varying number of tubes of collector, the tank capacity and climatic data for given months of winter and summer.

Keywords : acrylic, fibre reinforced plastic, solar water heating, thermal model, conventional water heaters

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