ABSTRACT

Both domestic and industrial applications require low temperature hot air. These requirements are generally met by combustion of fossil fuels. Rising fuel prices, depleting fossil reserves, global warming and other environmental concerns are leading ways for wider applications of renewable and clean energy sources. Among all the renewable sources, solar energy is one of the most important renewable energy sources. The simplest method to harness solar energy is by converting it into thermal energy using a suitable fluid. Some of the most common application areas are steam, preheating, hot water, pasteurization, sterilization, cleaning, space heating, chemical reactions, drying and dehydration processes etc. The application of solar energy in supplementing thermal energy in tea processing is found promising in earlier studies. However, limited number of solar thermal technology is available for applications. Solar air heater applications have also found very limited primarily because of lower performance. In this work, an attempt has been made to identify techniques for enhancement of performance of solar air heater. Packed bed absorber medium is used in a solar air heater and tested in laboratory as well as in field. The design parameters of packed bed absorber medium are assessed through experiments for thermal and hydraulic performances. Experiments were conducted with two different level porosity (0.8 and 0.9) and with two different surface colours (black and white) of packed bed material as an absorber material at varying mass flow rates (0.01, 0.02, 0.03 and 0.04 kg/s) and varying level of available solar insolation (200-1000 W/m^2). The highest output temperature from the solar air heater fitted with packed bed has been found to be 83.5^oC corresponding to the flow rate of 0.01 kg/s and insolation of 926 W/m^2. The thermal performance of the packed bed solar air heater was found to vary with mass flow rate and solar insolation. The thermal performance during the afternoon was found higher compare to morning hours. This might be due to storage of thermal energy by the packed bed during the morning hours and releasing the same