

# Experimental study on performance of square tube absorber with phase change material

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## ABSTRACT

The intermittent nature of solar radiation has decreased the performance efficiency of solar heaters. Integrating the solar heater with thermal energy storage component could increase its performance effectively. In this article, an investigation on the effect of phase change material (PCM) as the thermal energy storage component on the performance of square aluminum tube was carried out experimentally. In the first phase, the temperature behavior of square aluminum tube with two types of PCM, namely, generic plant-based PCM (A2) and paraffin wax (A3), was compared with square aluminum tube without PCM (A1). In the second phase, the performance of square aluminum tube was investigated with different paraffin wax masses of 38 g (B1), 48 g (B2), and 58 g (B3). Based on the result, the A3 tube configuration performed better than A1 and A2 tube configurations with higher heat gain rate (0.08°C/s) and lower heat discharge rate (-0.04°C/s). The B2 tube configuration was found to have maximum heat gain of 3.73 kJ with higher heat discharge rate as compared with other square tube configurations. The average temperature difference between internal and external surface tube of B2 was lower (4.3°C) leading to higher average temperature difference at ambient temperature of 25.3°C. Instantaneous efficiency of the tube B2 is higher than the B1 and B3 tube configurations by 16% and 26%, respectively. The result suggests that the insertion of paraffin wax inside the square absorber tube improves the temperature response of the absorber in the situation of intermittent solar radiation.

**KEYWORDS:** cross-matrix absorber (CMA), phase change material (PCM), solar energy, thermal energy storage

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