

ABSTRACT

The goal of this project is to modify an existing parabolic trough solar collector to be a hands-on educational platform for the Cooper Union. A parabolic trough collector, one of many types of solar collectors, consists of a parabolic mirror, and a pipe, known as the receiver, that is located at the focal point of the mirror and runs along the length of the collector. Sunlight enters a rectangular aperture of length 1.36 m and width of 0.30 m, is reflected by the mirror, and concentrated onto the receiver, a copper pipe of outer diameter 0.625 cm and length 1.36 m (which extends beyond the mirror). Water, stored in an insulated 5 gallon reservoir equipped with a submersible pump, is pumped steadily through the receiver. Modifications included upgrading the instrumentation to include a data acquisition system to allow dynamic measurements of various temperatures (reservoir, receiver outlet, receiver surface temperature and ambient), solar insolation and fluid flow rate. The apparatus was improved by painting the receiver black to increase its absorptivity, installing a new mirror, a solar photovoltaic panel to power the pump and a single axis solar tracker. Data from 7 tests (30 to 60 minutes duration) are presented and analyzed. The unit was able to increase the temperature of 10 liters of water by 13 °C in 60 minutes. The measured overall efficiency of the collector was 43%. The average incident solar heat on the collector was 350 Watts. The average heat gain at the absorber pipe was 100 Watts. It was determined that the performance of the collector decreased as the surface temperature of the absorber increased. The goal is to motivate Cooper Union students to build upon the work presented here, and to think about renewable sources of energy, and their applications.