BRIEF COMMUNICATIONS

Experimental Studies of Water Temperature Regime in Trough Solar Collectors

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Abstract—Results are presented of comparative studies of water heating in large trough solar collectors with protected and open evaporation surfaces.

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To determine the possibilities of the manufacture of simple and inexpensive water-heating solar collectors from local building materials, we fabricated two prototypes and investigated the temperature regimes of the water heated by them. The collector overall dimensions were as follows: length 1.6 m, width 0.8 m, and front surface area (including the front surfaces of the side walls) 1.28 m².

The collector side walls and bottom of thickness 0.1 m were made from structural concrete. Their internal surfaces were protected by a watertight layer of black structural bitumen. The collectors were installed in the horizontal position on the ground. Their bottom parts were thermally insulated from the ground by an 0.1-m-thick heat-insulating reed fiberboard.

These collectors differed in that in one of them the water being heated was in a PVC bag, while in the other collector it was in direct contact with the ambient medium, i.e., it had an open evaporation surface.

Both collectors (with the water in the PVC bag and with the open evaporation surface) had radiation-absorbing surface areas of 0.84 m². They were installed side-by-side and were exposed to similar environmental conditions in the experiments.

In the course of the experiments, we measured the daily course of the surface flux density of the total solar radiation incident on the horizontal ground surface, the ambient air temperature (by dry- and wet-bulb thermometers), the wind velocity, and the water temperature in the collectors. The measurements were carried out from 8:00 am to 6:00 pm. The amount of cool water poured into the collectors and the amount of the warm water taken from them were measured at the beginning and end of the experiments.

The figure presents the results of the experiments carried out on July 14, 2007, when 50 l of water at 28°C was poured into the collectors. Analysis of the measure-

ment results shows that at 2:00 pm the heated water has a maximal temperature of 51°C in the collector where it is in the PVC bag, and 42°C in the collector with the open water evaporation surface, while the maximal ambient temperature at this time is 35°C. The experimental results also show that in the first collector, owing to the PVC film covering the heated water surface, the water temperature at 2:00 pm is 9°C higher than that in the second collector with the open evaporation surface.

The measurements of the volume of the warm water taken from the collectors at 6:00 pm revealed water losses of 5 l in the collector with the open evaporation surface.

Results of one-day comparative studies of collectors on July 14, 2007: (1) ambient air temperature; (2) surface flux density of total solar radiation incident on the horizontal ground surface; (3) water temperature in the collector with PVC bag; (4) water temperature in the collector with open evaporation surface.