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Performance Evalution of Two Different Types of Solar Water Heater for Solar Still Hybrid System Construction

S. B. Muhammad[1], A. S. Abubakar[1], S. Aliyu[1], M. M. Garba[2],
[1] *Department of Physics, Usmanu Danfodiyo University, Sokoto, Nigeria*
[2] *Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto, Nigeria*

Abstracts: *There is an urgent need of clean, pure drinkable water. Often water sources are brackish and or contain harmful bacteria and therefore cannot be used for drinking. In this research work, proper selection of the type of solar water heater was made between the flat plate collector and evacuated tube collector type solar water heaters to construct a concrete cascade solar still hybrid system. The two types of solar water heaters were tested at the same time under the same metrological conditions. The results obtained shows that the evacuated tube collector type solar water heater with highest water output temperature of 97.2^oC at 13:00 was for found to be the most suitable against the flat plate collector type solar water heater with 71.7^oC at 14:00.*

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I. Introduction

Water is a precious natural gift and is being polluted by human activities, urbanization and industrialization. The ground water is often over exploited to meet the increasing demand of the people. Less than 1% of earth's water is available for human consumption and more than 1.2 billion people still have no access to safe drinking water. Over 50% of the world population is estimated to be residing in urban areas, and almost 50% of mega cities having population over 10 million are heavily dependent on ground water, especially in the developing countries like India. Most of the rural people still live in absolute poverty and often lack access to clean drinking water. Nearly half of the population is illiterate, not at all aware of the waterborne diseases affecting their health. Nearly 70% of the infectious diseases in India are waterborne. Indian villages are posed with problem of overexploitation of ground water due to increasing dependence on it as other fresh water resources are dwindling fast. To purify this water and make it portable different methods are utilized such as reverse osmosis, desalination, electro dialysis etc are used. Distillation process is considered to be one of the most widely adopted techniques for converting sea water. More than 90% of the Worldwide installed sea water desalination capacity is based on distillation process which can be supplied by solar energy or any other fuel while in reverse osmosis, vapors compression & electro dialysis mechanical or electrical energy is used. Solar distillation uses the heat of the sun directly in simple piece of equipment to purify water. The equipment, called a solar still, is a man-made gadget in which the natural hydrological cycle has been copied in miniature fashion and consists primarily of a shallow basin with a transparent glass cover. The sun heats the water in the basin, causing evaporation. Moisture rises, condenses on the cover and runs down into a collection trough, leaving behind the salts, minerals, and most other impurities, including germs. Although it can be rather expensive to build a solar still that is both effective and long lasting, it can produce purified water at a reasonable cost if it is built, operated, and maintained properly..Dev et al. (2012) carried out comparative study of simple solar still and evacuated tube integrated solar still. Annual yield of coupled & uncoupled solar still was obtained 630 kg/m2 and 327 kg/m2 respectively. Patel et al. (2012) studied the effect of dye on the productivity of single basin active solar still coupled with evacuated tube glass collector. When black dye was used, productivity was increased by 30.38 %. studied the effect on productivity of solar still on coupling evacuated tubes. After coupling of evacuated tubes with solar still, productivity was increased by 49.7%.Karuppusamy et al. (2012) studied experimentally and theoretically effect of coupling evacuated tube collector solar water heater with single basin solar still. They found that productivity of coupled basin solar still was double of simple basin solar still when operated for 24 hours.

This project focusesmainly on small-scale basin-type solar stills as suppliers of portable water for families and other small users. Of all the solar still designs developed so far, this basin-type continues to be the most economical

II. Methodology

A flat plate collector and evacuated tube collector types solar water heater were developed and tested at Sokoto energy research center, Usmanu Danfodiyo University Sokoto. This experiment was carried out from 8:00 and 18:00 each day for seven days, starting by introducing 50L of water into each of the flat plate collector and evacuated tube collector solar water heaters. The whole set-up was exposed under sunlight and readings of the water inlet, outlet and tank temperatures were recorded. Drills were made on the inlet and outlet pipes to provide small holes through which the thermocouple data logger wires were fixed to measure the various temperatures. Table 1 below shows various average recorded temperatures.

Plate 1: Evacuated tube collector type solar water heater

Plate 2: Flat plate collector solar water heater

Table 1

Time	Flat plate collector solar water heater (^oC)			Evacuated tube collector solar water heater (^oC)		
	T_{inlet}	T_{outlet}	T_{tank}	T_{inlet}	T_{outlet}	T_{tank}
8:00	20.1	31.3	39.0	22.6	50.1	41.3
9:00	23.7	42.9	43.5	28.9	48.3	45.0
10:00	30.0	60.6	46.3	35.1	60.2	48.8
11:00	35.2	62.3	49.4	44.0	73.8	52.4
12:00	40.4	61.3	52.0	47.7	88.2	57.0

13:00	44.0	65.7	54.6	57.0	93.5	63.2
14:00	50.4	71.7	56.1	62.4	91.5	67.0
15:00	48.9	60.9	55.8	63.3	96.4	60.1
16:00	45.0	57.1	54.7	59.9	89.2	56.2
17:00	39.9	51.1	50.0	55.5	82.4	53.4
18:00	30.4	42.0	45.0	47.6	39.7	50.9

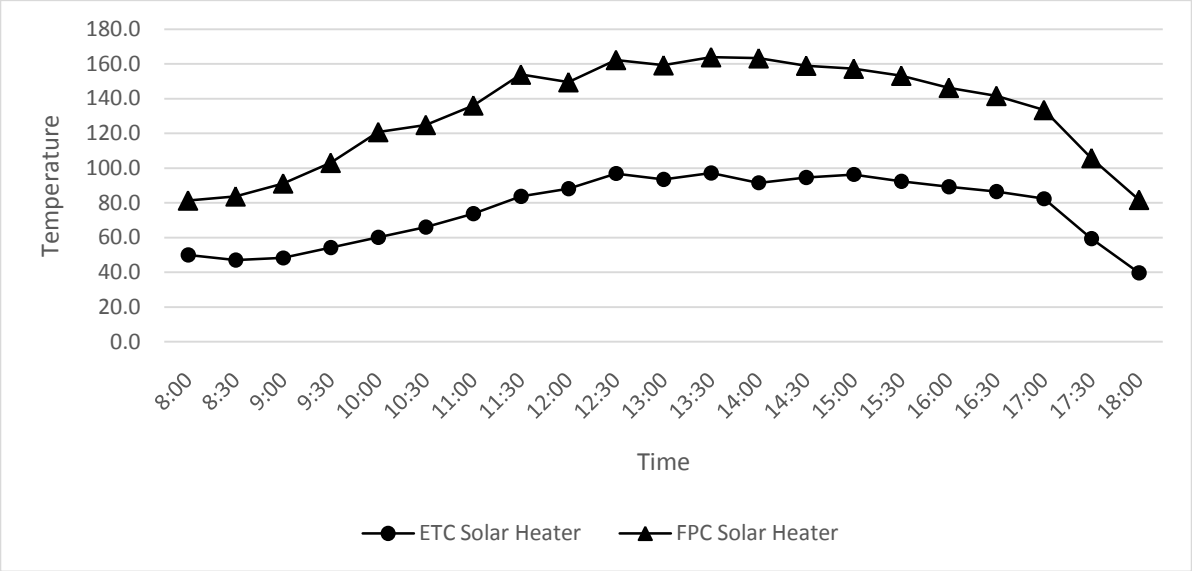

Figure 1: Variation of output temperatures with for the collectors

III. Conclusion

The experimental results obtained in this research, shows that the average daily output temperature of the evacuated tube collector type solar water heater was found to be 97.2^{o}C and that of the flat plate collector type solar water heater was 71.7^{o}C. It can therefore be concluded that the performance of the evacuated tube collector type solar water is greater than that of flat plate collector type solar water heater. Hence, the evacuated tube collector solar water heater is more suitable for solar still-solar water heaterhybrid system.

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