Experimental Investigation of Solar Water Heater cum Distillation

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Abstract—Experimental investigation of solar water heater cum distillation system has been carried out with different modes of feed water. The modes of feed were fresh water from the main supply and hot-water from the Natural Convection – solar water heater under withdrawal and non-withdrawal conditions. The natural convection solar water heater acted as an auxiliary pre-heater for the water to be distilled in the solar – still. The experimental investigation data on the distillation system consists of the distillate output and temperatures in the still at various locations from the absorber plate up to the glass cover and it’s ambient. While, on the solar water heater, the data recorded were temperatures at the inlet and outlet of the water flowing inside the riser tubes. The experimental data were collected between 11:00 Hours and 14:00 Hours on different days after every 10 minutes. The global radiations were also recorded simultaneously. Temperature profile in the still and average temperatures of the water basin, base plate, glass –cover and the vapour have demonstrated graphically and discussed. The distillate output and efficiency of the solar still at outdoor conditions with fresh feed water and that from the solar water heater under withdrawal and non-withdrawal conditions have been investigated and their effects discussed.

Keywords—Distilled water, saline water, solar flux, solar still, tilted angle.

I. INTRODUCTION

The need of pure water is important in day-to-day life. The chronic shortage of potable water is the most important issues in the developing countries and using water for survival from contaminated sources cause serious damage to health. The availability of drinking water per capita is shrinking because of growth of population. The possible water sources are the boring wells, rainwater, river or lake water. This surface water, however, must be purified for human consumption. This may involve removal of (i) undissolved substances (ii) dissolved substances and (iii) harmful microbes. Popular methods are filtering with sand which only removes undissolved material while chlorination and boiling kill harmful microbes only. Solar distillation does all these three functions.

II. SOLAR DISTILLATION

A water distiller captures the process of evaporation and condensation in a chamber leave in behind all impurities, such as inorganic materials and chemicals. It can even purify seawater. Distillation is one of mankind’s earliest forms of water treatment, and it is still a popular treatment solution throughout the world today. In ancient times, the Greeks used this process on their ships to convert seawater into drinking water. Today, distillation of water is still used to convert seawater to drinking water on ships and in arid parts of the world, and also to treat water in other areas that are fouled by natural and unnatural contaminants. Solar stills can be best suitable units to be used as low-capacity and self-reliance water supply systems, since they can produce pure water by using solar energy only, and do not need other expensive energy sources such as fuel or electricity. Among the various types of solar stills, the single slope passive solar distillation system is the most simple and least expensive.

III. EXPERIMENTAL SETUP AND SPECIFICATION

Experiments have been conducted on the distillation plant, in the open atmosphere by means of the solar energy under the following conditions:

(a) With fresh water (supply water) feed in the still
(b) With feed water from the solar water heater (Non-withdrawal of hot water)
(c) With feed water from the solar water heater (Withdrawal of hot water for other usage)
IV. EXPERIMENTAL PROCEDURE

The temperatures of the solar water heater and solar still were recorded for different days in the month of September-2013. The readings were taken at intervals of ten minutes, and were continued for the subsequent hours steady state.
Depending upon the case of steady, the solar still was filled up to a desired water level in the basin either with the fresh water or with the hot water from solar water heater storage tank, just before the experiments was to be conducted. As, distillation proceed in the still, the loss of water –level in the basin was fed with the water to make up the water level and keep the desired water depth as constants.

V. RESULT AND DISCUSSION

Distillate output of solar still has shown in Fig.2 with of the day/solar flux for different modes of charge and feed water. Increase in the distillate output when the solar water is fed in the still can be seen, that is for the distillate collected between 11:00 hours to 14:00 (2 P.M.) for three hours, the output is 870 ml, while it is only 165 ml when the charge and feed water are from the supply line. The output of the distillate, however, becomes slightly less when there is withdrawal of hot water in addition to that fed to the solar still. But this decrease is 855 ml for the same time as above.

VI. CONCLUSIONS

1. The temperatures of the humid air/ vapour in the solar still, drastically increases from the water level and the falls at the glass surface, probably due to greenhouse effect and incomplete condensation because of slow cooling on the glass surface.

2. In case of the fresh water feed, the absorber, water and the vapour temperatures rise slightly with rise in the solar flux.

3. In case of the hot water feed from the solar water heater (SWH), the absorber plate temperature remains almost constant; being higher than the former case to around 70 °C under some withdrawal of the hot water, there is slight reduction in the absorber temperature.

4. Distillate output for three hours, with solar water feed is 870ml, while with fresh water feed it is only 165 ml; become slightly less when there is withdrawal of hot water that is 855 ml.

5. The efficiency of solar still after 3 hours, with fresh water feed becomes 13.81 %, while with the hot water feed from solar water heater, it goes up to 65.57 % and 64.87 % when there is extra withdrawal.

6. Use of water from solar water heater enhances efficiency of the solar still from 13.81 % to 65.57 %

VII. FUTURE WORK

➢ Performance of the proposed combined solar still and water heater be studied with year-round data and other parts of country.

➢ Thermal modeling of the combined system be carried out.

➢ In place of single slop solar still double slop still can be used.

REFERENCES


