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A Study on Solar Still with Separate Condenser

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Abstract: Solar still is simple device used to convert available saline water into drinking water. A conventional solar still is widely used for water purification but its efficiency is low. Numerous modelling and design attempts have been made to improve its performance i.e. increase the daily productivity of the still. This experimental study is carried out to evaluate the effect of using a separate condenser on the performance of a single slop solar still. This research work focused on the comparative study between solar still with separate condenser and conventional solar still. The result shows that the basin type solar still with separate condenser is 19% more efficient than the conventional still.

I. INTRODUCTION

Water is one of the most basic natural resources on earth, and it covers three-quarters of the earth's surface However, approximately 97% of the earth's water is salty water in the seas and oceans, and 3% is freshwater. But only 1%water is useful for drinking and not equally distributed under the earth. So water purification is very necessary. In traditional distillation process, large amount of energy required .So large amount of fossil fuel used which is not eco-friendly for environment. Consequently unconventional energy source like as solar energy is best alternative distillation process. Solar still distillation represents the attractive and simple technique among distillation processes, and it is particularly suited for production on a small scale. It is easy to set up and needs little and cheap maintenance [1]. Different designs of solar still are fabricated (spherical, pyramidal, hemispherical, double basin, concentrator-coupled CPC tubular, CPC coupled with pyramid solar still) and study the performance of still. It observed that tubular solar still coupled with pyramid type solar still shows the maximum amount of productivity due to the concentrator effect

The major designing factors affecting the distiller productivity which depends on the atmospheric temperature, glass temperature, water temperature, solar intensity, slop of the glass cover, thickness of the glass wind velocity etc. [2-3]. Various design of conventional solar still used but productivity of the still is low. Therefore uses an internal and external condenser for enhance the distillate output. Some research work reported on the use of internal condenser as to improve the performance of the basin type solar still. They reported improvement of the productivity of the still up to 20%. A single effect of solar still with internal condenser, copper tube used as condenser and enhance the efficiency up to 10% [4-5]. Some studies are carried out on simple solar still with external condenser with passive source. These external condensers made by G.I. sheet in the shape of cylindrical or box type which enhances the productivity of the system. [6-10].

In this experimental work, a basin type solar still with separate condenser is designed with following objectives:

1. To design and fabricate an inclined solar still with separate condenser.
2. To measure the performance of the new type solar still.

II. XPERIMENTAL SETUP

An ideal solar still is defined as one which has no conductive losses and water depth is sufficient small so that the sensible heat stored is negligible compared with the energy transfer rates to and from the water. With the above points in mind a small solar still with separate condenser are designed for experimental operation which shown in figure and compare the performance between conventional solar still. In this experiments are conducted at SHIATS University Allahabad, U.P. in the India in April to May 2016.

In this experimental research, basin type solar stills are designed and constructed from 1.4 mm galvanized steel with a net basin area is 1 m^2. A 4 mm thick glass cover is used as top cover at an angle of 26^o to the horizontal. In order to maximize the absorption of solar radiation, the inner surfaces of the galvanized basins are painted by black paint. A separate condenser unit attached in back side of the still. The condenser unit are designed and constructed by same G.I. sheet and also provide small ports due to enhance the condensation rate. Glass cover is used as a top cover on the separate condenser. The water level was checked before and throughout the tests. A collecting channel of suitable shape and size was fitted at the lower edge of each glass cover. It is used to collect the condensate fresh water at the lower side of the solar still. The distillate is collected in a bottle then measured by a graduated cylinder.

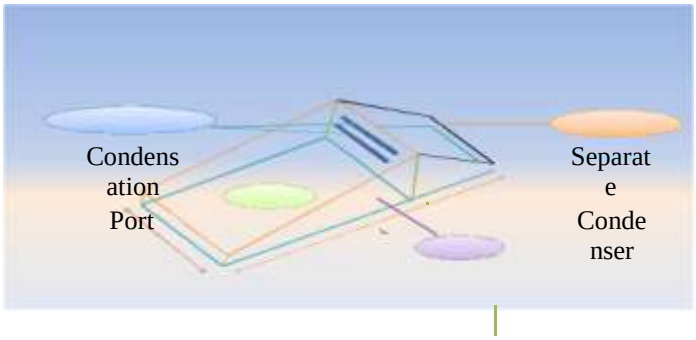

Figure 1(a) Schematic model diagram of solar still with separate condenser
Performance Study of Solar Still with Separate Condenser

Figure 1(b) Schematic model diagram of solar still with separate condenser

Thermocouples are used for temperature measurement to locate in different places of the still. They record different temperature, such as glass cover and water temperature of the basin. Total incident solar radiation is measured by solar meter.

III. RESULT AND DISCUSSION

The aim of this experimental work is to develop a solar still with improved distillate output. This experimental work was comparative study of performance of conventional and advanced stills are simulated under the same weather conditions. Simulation results showed that a separate condenser solar still yielded 19 % more distilled water per unit area of basin than a conventional distillation system. Total incident solar radiation, glass cover temperature and basin water temperature for the still with and without separate condenser are shown in below figure. The fig. 2 shows that the incident solar radiation gradually increased to reach its maximum value and constant in noon time then after decreases.

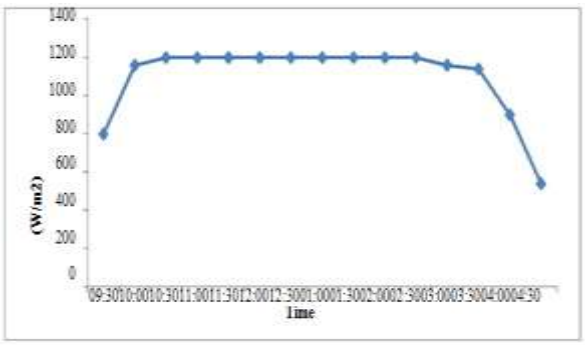

Figure 2 Variation of solar intensity with time

Basin water temperature and glass temperature for with and without separate condenser behave in same way. Temperature is maximum at12:30PM to01:30PM. Production rate of distillate water depend on the vaporization and condensation rate of water which depend on solar intensity and temperature difference between water and glass temperature. Figure 4&5 shows the productivity and efficiency of still varying with time and it maximum at noon time.

Productivity and efficiency of still gradually increase and reach maximum value then decreases.

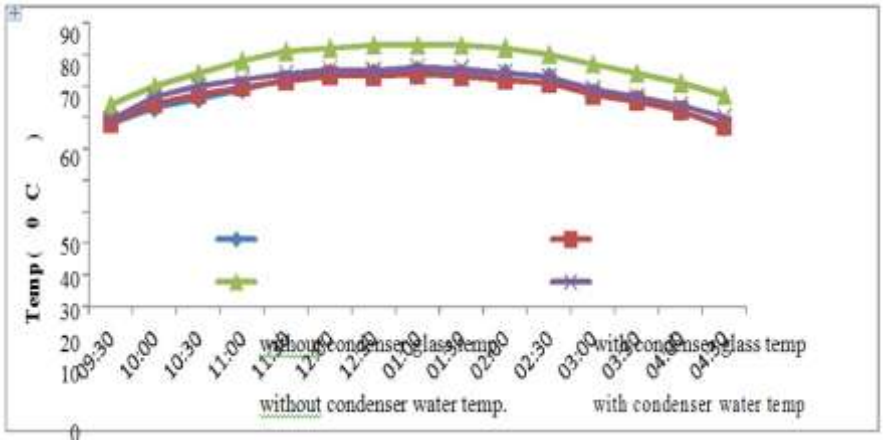

Figure 3 Variation of glass and water temperature vs. time with and without separate condenser

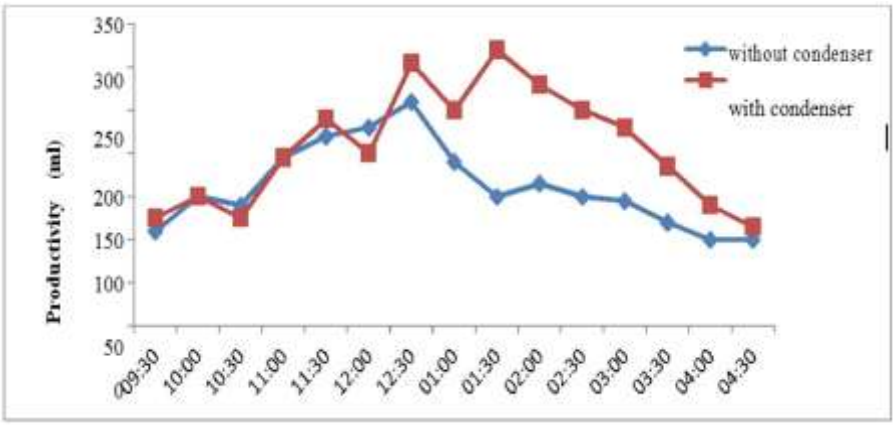

Figure 4 Variation of productivity vs. time with and without separate condenser

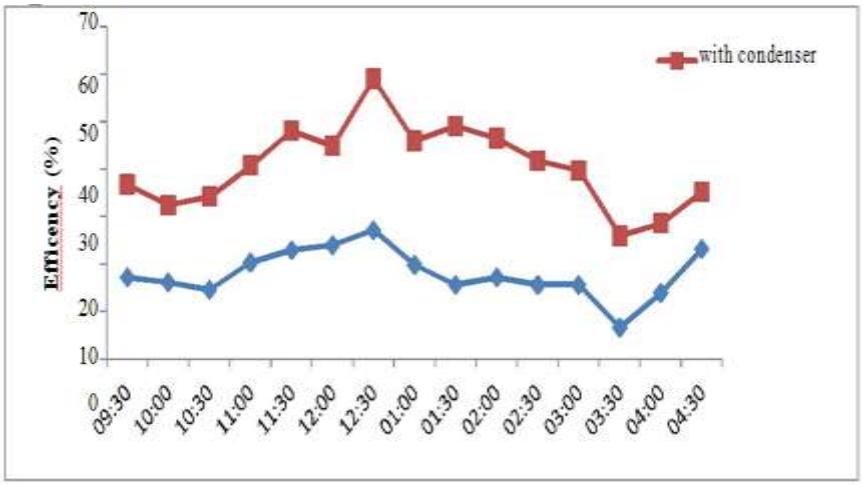

Figure 5 Variation of efficiency vs. time with and without separate condenser

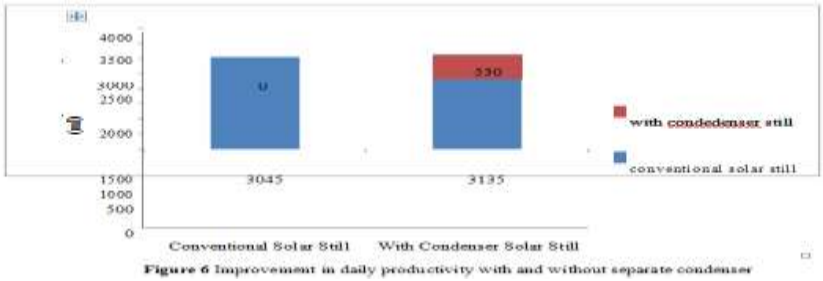

Figure 6 Improvement in daily productivity with and without separate condenser

IV. CONCLUSION

This experimental work result shows that basin type solar still with separate condenser is more efficient than conventional solar still for same depth of water. Daily productivity of still with separate condenser is 19% more than conventional still. Due to separate condenser 5% efficiency increases of the system in a day.

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