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Performance analysis of Solar Distillation and Domestic Heating Water System

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Abstract—*Most of the distillation system works by consuming energy either by burning fossils fuels or electrical energy. In the case of solar distillation system no conventional form of energy is required except the solar energy. It works on the principle of simple evaporation and condensation process similar to the formation of clouds. It takes brackish or impure water as an input and gives pure distilled or drinkable water. Performance of this system provides the detailed information about the effect of variation of temperature, wind speed and solar irradiation on the overall performance of the system.*

Keywords*: SWDS, PTFE, distilled volume*

1. INTRODUCTION

According to World Health Organization (WHO) almost 1 billion people do not have adequate fresh water that is safe for drinking and 2 million deaths are attributable to unsafe water, sanitation and hygiene every year. Solar powered distillation of water can help to reduce these numbers. Out of all the water on Earth, saline water in oceans, seas and saline groundwater make up about 97% of it. Only 2.5–2.75% is fresh water, including 1.75–2% frozen in glaciers, ice and snow, 0.7–0.8% as fresh groundwater and soil moisture, and less than 0.01% of it as surface water in lakes, swamps and rivers. In areas with no fresh water on the ground surface, fresh water derived from precipitation may, because of its lower density, overlie saline ground water in layers. Most of the world's fresh water is frozen in ice sheets. Many areas suffer from lack of distribution of fresh water, such as deserts because of limited fresh water. There are many causes of the apparent decrease in our fresh water supply. Principal amongst these is the increase in population through increasing life expectancy, the increase in per capita water use and the desire of many people to live in warm climates that have naturally low levels of fresh water resources. Climate change is also likely to change the availability and distribution of fresh water across the planet. Solar Water Distillation System (SWDS) is promising alternative that can partially fulfil the fresh water demand. This system required no conventional energy source. SWDS is pollution free and environmental friendly. Xing li et al.(2014) glass have performed the solar humidification and dehumidification using glass evacuated tubes and optimization by mathematical design method. Cihan Yildirim and Ismail Solmus (2014) have given the mathematical analysis by using the fourth order Ranga- Kutta method for humidification and dehumidification desalination system. J. Orfi et al.(2007) discussed the production of fresh water with respect to the brackish water and speed air. . Shaobo Hou et al. (2005) have used the pinch technology for performance optimization of solar humidification and dehumidification desalination system. Pinch technology focussed on the ratio of mass flow rate of water to the dry air at a different spraying water temperature. Hassan E.S. Fath and Ahmad Ghazy (2002) showed the influence of environmental and design parameters. He also explains that the flow rate of feed water is insignificant on solar desalination system.

2. SYSTEM DESCRIPTION

Solar water distillation system is simple, easy to use and its development cost is very low. Solar water distillation system consist of teflon thin sheet (PTFE), work as glazing surface for condensed water. Glazing surface area is 0.53x0.53 m2 , weight is 5 kg. And connected through a water tank having capacity of 25 litre. Black wet cloth act as a humidifier and PTFE sheet act as dehumidifier. SWDS has been design in such a way that it can carried easily in hand or on back. SWDS has kept at 45 degree with the help of stand facing equator. The development of SWDS is done specially for those places where the availability of fresh water is less and hill remote areas of country. This system is very useful in disaster affected areas where the chances of disease are very high caused by impue water. Solar powered distillation of water can be defined as measures to separate and extract clean water by vaporization. This can be particularly useful to turn seawater, brackish or even contaminated water into clean water safe for drinking. The working of the system fully depends on the sun radiation striking on the glazing surface. The inside temperature reached upto 60-70 degree depending upon the solar radiation in four to five hours. This high temperature caused the evaporation of water present in wet cloth. The evaporated water vapour collected on the inner

surface of the PTFE sheet. Water start condensing and running due gravity effect through PTFE sheet and collected in the distilled water tank.

3. PERFORMANCE ANALYSIS AND RESULT

Performance of SWDS has been done to analyse the volume of distilled water. The analysis has been carried out on the basis of data collected for a day. The performance of SWDS has been analysed for the period of six hour in day time from 10:00AM to 4:00 PM. The performance of SWDS is depends on three parameters namely temperature, solar radiation and wind speed

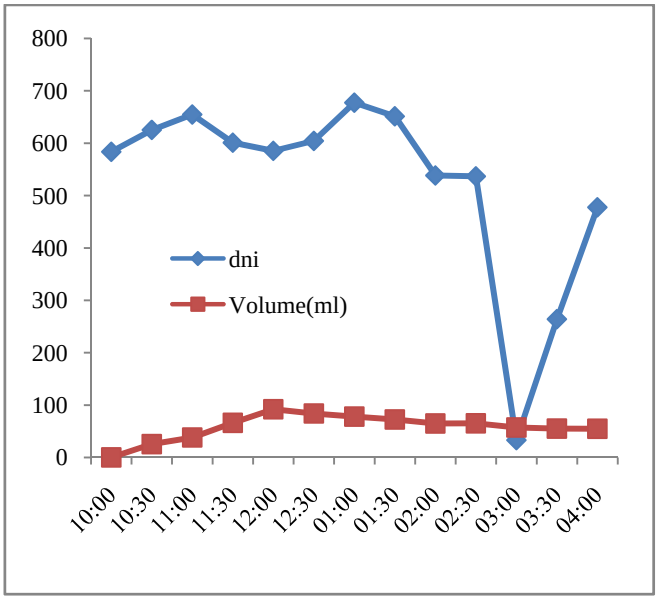

Fig. 1: Volume calculated corresponding to the solar radiation.

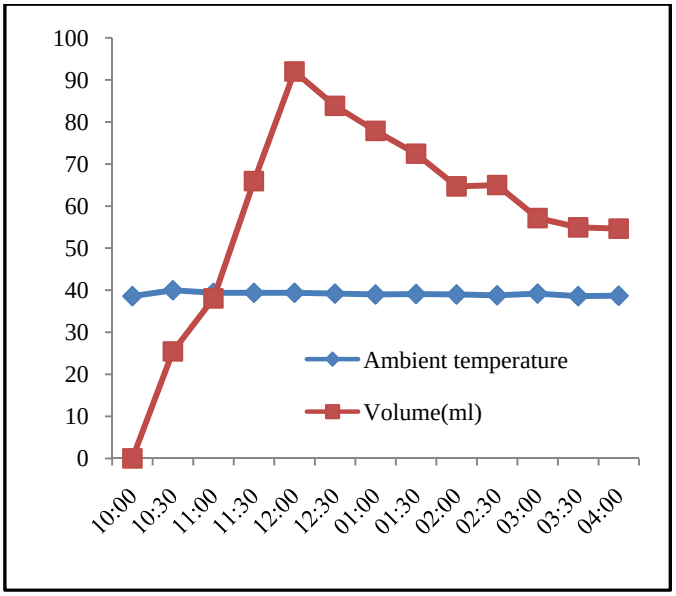

Fig. 2: Volume calculated corresponding to the ambient temperature.

Fig. 1 shows that the volume of distilled water depends on intensity of solar radiation falling on the glazing surface of system.

Fig.2 shows that as the ambient temperature increases the volume of distilled water is also increases and maximum between the time span of 11:30AM to 1:00PM of testing.

Fig.3 shows that as the wind speed increases the volume of distilled water is also increases and maximum between the time span of 11:30AM to 1:00PM of testing.

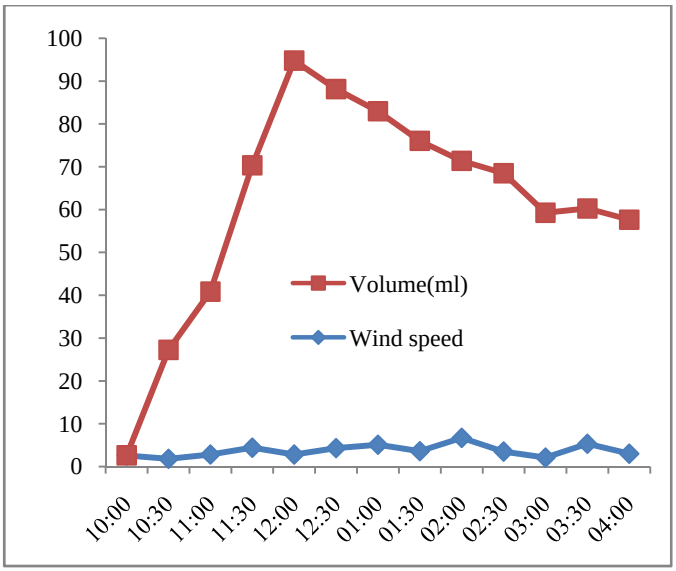

Fig. 3: Volume corresponding to the wind speed.

Fig. 4 shows the variation of volume corresponding to the DNI, Wind speed and ambient temperature

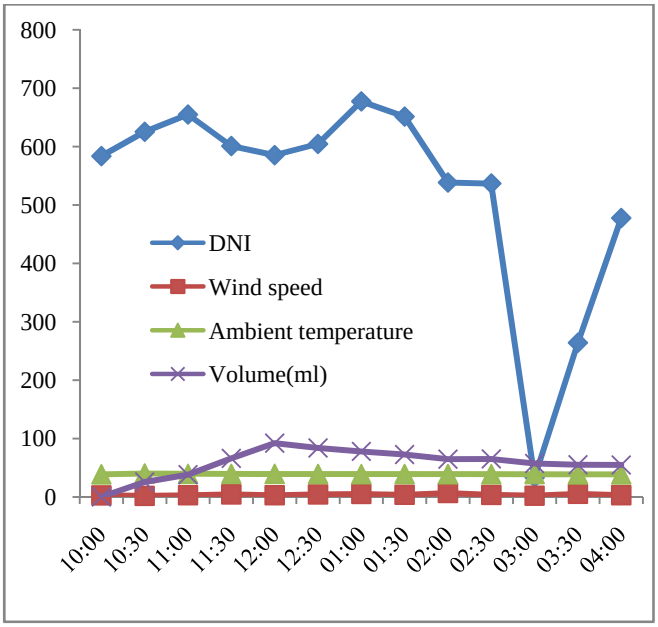

Fig. 4: Variation of volume corresponding to the DNI, Wind speed and ambient temperature

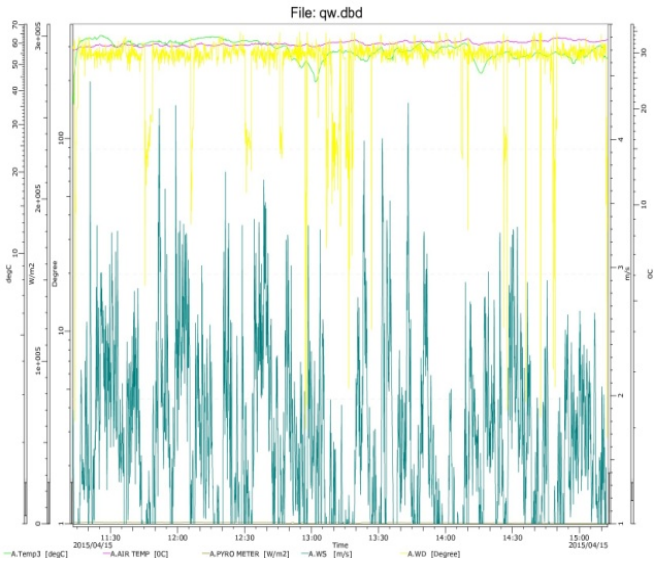

Fig. 5: Characteristic of air temperature, ambient temperature, pyrometer, wind speed and air wind direction.

Fig. 5 shows the Characteristic of air temperature, ambient temperature, pyrometer, wind speed and air wind direction.

4. CONCLUSION

From the above graphs we can conclude that as the environmental parameters like ambient temperature, solar radiation (DNI) and wind speed increases the rate of evaporation increases and finally we got more distilled water. The amount of water is more in between 11:30AM to 1:30PM generally. The purpose of our experiment is to get pure water from available brackish or impure water.

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