

# HYBRID SOLAR THERMAL-INDUCTIVE DESALINATION UNIT FOR RURAL HOMES

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**Abstract**— Desalination is one of mankind's earliest forms of water treatment, and it is still a popular treatment solution throughout the world today. In nature, solar desalination produces rain when solar radiation is absorbed by the sea and causes water to evaporate. The evaporated water rises above the surface and is moved by the wind. Once this vapour cools down to its dew point, condensation occurs, and the freshwater comes down as rain. This basic process is responsible for the hydrologic cycle. This same principle is used in all man-made distillation systems using alternative sources of heating and cooling. Desalination uses a large amount of energy to remove a portion of pure water from a salt water source. Salt water (feed water) is fed into the process, and the result is one output stream of pure water and another of wastewater with a high salt concentration.

**Index Terms**— Dew Point, Condensation, Desalination, Hydrologic Cycle, absorbed

## 1 INTRODUCTION

Water is one of the most important natural resources on the earth. All our day-to-day activities: agricultural, industrial and domestic directly or indirectly depend on the usage of water. The combined effect of continuous increase in world population, changes in life style, increases in ground water salinity and infrequent rainfall together with the increasing industrial and agricultural activities all over the world contributes to the depletion and pollution of fresh water resources. Thus, industrial desalination of seawater is a major contender for providing a sustainable source of fresh water for arid zones and during drought periods.

There are number of methods available to treat brackish water but every method has its own advantages and disadvantages. Considering the increase in energy costs of recent years and that this trend is likely to continue, it is very important to look for alternative energy powering sources for the economic production of fresh water.

Solar desalination is a green energy method of producing potable water, specifically in remote rural locations round the world, there is more salty groundwater than fresh, drinkable groundwater. For example, 60 percent of India is underlain by salty water — and much of that area is not served by desalination plants. In Chennai and in many coastal regions there is a scarcity of water. In order to overcome the problem of saline water we use this technique to desalinate the water that can be used for multi-purpose applications.

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## 2 LITERATURE REVIEW

Hazim Mohameed Qiblawey\*, Fawzi Banat [1] has done a detailed study on “Solar thermal desalination technologies”. In this they have studied about the characteristics of piezoelectric sensor and their uses. This article presents a review on harvesting energy from human locomotion. They designed a component to harvest mechanical energy dissipated in human motion. They came up with a conclusion that the DC power supply system, including the harvester and a power management circuit, is used to collect the mechanical energy dissipated in sensors and power some low-power wearable sensors, such as activity trackers etc. They were successful in harvesting the strain energy from person's daily activities.

K.S. Reddy , K. Ravi Kumar, Tadhg S. O'Donovan & T.K. Mallick [2] : “Performance analysis of an evacuated multi-stage solar water desalination system”, In this paper, a novel multi-stage evacuated solar desalination system is developed by utilizing latent heat recovery. A transient model is proposed for the solar desalination system. The effect of various design and operating parameters on the system performance is studied to optimize the configuration. The distillate yield increases initially due to enhanced evaporation caused by the presence of a thin layer of water in the stages. The distillate yield decreases with increase in salinity of water due to an increase in ion activity and the reduction of thermodynamically spontaneous change from liquid to vapor.

Yunsong Pang, Jiajia Zhang, Ruimin Ma, Zhiguo Qu, Eungkyu Lee, and Tengfei Luo [3] in the article “Solar-Thermal Water Evaporation: A Review” has stated that Solar-thermal water evaporation (SWE) has received much interest in recent years due to a few seminal works on materials innovation and thermal management. With many studies proposing applications like water desalination and sanitization, SWE has become

attractive as it can use renewable energy to potentially address pressing water-energy nexus challenges. In this Review, we follow the most researched aspects of SWE indicated by the analytics from text mining the abstracts of papers in this field. We review recent research activities in each aspect and discuss how these studies help improve the overall efficiency of the SWE processes and/or advance their applications, besides pointing out critical deficiencies in the research. We also highlight some interesting findings and inventions emerging from this field.

R.K. Khanna , R.S. Rathoreb & C. Sharmab [4] “Solar still an appropriate technology for potable water need of remote villages of desert state of India — Rajasthan” has concluded that Solar distillation and desalination unit is most appropriate for remote area dwellers because it is economical, easy to construct and maintain. Most parts of Rajasthan have enough solar radiation available which is the prime input for the system.

### 3 METHODOLOGY

#### Design:

The average size of the steel vessel used is 20inch in diameter mounted by a hemispherical lid on the top. The vessel is used to store and collect water. The desalinators unit is connected with a tap to regulate the flow of desalinated water. The bottom part of the unit is wound with inductive coil, which is connected to the main power supply. The other part of the vessel is wound to a copper coil of small diameter which in turn is connected to the mechanical pump. The Domes shaped lid of the vessel is designed so as to condense the vapors of salt free water. These vapors on cooling turns into a liquid and gets collected on the slope given in the vessel. The lid of the vessel can be removed out of necessity.

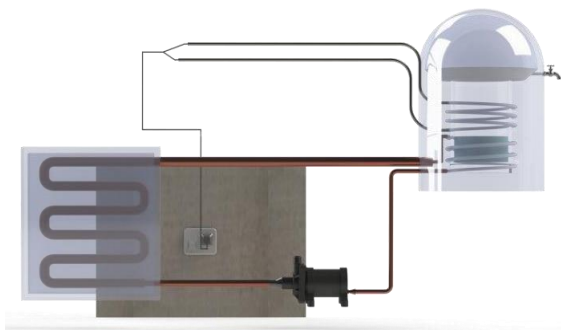


Fig. 1 CAD Model of the desalination unit

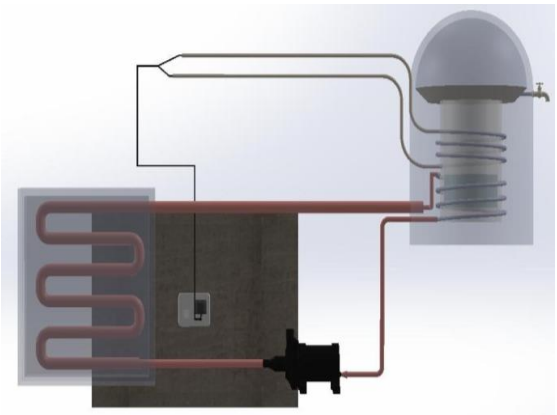


Fig. 2 Front view of the desalination unit

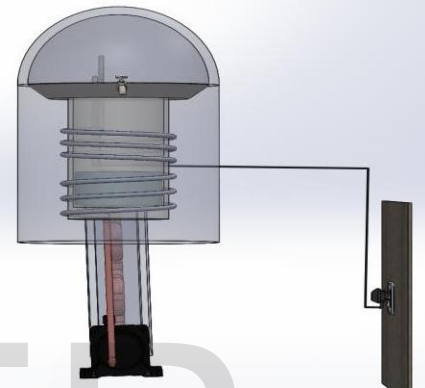


Fig.3 Side view of the desalination unit

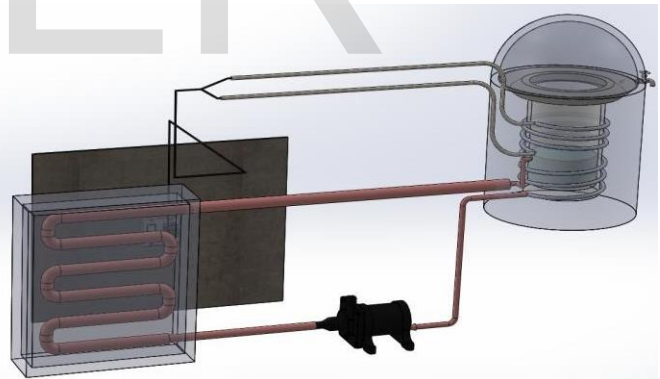


Fig. 4 CAD model of desalination unit

coil: The copper coil used here are manufactured based on the requirements of specifications under JIS H3300. They are light weight, high corrosion resistance, suitable for heat exchanger, and minimize the need of joints. The hardness and strength of coil are defined by its temper, which is drawn and annealed. Higher thermal conductivity of copper makes it suitable for solar energy harvesting.

Self Priming monset Pump : The pump used in this unit is a self-priming centrifugal pump. It helps to pressurise the water pump into the copper coil. It has capacity of 0.5 HP.

#### 4 RESULTS AND DISCUSSIONS

The simulation of the copper coil was carried out. Certain number of coils were simulated on the basis of thermal load. The simulation in increasing number of coils showed that as the turns increase in the copper coil temperature also increases with also increase in time for the water to flow from inlet to outlet.

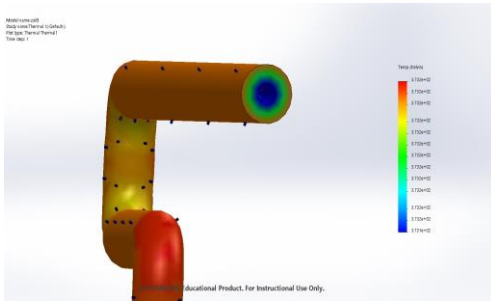


Fig .9 Radial simulation of coil

In the above figure the temperature of water increases radially from the centroid of the coil. It indicates that the surface exposed to sunlight turns red due to increase in temperature to about 61 deg celsius.

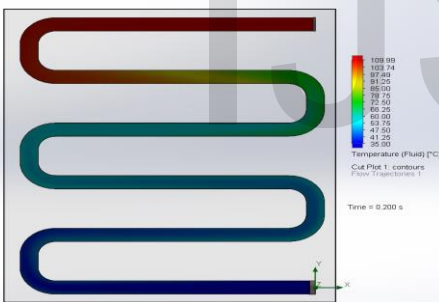


Fig.10 Simulation of coil with 3 turns

In the above figure coil with 3 number of turns heats to a lower temperature compared to that of with 4 and 6 turns.

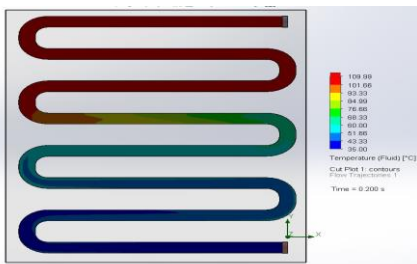


Fig.11 Simulation of coil with 4 turns

The temperature of fluid flowing out is greater than previous coil. It has high temperature.

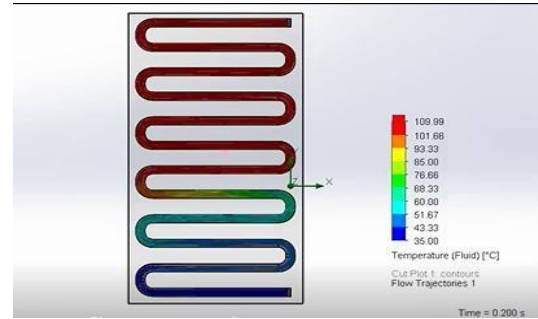


Fig.12 Simulation of coil with 6 turns

In this coil there are six number of turns, hence the time needed by the water to flow is also high.

Thus high temperature is achieved in this case.

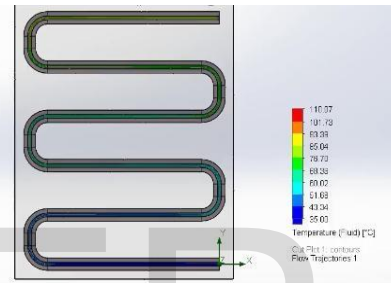


Fig.13 Simulation of coil with varied diameter

#### 5 CONCLUSIONS

An overview of solar thermal desalination methods is presented, focusing on those technologies appropriate for use in remote villages. Solar energy coupled to desalination offers a promising prospect for covering the fundamental needs of power and water in remote regions, where the water scarcity is severe.

There are two ways in which water is desalinated in this project. Both the methods are efficient and effective in remote areas. The above said desalination unit was designed and optimized using solid works. The graphs related to certain solar parameters was studied.

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