DESIGN AND FABRICATION OF SOLAR DESALINATION SYSTEM

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ABSTRACT:

Direct sunlight has been utilized long back for desalination of water. Solar distillation plants are used for supplying desalinated water to small communities nearby coastal remote areas. Solar stills are easy to construct, can be done by local people from locally available materials, simple in operation by unskilled personnel, no hard maintenance requirements and almost no operating cost. But they have the disadvantages of high initial cost, large land requirement for installation and have output dependent on the available solar radiation. If there is no sunshine, the productivity is almost zero for the conventional basin type model. However, from the simplest basin type models of solar still in earlier days, researchers have progressed a lot to increase its efficiency. Suitable modification of solar still can produce high output using minimum areas of land and even in cloudy days. One of such upgraded version is capillary stills, which are gaining popularity for their high output.

1. INTRODUCTION

Water is life in all its forms. All living organisms contain water: the body of a human being is composed of approximately 60% of water, a fish of 80%, plants between 80 and 90%. Water is necessary for the chemical reactions that occur in living cells and is also in the middle of this water that these cells are formed. Water is essential to sustainable food production as well as all living ecosystems; a human development is based entirely on the hydrological cycle. Water covers about 70% of the global area. Furthermore, 97% of this water is located in the oceans. Freshwater is only 3% of the total water on our planet. In this low percentage, rivers and lakes are 0.3%, while the rest is stored in the polar caps and glaciers. Freshwater tanks are very unevenly distributed on the surface of the globe. While Western countries, for example, have the chance to have huge reserves which will renew each year to feed a population that acknowledges a low population growth for most. Similarly, this lack can be linked directly to 80% of diseases affecting the world's population and 50% of cases of infant mortality. All these data so eloquent drew our attention on the need to search other sources of drinking water. On the other hand, and worldwide distribution of drinking water is not commensurate with the needs of each region. This is manifested by finding a surplus of water in regions, while others have chronic shortages. For the latter, the desalination of brackish or sea water is becoming an inevitable solution. Furthermore, in addition to the vital need for water, human beings live also have a crucial need for energy.

1.1 SOLAR ENERGY

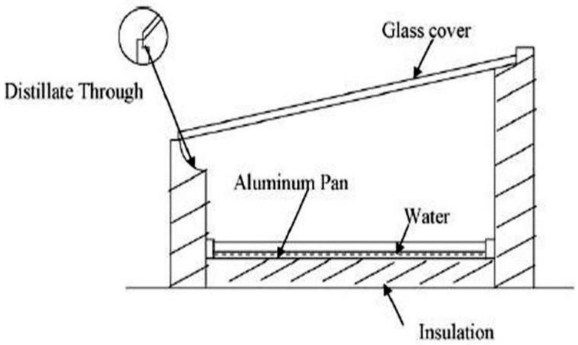
Solar energy has been used since time immemorial to dry agricultural products, to provide space heat in cold seasons or to create ventilation in homes, applications which are still used in many developing countries. More than two thousand years ago, Heron of Alexandria constructed a simple water pump driven by solar energy and in 214 B.C. Archimedes of Syracuse used concentrating solar mirrors to set fire m Roman ships. The daily work of those complex and elegant solar collectors, the leaves of plants and trees, directly or indirectly provides our food, creates the cooking fuel for millions of households throughout the world, and has created all our fossil fuel reserves in the past. This does not imply that there is nothing new in applying solar energy (solar photovoltaic cells are only a few decades old), but some historical insight helps to put things in perspective. People have been using and are still using solar energy technologies without even knowing the term, simply because it is useful and practical to them.

At the present moment, two methods exist by which sunlight can be converted into directly usable energy: conversion to warmth (thermal energy) and conversion to electricity (photovoltaic energy). In the first method, for example, sunlight is absorbed by a blackened surface, which then warms up. If air or water is passed alongside or through this warmed surface, it too will be warmed. In this way, the warmth can be transported to wherever it is needed. For storage, an insulated chamber is usually employed, From which, for example, hot water can be drawn. This, in brief, is a principle of thermal conversion. In photovoltaic conversion, sunlight falling onto a 'solar cell' induces an electrical tension; a number of cells combined in a panel are capable of generating enough current to drive an electric pump or to charge a battery

II. LITERATURE SURVEY

2.1 SOLAR STILLS:

Solar still is possibly the oldest method of desalination of water. Its principle of operation is the greenhouse effect; the radiation from the sun evaporates water inside a closed glass covered chamber at a temperature higher than the ambient.The saline water is fed on a black plate in the lower portion of the solar distiller. The heat of the sun causes the water to evaporate and water vapour condenses to form purely distilled droplets of water when it reaches the cool transparent leaning surface made of glass or plastic. The droplets slide down along the leaning surface and are collected through special channels located under the leaning surface.



This is the basic model. Over decades several other designs mostly based on variations in the geometric configurations have been developed to improve the efficiency of passive basin type solar stills (Hamed et al., 1993). Shankar and Kumar (2012) summarize the solar distillation systems n the broad category of solar stills, it is classified into passive and active distillation systems (Tiwari et al., 2003). In active systems, an external source (such as a flat plate or concentrator collector)

for additional thermal energy is used to increase the temperature of the saline water in the basin. This class is suitable for commercial production of distilled water. The passive distillation system does not employ an outside source of energy. The advantages of such solar distillers are their design simplicity, low installation cost, independent water production and simple maintenance. But they also have several disadvantages such as low efficiency and deposition of salt, scale and corrosion

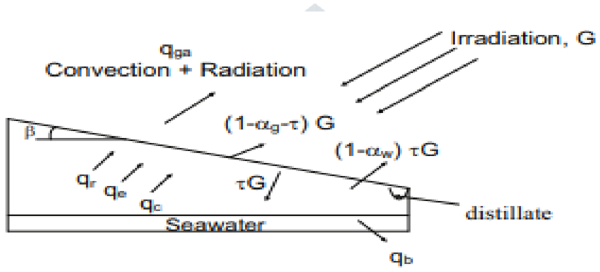
III. DESIGN AND CALCULATION

3.1) MODELLING OF SOLAR DESALINATION PLANT

Typical design problems encountered with solar desalination plant relate to brine depth, vapour tightness of the enclosure, distillate leakage, methods of thermal insulation, and cover slope, shape, and material. Various heat transfer components are shown in this figure, including solar irradiation falling on the solar still, heat transfer within the solar still that includes the thermal radiation transmitted through the glass cover to the water surface and heat transfer by convection, radiation, and evaporation from the water surface back to the glass cover, heat loss through the still opaque material, and heat loss to the ambient air through both convection and radiation heat transfer modes. It is assumed that the capacitance of the glazing is small compared to that of water and basin and hence it is neglected in the present work

Reference	Geometry	Production, L/m^2-day
Ismail[38]	Hemispherical	2.8–5.7
Cappelletti[75]	Conventional	2/5 (winter/ summer)
Al-Hinai et al.[76]	Double slope	4 (annual av- erage)
Al-Hinai et al.[44]	Single effect Double effect	4.15 6.1
Jubran et al.[48]	Multistage solar still with expansion noz- zle, recovery features, and a vacuum pump	9
Nijmeh et al.[54]	Using violet dye/charcoal	5.3
Abdel Rahim and Lasheen[57]	External solar heater (using a heat transfer fluid)	2, 2.75 (conventional/ modified)
Ahmed et al.[42]	Multistage still with an effective vacuum pump	18 (for $P = 0.2$ bar) 10 (for $P = 1.0$ bar)

TIME	TEMPERATURE OF WATER °C
09.00 AM	00
10.00 AM	10
11.00 AM	19
12.00 PM	49
01.00 PM	76
02.00 PM	65
03.00 PM	52
04.00 PM	49



Heat flux from the water to the cover by radiation Qr can be estimated using the relation planes. The radiation involved is considered as diffuse radiation in long wavelengths, so that specular reflection between the transparent cover and water surface is negligible. As a result, the shape factor can be closely approximated by the emissivity of the water surface, usually taken as 0.9 for the conditions inside the still.

3.2) SOLAR DESALINATION PLANT

The principle of pure water production from saline water using different designs of a solar water distillation technique is the same. The saline water in the trough mostly absorbs the solar radiation transmitting through the cover. The cover and the trough absorb the rest. Thus, the saline water is heated up to evaporates. The water vapour density of the humid air increases due to evaporation from the water surface. The water vapour condensed at the inner surface of the cover, releases its latent heat due to evaporation. Finally, the condensed water trickles down due to gravity and is stored in a collector

IV. RESULT AND DISCUSSION

The average daily output of the system is 5 mL/m2/day . The heat extraction of water in the system temperature is further increased by the incoming solar radiation. So the water temperature is increased within a short interval of time. The sudden rise in water temperature induced the evaporative heat transfer in the system. Therefore, the distilled yield increases more than conventional solar desalination systems. A further increase in yield rate is also observed for the cooling over the pyramid solar still under same mode of operation. Thus, this result conformed that the assistance of concentrator certainly increased the yield rate of distilled water.

V. CONCLUSION

Distillation of water using solar desalination method is the most economical method to get portable drinking water. Salt, bacteria and other impurities are contaminated which are to be removed completely in the distillation process. The solar stills are best technology for living beings and environment because they do not need electricity for processing, no running water is required, lifetime is more and easy to maintain. In the experiment it has found that the black coated solar desalination system is more effective when compared with the white coated system.

V1. REFERENCE

i. S. Kalogirou, "Use of parabolic trough solar energy collectors for sea-water desalination," Applied Energy, vol. 60, no. 2, pp. 65–88, 1998.

ii. V. Smakhtin, C. Revenga, and P. Doll, Taking into Account Environmental Water Requirements in Global-scale Water Resources Assessments, Comprehensive Assessment Research Report 2, Comprehensive Assessment Secretariat, International Water Management Institute, Colombo, 2004

iii. T. Oki and S. Kanae, Global hydrological cycles and world water resources, Science, 313:1068–1072, 2006.

iv. J. Kucera, ed., Desalination: Water from Water, Scrivener, Scrivener Publishing LLC, Salem, MA, in preparation

v. UNESCO, The Practical Salinity Scale 1978 and the International Equation of State of Seawater 1980, Technical Paper Mar. Sci., vol. 36, 1981.