TECHNIQUES TO IMPROVE PRODUCTIVITY OF SPHERICAL SOLAR STILL

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ABSTRACT

Clean water is essential for social and economic development of any country. There is limited access to water that meets standard limits of water quality, especially in the Indian region. The water quality can be improved through desalination. Techniques used for desalination are available but the energy requirement is more, and also fossil fuels affects environment. Consequently, there is need to use renewable energy sources, solar energy is also one of the most promising alternatives. A conventional solar still is experimented but it has low efficiency. Thus, many modelling and design attempts have been made to improve its productivity. Models which are experimented would therefore have limited accuracy. For still design, different modifications that included the use of a reflector and external condenser were experimented. The objective of this investigation is to find out different techniques to improve the productivity of spherical solar still.

Keyword: - *Spherical solar still, Condenser, Techniques, and Reflector etc….*

1. INRODUCTION

Clean water is very essential for good healthy life which also supports the nation development. In world population, 89% of people had used water suitable for drinking in 2012. Nearly 4 billion had used tap water while another 2.3 billion had used wells or public taps. 1.8 billion people still use an unsafe drinking water source which may be contaminated. This can result in infectious diarrhea such as cholera and typhoid. Requirement of drinking water varies by as per the whole day activities, age, health, environmental conditions. Water requirement is changing with the climate, in hot regions up to 16 liter of water can be used per day. 60% of weight is of water in man and it is 55% for women. In many countries, mainly tap water is used for drinking even it is not as per the standards. In many cases, level of toxins and impurities are much more higher in water. The amount of water is very less which fulfil the standard of drinking water. 71% of earth surface is water from that 96.5% of earth water is salty, 1.7% is ground water, 1.7% is in the form of ice and others.

The pollution is increasing very rapidly due to industries and use of non renewable fuels. Untreated sewage, excessive use of fertilizer in agriculture, unregulated small scale industries are major reason of water pollution in India. Pollution in underground water is also increasing. A 2007 study shows that major reason of water pollution is untreated sewage water. A 1995 report shows that 114 cities are releasing untreated water into the Ganges river. A 1992 World Health Organisation (WHO) report shows that there are 3,119 towns and cities in India, out of which only 209 are partially sewage treatment plants, and only 8 have full waste water treatment plants.38,354 million litres per day (MLD) sewage is producing from major Indian cities but from this only 11,786 MLD is treated.

1.1 Present status of water availability in India

Pure drinking water supply in India continues to be improper, despite many efforts by the government and other organizations. The investment to improve water quality is lower by international standards, and also increased in size during the 2000s. Requirement has also increased due to increase in population significantly. For example, in 1980 sanitation in rural areas coverage was estimated at 1% and increased 21% by 2008. The use of water sources in

India is also increased significantly from 72% in 1990 to 88% in 2008. It also seen that the government of India is financially weak to maintain water purification stations which are in operating conditions and also to improve the purification method. Also, there is only two Indian cities which have continuous water supply according to requirement. About 69% of Indians still not sufficiently access sanitation facilities from 2008.

A number of innovative techniques have been tested to improve water quality in India, in the early 2000s. It also include demand-driven approaches in rural water supply since 1999.

1.2 Solar still

It is proven that the efficiency of conventional solar still is lower than that of spherical basin type [01] because of shadow of wall [02]. Many design improvement have been made to improve the efficiency of conventional solar still like change of inclination of basin at angle, multi effect solar stills, hemispherical and spherical basin type solar still, use of reflector. There limitations of each and every design for example it is difficult to maintain inclination angle throughout the year.
The main drawback of solar still is its low distillation output as per the investment. The distillation of solar still is mainly 3 to 7 l/day/m^2. The amount of distillation is very low so it is not usable for any kind of application. But solar stills can be used where water availability is very less and the intensity of solar radiation is more. For rural areas the solar still is better option because the availability of water is less so in these areas we can reuse water by using solar still.

2. Methods of improving productivity

There many methods to improve efficiency of solar still but all are not applicable for spherical type solar still like there is no change of inclination angle in spherical solar still. Some methods are common for both spherical solar still and other like use of wick material and use of reflector. In the present work, the various methods to improve productivity of spherical solar still are described as follows.

2.1 Reflector

Use of reflector can improve the productivity of spherical solar still because for the same basin size energy incident will be increase [03,04]. The parabolic reflector is best for spherical type solar still. There are three possible design which can be compared with each other. One is without any reflector. In second one, size of basin is same as of first one but there is parabolic reflector larger than basin. Third one is without reflector but the size of basin is same as the size of reflector in second one. If the size of the basin is same for both reflector and without reflector, the productivity is more due to use of reflector because the intensity of radiation will increase due to reflected radiation and also the heat losses will increase due to higher temperature of system. If reflector is used and in another the size of basin is same as that of reflector (second and third type), the productivity of without reflector is more because the losses are reduced.

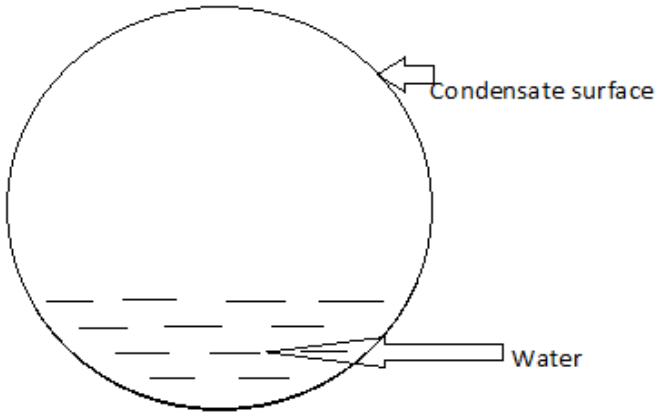

Fig -1: Line diagram of spherical solar still

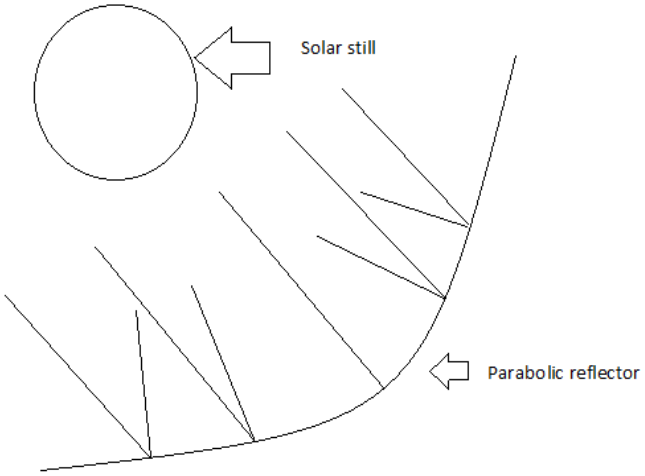

Fig -2: Line diagram of spherical solar still with parabolic reflector

Spherical solar stills are shown in figures above. In figure 1, the simple line diagram of the spherical solar still without reflector is shown. In figure 2, the parabolic reflector is shown with spherical solar still.

2.2 Providing cooling to condenser part

It is proven that the cooling of condenser part of the solar still will improve the productivity [05]. In the spherical solar still, the upper part of the sphere is working as condenser part. If the cooling is provided to that part, the productivity will increase. Incoming water can be used as a coolant. If the incoming water flows from the upper part of the basin and then flows inside the solar still through channel as shown in figure 3. As shown in figure 3, if the water is feed to the upper part of the solar still, it flows downward due to gravity and collected in the channel and through the channel it flow inside the basin.

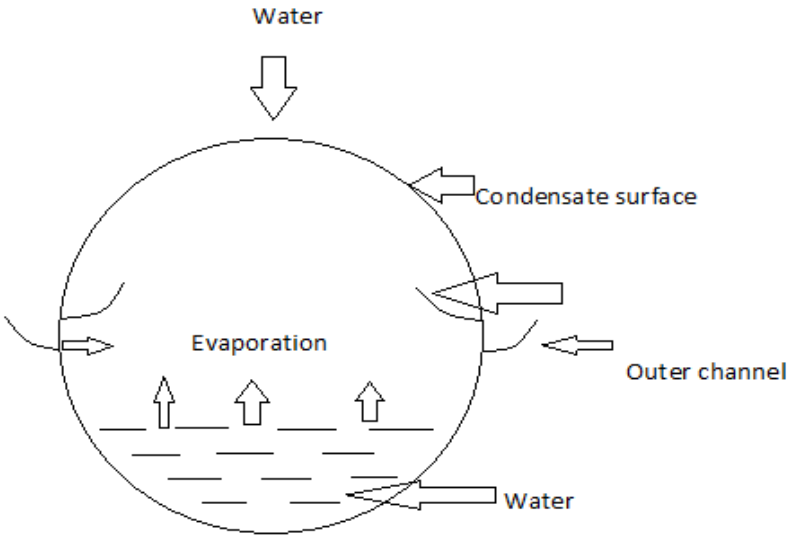

Fig -1: Line diagram of spherical solar still with collecting channel

2.3 Preheating of inlet water

The productivity of the solar still can be improved by providing preheating to incoming water or saline water. In spherical solar still, preheating to saline water and cooling to the condenser can be achieved with the same method. As shown in figure 3 when the saline water feed to the upper part of the solar still it absorb the heat energy from the upper hemisphere of the solar still and get preheated.

2.4 Providing vacuum

Vacuum increases the rate of condensation [06]. If the vacuum is created inside the solar still, the productivity will increase. As the pressure inside the solar still reduced the evaporation temperature of water is also reduce so the evaporation rate is increased. Nearly 50 to 70 % of productivity can be increased by providing vacuum.

2.5 Nanofluids

The thermal conductivity of water increase due to mixing of nanofluid in water thus the rate of evaporation will increase and the productivity is also increase. The increase in productivity is depends on the properties of nanofluid used. Productivity of solar still can be increased 50 to 70 % by mixing nanofluid in water. Cuprous oxide gives nearly 10 % more productivity than that of Aluminium oxide [06]. The cost of the nanofluid is more and it is also not easily available.

2.6 Using proper glass thickness

The glass cover thickness have significant effect on productivity of solar still. As the glass cover thickness increases from 2mm to 6mm the productivity is also increases [07]. So by providing proper thickness of glass cover the productivity of solar still can be improved.

2.7 Using wick material in basin

The rate of evaporation increases as the area of water surface increases [05]. The area of water surface can be increased by using wick material. Jute is one of the best absorber in India which is also a good absorber of water. The productivity of water can be increased by 20 % than that of conventional one.

2.8 Tracking system

The Tracking system is not required in spherical solar still but if the reflector is used, the efficiency can be improved by using tracking system. In tracking system solar energy can be used to track sun by using PV cell and PLC controller. Tracking is costly method so it is not used.

3. CONCLUSIONS

There are many methods to improve productivity of solar still. Some are expensive and some are cost effective. Also the cost effectiveness of method is depends on the requirement of the water. But for Indian region tracking, nanofluid and vacuum methods are not cost effective. So these methods are not useful for those region where water requirement is not to high.

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