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Short Communication

Various Techniques to Enhance the Productivity of Solar Still

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INTRODUCTION

Water is the one of the most requirements for all humans, animals lives on this earth. Life is not possible without water. Pure drinking water is one of the prime requirement also. The major portion on earth is covered with water, but it is saline water and not directly usable for drinking and other routine purpose. According to WHO/UNICEF 2019, 2.2 billion people lack access to safely managed drinking water services. Around 2 billion people in the world live in the countries experiencing with high water crisis (UN 2019). 297,000 children under five die every year from diarrhea diseases due to poor sanitation, poor hygiene, or unsafe drinking water. WHO/UNICEF 2019 majority of disease on human body occurs due to unhealthy water. Many regions in African country suffers from clean drinking water. Also Agriculture accounts for 70 per cent of global water withdrawal (FAO). In India by the end of 2030 45% people suffers from pure drinking water and it may effect on Indian GDP (WHO 2018). From this data of global water crisis it is necessary to increase the resources which can convert the impure water into pure form and fulfill the clean water demand.

REQUIREMENT OF DESALINATION TECHNOLOGY

Desalination is the technique which can covert the saline water into clean drinkable water. It is the process of removing excess salts and other dissolved chemicals from the saline water and maintains the salt concentrations at or below the World Health Organization's drinking water limit of 500 ppm. Using desalination technology saline water can be used for drinking and other purpose like industrial, agriculture etc. Desalination technique overcomes the demand of pure water worldwide. There are basically two types of desalination processes: 1) Thermal based and 2) Membrane based [1]. Thermal based technology operate use with thermal energy to evaporate the water and it condense on the glass cover and give distillate water. It is used in the areas, where level of salinity is high and electricity is not available [2]. The examples of thermal based technology are Multi-stage flash (MSF), Multi-effect distillation (MED), and Vapor compression system. Membrane based technology require electricity to operate the pump and to remove the salt from water. It is widely used due to its low energy fuel consumption. Ultra-filtration, Electrodialysis and Reverse osmosis are example of membrane based technology.

Solar distillation-solar still

Solar desalination is the thermal based technique used to desalinate the brackish water into pure water with the help of solar energy. The device used for this technique is known as solar still which is shown in Figure 1. Solar still is simple box type device which works on physics principle of evaporation and condensation. It is made from galvanized material or any other insulating material. The basin surface of solar still is made of galvanized material and its top surface is covered with transparent glass cover which can allow the solar radiation to pass inside the still. To reduce the bottom and side losses insulation material are used. The basin surface is painted with black colour to absorb the more solar radiation. The glass cover is inclined at latitude of city from the horizontal surface. To allow the maximum solar radiation to pass on the still its thickness is taken as 3-4 mm.

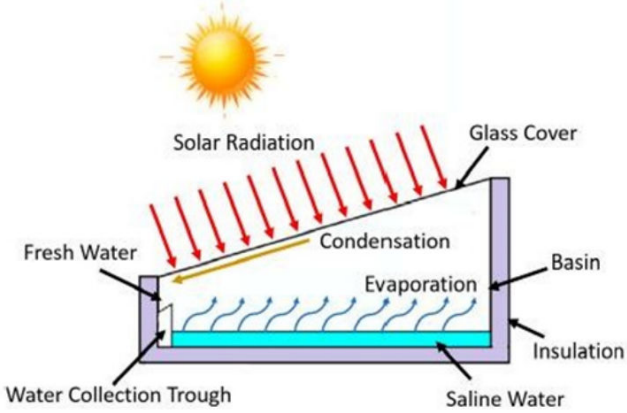

Figure 1: Simple box type solar still.

In solar still, radiation is pass through the glass cover and absorb by the basin surface. The solar radiation evaporate the water inside the still and becomes the vapor. Due to pressure

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difference inside the still vapor moves toward the glass coves, where the droplet condense and due to the slope of glass cover it can moves downward direction and collected in distillate trough. This way a pure drinking water can be collect.

Advantage of solar still:

- It requires no electricity to operate, so can be useful in remote areas where electricity problem occurs.
- It is simple technique and easy to operate, so no skill person require to operate it.
- It is economically viable, no higher cost require to manufacture.
- It can easily transportable from one place to other.

The major drawback using solar still is its low productivity and less distillate output. So to improve the productivity is a major research topic for researchers. Many researchers have used different technique like flat plate collector, absorbing material, fins, evacuated tubes, condenser within the solar still and changes the design of solar still to increase its productivity [3].

Different techniques to improve the performance of solar still:

- **Flat plate collector:** Flat plate collectors (FPC) are used within solar still to improve its productivity. It can increase the efficiency of solar still by preheating the water inside the still with flat plate collector. Solar still with FPC gives higher efficiency than without it.
- **Absorbing material:** In solar still different absorbing material like cotton jute, rubber, pebble, nano materials etc. are used to reduce the heat loss inside the still, which affect on productivity of solar still.
- **Fins:** Fins collect the more solar radiation which increase the heat transfer area inside the basin and increase the evaporation rate of water, due to that higher productivity can be achieved [4,5].
- **Evacuated tubes:** Evacuated tubes are widely used with solar still now a days. It can collect the solar radiation from all direction. In evacuated tube one inner and other outer tubes are used, both are overlapped to each other. Inner tube is made of borosilicate glass and outer tube remains transparent. Vacuum is fixed between two tubes.
- **Condenser:** The higher temperature between evaporating and condensing area inside the still affect on productivity of solar still. To increase the productivity of solar still this temperature difference should be maintained. To maintain these difference condensers, fans, storing materials etc. are used within solar still [6].

CONCLUSION

Fabricate three single basin solar stills with variations of insulation thickness and optimum thickness is found. Fabricate single basin solar still with modifications of basin and tested in climate conditions of patan to find best modification. Design air cooled condenser and attached with best modification and compared with conventional solar still to find increment in distillate output. Integrate different fins with variations of PCM materials compared and best configuration is determined. Above system integrated with condenser and compared without condenser. Above system integrated with evacuated tubes and compared it without attachment of evacuated tube in terms of percentage distillate output. To carry out life cycle cost analysis of system.

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