

SOLAR DESALINATION

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Abstract

The use of solar power in thermal desalination processes is one of the promising applications of the renewable energies, solar desalination can be conducted by two methods namely direct and indirect. direct method includes conversion of saline water into potable water by evaporation and condensation method, whereas in indirect method the saline water is made to pass through the membranes which is capable of removing the salt content in the water. Indirect method consists of Multi stage Flash (MSF), Vapour Compression (VC), Reverse Osmosis (RO), Membrane distillation (MD), Electro qualitative analysis. Direct solar desalination compared to indirect solar desalination method requires more area for installation and has a low production rate but in direct method it is very easy to maintain and is very economical. This paper gives a clear picture about the solar desalination methods and this technology can be used in remote areas.[1]

Keyword: *Seawater desalination; Renewable energies; Solar energy.*

1. INTRODUCTION

Water may be a basic necessity of man together with food and air. H₂O sources are thought-about to be rivers, lakes, and underground water reservoirs. These sources were the sole sorts that man relied on for an extended time. However, the utilization of water from such sources isn't perpetually doable, particularly due to the impure surroundings (i.e. acid rain). So, rummage around for alternative sources becomes a requirement.

The sun is thought to be the supply of energy for its constant period and hygienical state, and its outstanding potency of not polluting the environment, as other forms of energy, like coal and therefore the derivations of oil that cause the pollution of atmosphere and surroundings.

The arid zones of the planet, wherever insolation levels are high, are largely within the developing countries. From now, most scientists, due to the swarming convenience of sun shine that satisfies our wants for the approaching years ahead, emphasised the importance of the solar power.[2]

It's also a fact that production of fresh water requires a large amount of energy: 1000 m³ of freshwater per day requires 10 000 tons of oil per year . Though solar energy is often labelled as 'free energy', it's not so simple to evaluate feasibility and cost for solar desalination.[3]

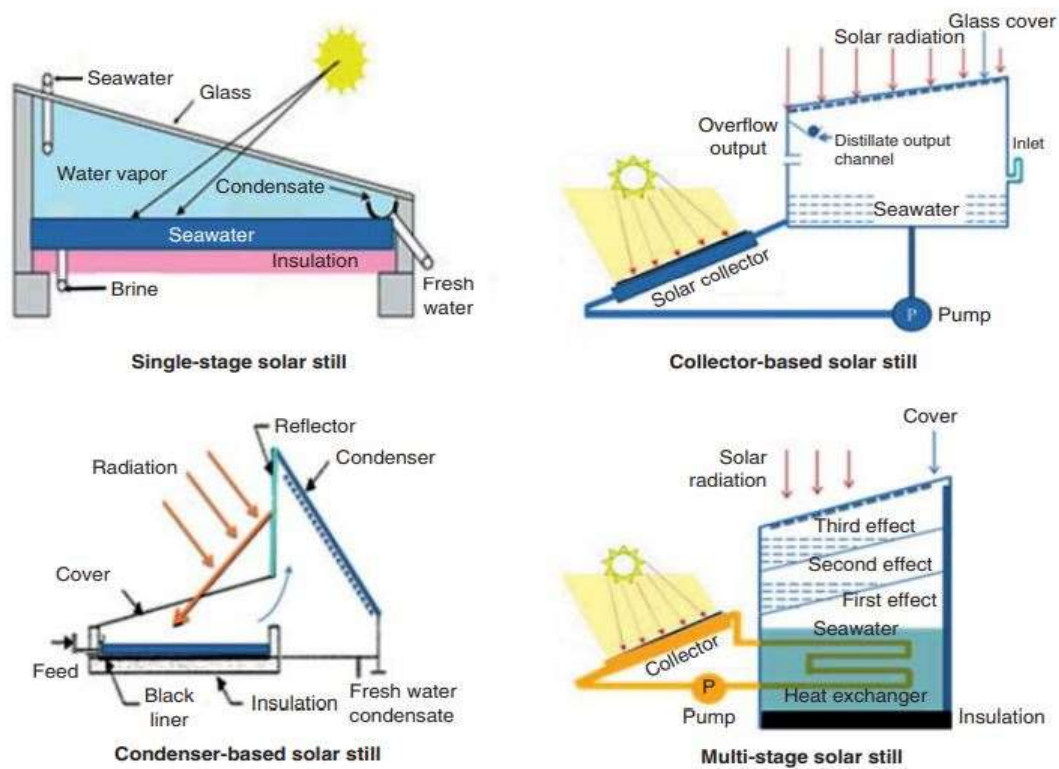


Fig 1: Different types of solar stills

2. About solar energy:

Solar energy is a very large energy, inexhaustible source of energy. The power from the sun intercepted by the earth is approximately 1.8×10^{11} MW, which is many thousands times larger than present all commercial energy consumption rate on the earth. Thus in principle, solar energy could supply all the present and future energy needs of the world on a continuous basis. This makes it one of the most promising of all the unconventional energy sources.

The sun radiates the energy uniformly in all direction in the form of electromagnetic waves. When absorbed by body, it increases its temperature. It is a clean, inexhaustible, abundantly and universally available renewable energy, solar energy has the greatest potential of all the sources of renewable energy and if only a small amount of this form of energy could be used, it will be one of the most important supplies of energy, especially when other sources in the country have depleted.

This solution is solar water distillation. It is not a new process, but it has not received the attention that it deserves. Perhaps this is because it is such a low-tech and flexible solution to water problems. Nearly anyone is capable of building a still and providing themselves with completely pure water from very questionable sources. 3.8×10^{24} joules of solar radiation is absorbed by earth and atmosphere per year. Solar power where sun hits atmosphere is 1017 watts and the total demand is 1013 watts. Therefore, the sun gives us 1000 times more power than we need. If we can use 5% of this energy, it will be 50 times what the world will require.

The above figure 1.1 shows the average solar intensity with respect to month of the year. Solar intensity is varies from month to month and it is depending upon weather condition. In the summer season intensity will be more compared to rainy and winter season hence scarcity of drinking water will be more so solar desalination system is one of the best method to reduce the scarcity of water.

3. Concept of solar desalination:

Distillation is one of many processes available for water purification, and sunlight is one of several forms of heat energy that can be used to power that process. To dispel a common belief, it is not necessary to boil water to distil it. Simply elevating its temperature, short of boiling, will adequately increase the evaporation rate. In fact, although vigorous boiling hastens the desalination process it also can force unwanted residue into the distillate, defeating purification.

Solar desalination is a technique to desalinate water using solar energy. There are two basic methods of achieving desalination using this technique; Direct and Indirect. In the direct method, a solar collector is coupled with a distilling mechanism and the process is carried out in one simple cycle. Indirect solar desalination employs two separate systems; a solar collection array, consisting of photovoltaic and/or fluid base thermal collectors, and separate conventional desalination plant.

The Saline Water Conversion Corporation (SWCC) of Saudi Arabia is currently operating small scale single purpose thermal desalination plants with water production capacities ranging from 250 to 9000 m³/day.

The heat required for the evaporation of the water droplets can be supplied / recovered from the following sources: sun, light, double walled insulated glassing effect, black colour effect, heat generated by the vacuum pump, heat collected from the PV panels and latent heat recovered from the generated vapour.

4. Methodology

The main objective of the project is to convert the brackish water into potable water with the help of solar energy which is a convenient form of energy. The salt water can be converted into potable water by two methods:

- Direct Method
- Indirect Method

In this project we are using Direct Method of Solar Desalination method, where the saline water is evaporated and condensed to obtain the potable water.

Vacuum pump is used in order to reduce the pressure in the chamber. The saline water will be having a high density of 1029 Kg/m³, that is the boiling temperature of saline water will be very high at normal atmospheric pressure. Hence in order to reduce the boiling point of saline/ brackish water the pressure has to be reduced below the atmospheric pressure of 1.01325 bar. The decrease in pressure will result in expanding the surface area of the water molecules there by providing more surface area of the water molecules which will result in evaporating the water molecules very easily at a comparatively lower temperature.

The Aluminium foil is used in order to direct the solar radiations onto the water surface that is being transmitted through the polycarbonate glass, this is done in order to avoid any sort of loss in the solar radiation acquired.

The brackish water of a known quantity is filled in the closed chamber and is kept in open space where sufficient solar radiation is acquired. Now the vacuum pump is used to reduce the pressure inside the chamber to a known value and the temperature readings are noted regularly with the help of thermo couples.

The water gets converted to steam at a faster rate with the help of the negative pressure, this steam gets condensed on the polycarbonate glass that is assembled at a 30° inclination. The droplets combine together and begin to flow downwards and get collected at the collector pipe attached at the lower end of the polycarbonate glass.

The water so obtained will be distilled water which will not be having any minerals that potable water consists of. Hence the water so obtained will be passed through the Bio-Degrader where the distilled water acquires all the required minerals and becomes potable which can be used for domestic use.

5. Conclusion

Solar energy driven chemical process units can discontinue carbon emissions and might offer desalinated water in an exceedingly property method with negligible impacts on atmosphere and are extremely appropriate for remote and rural areas wherever provision for power supply and H₂O pipe lines don't seem to be potential. Currently, star based mostly chemical process units are treating solely salt or saline water thence additional analysis is required on treatment of waste water exploitation these units thereby significant exploitation of well water is stopped. Identification and development to novel corrosion free materials and long life membranes are required for increased and reliable operation of those units. Brine disposal may be a massive drawback in each chemical process business thence correct ways in which to extract minerals from brine and use of brine for cultivation and irrigation must be practiced. alternative energy has the potential to create chemical process business greener and any development in star thermal collectors and PV panels are additional beneficial to desalination industries

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