Special Article:

TOWERED SOLAR DESALINATION PLANT

(An alternative source of water)

Akhter Iqbal Zuberi*
Hira Zuberi**

ABSTRACT:

Water is the most essential commodity for the survival of life. The Consumption of water by human population is increasing much faster than the population itself. On the other hand, the fresh water resources are rapidly becoming polluted, and scarce to meet the increasing demand. According to an estimate by 2025, two-thirds of the World will be living under a condition of water scarcity.

To cope up with water scarcity, non-solar desalination plants as an alternative source of water, are being installed throughout the World. These methods, depend upon the fossil fuel for processing water, are energy-intensive and unaffordable. While the conventional Solar Desalination Plant is comparatively cheaper method and does not depend upon the fossil fuel energy while its production capacity is very low. However, the Towered Solar Desalination Plant is the solution that keeps the cost of cleanest water extremely lower and is highly productive plant.

INTRODUCTION

The conventional solar desalination plants are horizontally spread on ground consuming space produces only 4 to 6 liters water per square meter per day. First major solar plant of the capacity 6000 gallons per day was built in Chile in 1872, this technique is being used more or less in its original form till now all over the world. In 1995, the scientists of Kiel University of Germany succeeded in obtaining 20 liters from 4 square meter plant.

The conventional solar desalination plants developed in different areas of the country. The largest one of the capacity of 6,000 gallons per day covering an area of 2 acre set up at Gawadar, to meet the requirement of Pakistan Navy, developed by the Solar Energy Research Center of PCSIR, Hyderabad.

Towered Solar Desalination Plant invented by one of the co-author of this paper Akhter Iqbal Zuberi, works on the natural process of water cycle- evaporation - condensation. It is a towered structure made from locally available materials. It breaks the production limitation of previous technology by producing 40 liters of water on one square meter area per day.

It is an economical source of water as all the energy requirements are met from solar energy; furthermore there is no need of filtration, purification or of adding any chemical throughout the process. This technology curtails the expenses which are necessary for energy consumptive non-solar desalination plants. It does not depend on consumables as in other technologies. Hence from its low installation investment and with very little running cost it is the cheapest source of water for the water deficient countries.

* Independent Researcher, Email: aizuberi@yahoo.com,
** Research Scholar, zuberihira@yahoo.com, Date of Receipt: 23-6-2013

METHODOLOGY

The plant consisting of hollow rectangular or round high tower made of cement and at the top a tank is provided. The outer surface affixed with rough wet able material. The cement tower is covered with similar shape glass slightly bigger size and the distance between the cement structure and the glass remains 0.5 to3 centimeters.

The tank is filled with saline water and allows water from an outside tank to fall, drop by drop in this inner tank. The excessive water in the inner tank allowed falling continuously wetting the cement walls of the tower, from top to bottom. By the solar radiation the water on the wet surface and in the tank evaporate and condense on the inner surface of the glass cylinder and flow down the collecting drain channel while the concentrated saline water drains out through the saline drain provided.

In this process fresh saline water is continuously added to the walls from the top of the tower and after evaporation the remaining saline water falls down and drain out continuously. The movement of water would also increase the energy of molecules continuously and increase evaporation process. And the increase in height also increases the production. Salt as by-product is also extracted from the process. While in the conventional system the water filled remains stand still for several days.

To increase the efficiency of plant and to accommodate heat inside the tower different possibilities were used. Mirrors were provided; reflecting sun rays on the plant increased the inner temperature of plant. Parabolic mirrors focused on the black pipes in which salt water passes. Hot water thus obtained in black pipes enter into the plant. Continuous adding of hot water will increase the clean water yield.

The towered solar desalination plant receives solar energy from sun rise till sun set; provides more water during day (8 hours) however the process of evaporation-condensation slows down during night. From early morning, it receives perpendicular radiation on one side of the plant. While at noon its top, gets radiation equivalent to the horizontal plant from noon till sunset, the other side receives maximum radiation. By increasing the height, the tower plant receives more solar energy and the inner temperature increases to 86^{o}C as the height increases. Ultimately this increases the water yield.

The plant is 3.5X1.5 square feet and 10 feet high gave water about 14 liters water per day, and can give more. The water yield in different time period in a day explains below.

Water yield in different time period in a day in clear sun shine				
Time	7:00pm to 8:00 a.m.	8:00a.m. to 11:oo a.m.	11:00 a.m. to 3:00p.m.	3:00 p.m. to 7:00P.m.
Water yield	1.5-2 liters	3-4 liters	4-5 liters	4 liters

ADVANTAGES OF TOWERED SOLAR DESALINATION PLANT

Concentration of vapors

The plant has a minimal possible distance between the wet walls of the tower and the glass. As a result the water vapors crowded and start collecting on the cool surface of the glass.

Heating

The wet vertical tower surface has water at very low quantity and the heat of the sun incident quickly heats such a low quantity of water, increases the evaporation.

Increase area

Large area absorbs more solar energy and increases evaporation. Water spread on large area would increase evaporation. A high raised plant would cover an area including the surrounding walls and the top. Whereas in the plant developed horizontally, water spreads only the covered area on the ground. Hence the vertical plant, continuously wetting, would cover many times more area where water has to evaporate.

Continuous process

In this process hot water is continuously added from the top of the walls which would fall down and spread the water continuously. The motion of the water would increase the energy of its molecules consequently evaporation process will increase.

Dust proof

The outer surface of the plant is vertical wall of glass on which the effect of dust will be less as compared with horizontal surface.

No salt accumulation

In this plant, saline water is allowed continuously to be added from the top which will fall down and continuously drain out the concentrated salts.

An increase height a better yield

By using this method over a fixed surface area of the ground will be required and larger quantity of water can be achieved by increasing the height of the plant.

Effects of season

The average sun available 8.19 hours out of 12.131 hours possible sunshine a day. During winter sunshine reduces to about 10 hours. While during the summer its duration is about 14 hours.

The temperature and sunshine effect on the production, as well as on the consumption of water. During winter the production reduces about one third.

While during full cloudy condition and rain in winter season the production reduces to zero. These are not more than 5 days in a year.

RESULT

- The life period of such plants is more than 50 years much more sustainable than those of existing desalination technology. Just water is needed to be adding and it starts work.
- Conventional solar desalination technologies are working in different countries using a large area of land, that's why it is not feasible in our country whereas Towered Solar Desalination Plant with minimum area and maximum production is more practical.
- The entire energy requirements are met from solar energy.
- This project can be implemented anywhere there is ground water, brine or sea water available, even can be constructed on any waste land.
- This isolated plant does not depend on consumables. For installation no machines are required to import and no load of transportation expense. Thus the simple and user-friendly technology can be used to overcome water shortage at law cost.