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Portable Solar Desalination Plant

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Abstract: *Desalination is a process of converting sea water into fresh water which can be used by people for their daily uses. Man has always looked for oceans to enjoy the benefit of water. Some of the early discoveries of it is by Aristotle and others. The people of that time came up with distillation and filtration using soil deposits to obtain drinking water from the sea. After that many methods came of desalination like reverse osmosis, etc. and were used and thermal energy method was found cheapest and hence we came to know that we can use this processing a portable desalination plant. The potential of thermal energy is huge all around the world and it has been used in various processes all around. It is used for desalination process which will cure the problem of scarcity of water in the world and mostly in the water drought regions in India. This project is focused on making fresh water from sea water in the cheapest price available and in very small setup.*

Keywords *– Desalination, Thermal energy, Portable, Scarcity, Cheapest*

1. INTRODUCTION

The Project work presented in this report is based on implementation of portable solar desalination process to decrease the shortage of fresh water. Fresh water resources are going down as the need of water is increasing.

The best way to overcome this problem is to use solar energy for desalination The UNEP said in 2012 that 1/3 of the world's population have fresh water resources, while the rest will suffer water shortage by year 2025.According to WHO more than 1.6 billion people in the world will have polluted drinking water. There are still large population around the world who have no availability of drinking water and fresh water is also not distributed geographically. The best thing to do gain some fresh water is to desalinate sea water and convert that into fresh water.

2. OBJECTIVES

1. To create freshwater from sea water by thermal desalination process.
2. To remove salt from it
3. To extract maximum amount of fresh water from available sea water.
4. To deposit brine with less harm to environment.
5. To design a cost-effective system.

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3. RELATED WORKS

Muhammad Abbas et. al. [1] They proposed a method of brackish water desalination using solar energy. The required heat energy for this plant was brought from parabolic trough collector. They analyzed this on mat lab software and provided with the solution..

Ammar Al Muhairi et. al. [2] They analyzed a method and assessed the impact of desalination plant discharges in the Arabian Gulf. In this we find out of brine that it has a certain impact on surrounding water.

Avantika Basu and Bhaskar Kumar [7] developed solar and ocean thermal energy operated hi-tech ship having desalination facilities. This ships also saves extinct fossil fuels through non-conventional energy sources. They also use ocean water for the desalination procedure and also provide electricity for ships.

Mohammed Ghazi [4] presents a steady state modeling and analysis of four effects pilot unit of seawater desalination using thermal solar energy as a heat source and vertical tubes falling film evaporators type. It also can be modified

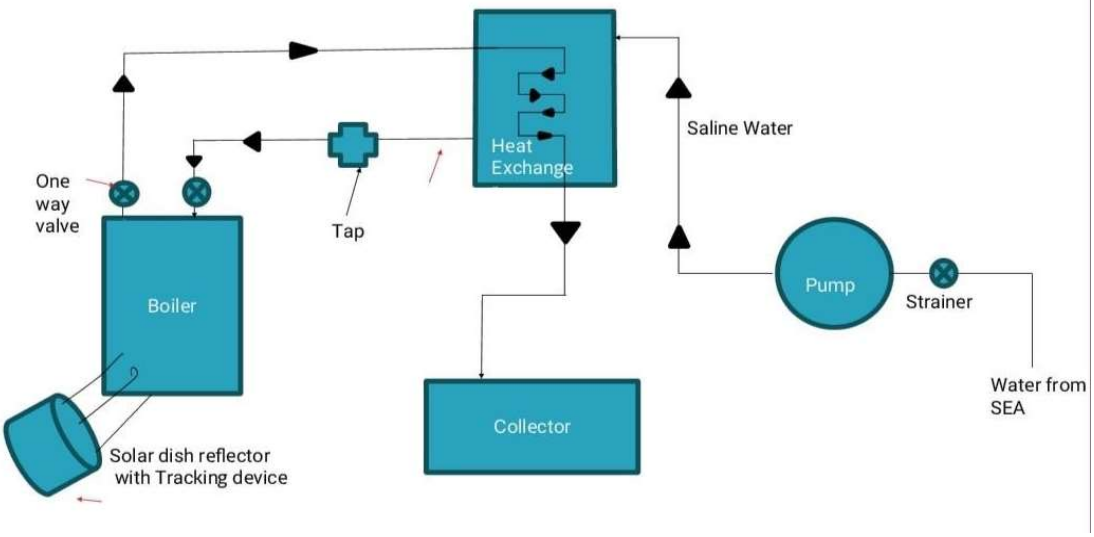
Daniel Butcher et. al. [5] studied on water desalination with evaporation from environmentally friendly waste heat sources. Thermal desalination is one way but they developed a new way of desalination through waste heat resources like from gas power stations or from A.C, etc.

Ihsanullah et. al. [3] studied about the recent developments in solar desalination and found out the use of solar energy for desalination not only has promising prospects, but is also a technically viable option to cater for the stressing energy and water issues. Solar energy powered installations are currently not comparable with conventional fossil fuel installations due to the high cost of solar collector/PV panels

Mahmoud Shatat et. al. [6] studied about various thermal desalination process and concluded that the desalination systems can be operated by the use of conventional and renewable energy sources and the vast majority of desalination plants over the world are currently operated by fossil fuel instead of renewable energy due to technical and economic barriers.

4. PROPOSED SYSTEM

In order to overcome the scarcity of water, we have come to a solution of making thermal water desalination plant. Reviewing of various research papers, ideas from GOOGLE & some basic books of thermal Engineering we are planning to make the same. As we all know that when water is heated it is converted into vapor and it evaporates. Thus our planning is to collect that vapor via pipe and convert it into water which can be used for drinking purpose.



Desalination process can be implemented using following steps;

Construction: Main parts of Portable Water Desalination plant are Boiler, Solar Parabolic Reflector, Heat Exchanger and a pump. As unit will be of medium size weight of the same will be approximate 30kg

The process starts like this:

1. We pump the sea water into the Boiler via Heat Exchanger, thus to remove the dirt particles a filter is installed which remove all the contaminants from the sea water. Then the water will come into the boiler for heating. Heating will be done by the rays of the sun. An parabolic solar reflector is placed beside the boiler. This reflector will focus the sun rays which are parallel to the axis of the reflector to a central point on the boiler.

2. When this rays will be focused on that central point, it will heat the water and evaporation will start. After evaporation vapor will come out of the water which will be collected in a collector. Now there will be a one way valve fitted in the boiler in the way where water will first come into the boiler from tank.

3. One way valve will stop vapor to get into that pipe and then vapor will go into other pipe. It also does not allow external air to come into the boiler which maintains vacuum inside the boiler .During the flow of the vapor into this, pipe heat will be exchanged between the vapor and the saline water. Now when the vapor temperature will decrease it will turn into droplets of water which will be further collected in the collector.

4. Treatment of brine

The byproduct that we will get after this process will be brine and using of this is also a big process. Brine is basically used as a preservative in meat packaging and pickling. In refrigeration and air conditioning brine is used as a heat transfer media because of their low freezing temperature or as vapor absorbing agents because of their low vapor pressure. So it will be our choice whether to give brine to the industries or privately sell it.

5. CALCULATIONS

1. PUMP

Discharge required (Q) = 5lit/min

$Q = 8.33 \times 10^{-5}\ m^3/sec$

$= 8.33 \times 10^{-5} \times 1050\ kg/sec$

$= 0.0874\ kg/sec$

$g = 9.81\ m/sec^2$, $h = 12m$

Power (P) = Q x g x h

= 0.0874 x 9.81 x 12

= 10.28 watt

Assuming 50% mechanical efficiency,

Power = 20 watt

2. HEAT EXCHANGER

Thermal conductivity of (C_u) = 385 w/mk

Length of copper tube in Heat Exchanger = 4 x 15 x π

=1.88 m

Area of copper tube exposing the saline water

A = 2 x π x r x l

= 2 x π x 0.005 x 1.88……..……D = 0.01m & l = 1.88 r

= 0.059 m^2

Temperature of vapour inside copper tube (T1) = 373 K

Temperature of Saline water (T2) = 303 K

Heat transfer in Heat exchanger (Q) = K x A x ΔT/ L

=385 x 0.059 x 70 / 1.88

=846.65 watt

3. SOLAR PARABOLIC REFLECTOR

Latent heat of water = 2260 kJ/kg

Sp. heat of water = 4.21 kJ/kg℃

Mass of water = 1kg

Heat required to raise temp of water to boiling point (Q) = $mC_p \Delta T$

=1 x 4.21 x 73

= 304 kJ

Total heat = SH + LH

= 304 + 2260

= 2564 kJ ≅ 2600 kJ

We require 2600 kJ in 15

$\therefore P = \frac{2600}{15 * 60}$ minutes.

= 2.88≅ $3kw$

4. PRESSURE GAUGE

Maximum Pressure inside the boiler should be below 1.40 kg/cm^2

Therefore, we select the pressure gauge of range between

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6. ANALYSIS AND ADVANTAGES

The proposed system has many advantages

1. A simple way to get fresh water.

2. System is cheap, so poor people can afford.

3. The system is portable, so we can take it anywhere.

7. CONCLUSION

The literature represented in this study describes the importance of fresh water in our life. Today thermal desalination solves all the water scarcity problems in the world. It solves all the problems related to water for the people.

Portable water is a rare thing in some areas. While conventional techniques can meet every demand of water. But conventional desalination processes are expensive to operate which prevent their utilization in remote areas. With the increase in cost of energy and later it will be unavailable, there is a need for cheap desalination system that is suited for small application.

Solar desalination can be the method to decrease the water shortage. Solar energy with desalination process can have a good impact and have a reliable source for portable water.

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