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Solar Water Distillation Plant Using Parabolic Mirror Concentrator

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Abstract - *The motivation for this invention is the limited availability of clean water resources and to impure water available for potential conversion into clean water. An apparatus is to efficiently produce clean drinkable water from solar energy conversion. To achieve this, a system was designed a parabolic mirror dish coupled with a custom designed distillation device. The incoming solar radiation from the sun is focused and concentrated onto a distillation device using a parabolic mirror concentrator dish, and heating the incoming impure water that will re-condensed into pure potable water. Providing circular spherical cavity on the distillation device for reducing reflection losses. Using solar tracking system, the system uses maximum energy from sun to make distilled water.*

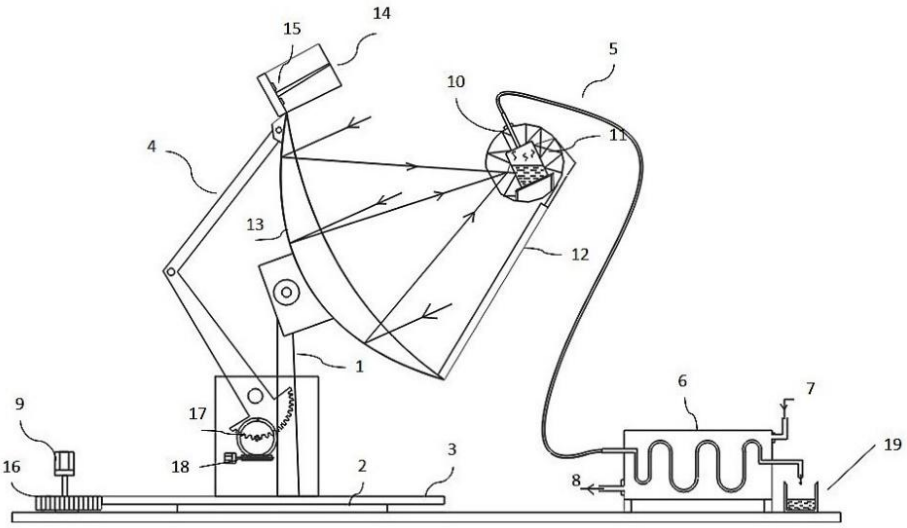
Keywords: *Solar distillation, parabolic concentrator, Solar tracking system, black body cavity*

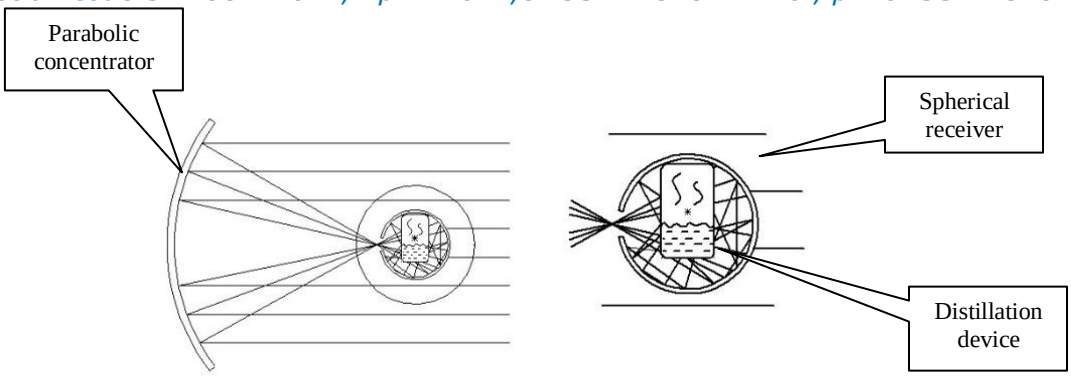
I. INTRODUCTION

Distillation has long been considered a way of making salt water drinkable and purifying water in remote locations. As early as the fourth century B.C., Aristotle described a method to evaporate impure water and then condense it for potable use. [15] Methods of solar distillation have been employed by humankind for thousands of years. From early Greek mariners to Persian alchemists, this basic technology has been utilized to produce both freshwater and medicinal distillate.

Distillation is a process of separating the component substances from a liquid mixture by the method Distillation is one of many processes available for obtaining fresh water from salty, brackish or contaminated water. Sunlight is one of several forms of heat energy that can be used to power that process. Sunlight has the advantage of zero fuel cost but it requires more space (for its collection) and generally more costly equipment to get high temperature. [7] The solar conventional distillation appliances are still less efficient. Most of the people and industries do not recognise the solar appliances as they are time consuming, less efficient and require high initial cost, to develop and manufacture appliance which can reduce the reflection losses and improve efficiency.

II. IMAGES





III. DESCRIPTION

Solar distillation system with parabolic mirror concentrator [13] is use for making of a fresh water from an impure water by converting into vapor of impure water. A distillation of impure water to fresh water by using solar radiation. We know that solar radiation is renewable energy source and the convection fuel are not enough to fulfill our needs.

In past time many researches are evaluated by scientist and also applied in the regular uses. But the heat does not gain effectively. In this system increase efficiency about 62% than ordinary system by using the spherical receiver cavity [10] .To increase efficiency of the system used 2-axis solar tracking system. Some modification is occurs to increase efficiency of system and achieve the goal for useful work.

Base structure made of iron triangular stand [1]. This stand is provide a stability to system. The whole system is placed on an iron triangular stand. A parabolic curved dish [13] is placed on the top of the triangular stand. On the surface of parabolic dish mirror strips are stitched. Mirrors are used to reflect the solar radiation on a distillation device [11]. A distillation device is placed on a face of dish. A distillation device is use for collect the impure water. Device is affix at focal point from parabolic dish. Focal point is the point where the solar radiation is concentrate at a single point to approach a higher heat point. From the use of parabolic curved dish get a focal point. This focal point increase a temperature four times more than environment temperature. Parabolic dish is made with press machine, hence no defects in manufacturing point of view.

Spherical receiver [10] is used as black body cavity in it for reduction in reflection losses .But in this system use the spherical receiver is hollow empty bowl. In spherical receiver provide one hole to enter the sun radiation inside of it. Spherical receiver have two parts joint together to open and close purpose. The two pieces are joint together with wood panel. An Aluminum foil paper is used as cavity. An aluminum foil is fix inside surface of spherical device .To this foil the solar radiation is reflected inside spherical receiver.

Into the spherical receiver, distillation device [11] is placed. This device is use for heat and vaporize purpose of impure water. In this system distillation device is made from aluminum. Aluminum is easily gain heat than other materials so distillation device is made from the Aluminum metal. On the top surface of the distillation device a hole is provide. When the heat gain by impure water the water causes heat and change the face liquid to vapor form.Vapour is less density than water so it's collect in top portion of the distillation device.
A copper tube [5] is provided to collect a vapor .A copper tube is fit on the hole of distillation device. This copper tube is goes outside from another hole of spherical device to condenser [6].in condenser the collected vapor is condense and cool down and change face vapor to liquid by inlet cold water [7] and outlet [8] in condenser. This condense water is a pure water.

To increase efficiency, providing a 2-axis solar tracking system.2-axis solar tracking system is the most accurate tracking system. From this tracking system get the solar radiation continue at 9:00 AM to 6:00 PM. One axis is track the sun horizontal axis and second axis is vertical axis. A solar tracking system is operate with a motor [9] and gear wheel [16] for horizontal axis. A vertical axis is track with worm wheel gear mechanism [17] with a 12V rechargeable battery. To track the sun, providing 4 photo voltaic diodes [15] placed on the shadow plates [14] on the top of parabolic dish. To rotate a triangular base of the dish, provided a wooden circular board [3] to rotate the system easily by using bearing plate [2] under the wooden board.

IV. THEORETICAL OUTCOME

Input Parameters:

Use of input	Input value
Vadodara Latitude	22°17′57″ N
Vadodara Longitude	73°12′29″ E
Solar Constant	1367 W/m^2
Exact radiation as per day of April	1322 W/m^2
Exact radiation as per day May	1328 W/m^2
solar radiation reflected	30%
solar radiation absorbed by atmosphere	17%
solar radiation reach the earth surface	53%
Reflection losses	10%

1) Exact radiation as per day Gon= Gsc [1+.033*cos(360*$\frac{n}{365}$)]

2) Extra-terrestrial Radiation:- Go= Gon cos θz

3) Solar incident radiation on earth
4) Direct incident radiation= GE = Gsc * .53
5) Diffuse Radiation= .22 * 711
6) Total radiation= Direct incident radiation + Diffuse Radiation
7) Projected area= A*Radiation
8) Reflection losses = 10%
9) Radiation incident on sphere hole= 0.90 * Projected area
10) Temperature inside sphere = Q= $\varepsilon\sigma AT^4$

11) Effectiveness of the model = $\frac{Practical\ Temperature\ Gain}{Theoretical\ Temperature\ Gain}$

Result Table:

Result name	Result value
Area of the Parabolic dish	0.348m^2
Direct incident radiation	711 W/m^2
Diffuse Radiation	156 W/m^2
Total radiation	867 W/m^2
Projected area	302 W
Reflection losses	10%
Radiation incident on sphere hole	271W
Temperature inside sphere	208^o C
Temperature inside sphere(practical)	130^o C
Effectiveness of the model	62.55%

V. CONCLUSION

Based on the theoretical outcome, the inside temperature of the spherical receiver (208o C) is more than practical result. But, because of the losses that are considered in the calculation, the temperature inside sphere is considerable. To gain more heat in the distillation device, different types of materials gives different results and we can get more effectiveness greater than 62.5% of the system.

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