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DESIGN OF CONCENTRIC SOLAR WATER DISTILLATOR

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ABSTRACT:

Distillation is one of many processes available for water purification, and sunlight has heat energy that can be used to power that process. Sunlight has advantage of zero fuel cost but it available in attuned format so requires larger collector areas i.e. absorber surfaces due to this it becomes costlier equipment. It is misnomer that for distillation we need to boil water actually simply elevating its temperature, short of boiling will adequately increase the evaporation rate. In fact, although vigorous boiling hastens the distillation process it also can force unwanted residue into the distillate, defeating purification. To boil water with sunlight requires more costly apparatus than is needed to distill it little more slowly without boiling. Different levels of purification can be achieved with this equipment which can be used for sterilized water for medical uses. Purification of heavy water in dissolved salts differs from purification of water that has been dirtied by other chemicals processes.

KEYWORDS:Radiation,Absorber,Concentrated solar power (CSP),Solar desalination unit. PTC solar absorber, solar equipment design.

I. INTRODUCTION:

There are many methods of converting brackish water into potable water. Among the processes which are now commercially employed, the distillation of brackish or seawaters is considered to be one of the simplest and widely adopted technique for converting salted water to fresh water. In this method, the water is evaporated using thermal energy and the resulting steam is collected and condensed as final product. Several research results were published where heat transfer coefficients are calculated theoretically.

A. PROBLEM DEFINITION:

Today clean and pure water for drinking is basic need as pure and clean water has become scarce. Drinking water has to be pure as it directly reflects on individual's health. There are many options available in market as a water purifier but many of them require electricity, chemical processes which becomes difficult and costlier and energy dependent while considering to use at rural places. Solar energy is harmless, pollution free, free of cost and amply available which motivates us to use solar energy for water distillation.[4],[1]

B. STEPS INVOLVED IN WORK:

Major topics covered in this project are:
Study and understand various solar collectors.
Study and understand the configuration of various solar panels and materials for insulation. Study and understand the meaning of radiation, conduction and convection that get develop in solar distillator. Understand basics of

construction of solar distillator. Mechanical design will be covering the following components.

1. Absorber pipe
2. Glass pipe
3. Inlet and Outlet tank
4. Piping system
5. Supports

Design of concentric solar collector by considering local geometry of Karjat, Raigad, Maharashtra, India

Actually manufacturing of designed solar equipment.

II) CONSTRUCTIONAL DETAILS OF SOLAR STILL:

A local solar geometry of location Karjat, Raigad, Maharashtra has been considered along with solar radiation available, wind velocity which will contribute to heat transfer during evaporation of water i.e. effect on radiation and convection also effect on cooling i.e. condensation of evaporated water, material properties like thermal conductivity, insulation etc. which leads to the following parameters [2]

Table 1: the constructional details of solar still

Parameters	Dimensions
Diameter of concentrator	1.1584 m
Diameter of absorber	0.04 and 0.044 m
Diameter of glass pipe	0.044 and 0.052 m
Length of pipe	3.44 m
Focal length	0.3450 m
Capacity of inlet tank	5 L
Capacity of outlet tank	5 L

A) ASSEMBLING AND MANUFACTURE:

Fabrication of the whole unit is pretty straight forward and involves metal cutting, fitting, glass cutting, sealing, painting and drilling. All these processes done at local workshop in khopoli using simple tools like – cutting machine, hammer, hacksaw, spare etc.

The steps in the process of assembling are outlined as follows:

1. The structure will be fabricated first. It will be made of wood and will be colored with metallic black.
2. The stages will be fabricated second the concentrator will be made at the time of Fabrication. It made up of GI sheet and fitted at both end to the wooden structure.
3. The absorber tubes and glass pipe are then made and attached to the centre of aperture.
4. Then elbows, tee, pipe are arranged properly so that it get connected from inlet tank to glass pipe. Then connect tee to distilled water tank.
5. The whole system is sealed using sealant to prevent the air from leaking in from the Atmosphere.

Figure 1: solar water distillator

B) USER'S GUIDELINES:

The usage will involve following steps:-

1. The user will fill the reservoir tank with water that needs to be purified.
2. Attach the pipe for collecting the purified water.
3. Then he will lift the whole device up a few Meters above the ground (around 2.5 m).This will ensure no shadows fall on the apparatus during any part of the day.
4. Leave it there till evening.
5. Remove the purified water for use.
6. Ready for use on the next day.[2]

C) MAINTENANCE:

1. The only maintenance that the device requires is replacement of the glass pipe in case of accidental breakage.
2. Daily cleaning of the plates is required.

D) COST ANALYSIS:

Table 2: The cost analysis of solar still.

Sr.no.	Material	Quantity	Cost
1	Wood	72 square feet	500/-
2	Nicrome pipe	7 feet	375/-
3	Glass pipe	7 feet	375/-
4	GI sheet	24 square feet	430/-
5	PVC pipe	7 feet	300/-
6	T section and elbows	2 pic	100/-
7	Stop valve	2 pic	100/-
8	Nails	30 pic	10/-
9	Inlet and outlet tank	2 pic	50/-
	Total		2240/-

III) RESULTS AND DISCUSSIONS:

Experiment is performed from 9:00am to 05:00pm in summer season.

1. READINGS TAKEN FOR STILL:

We have conducted the experiment by pouring water into the equipment through inlet tank at 9 am and noted the temperature of water in equipment at interval of

one hour the readings and graphical representation as follows:

Table 3: The reading taken for solar still.

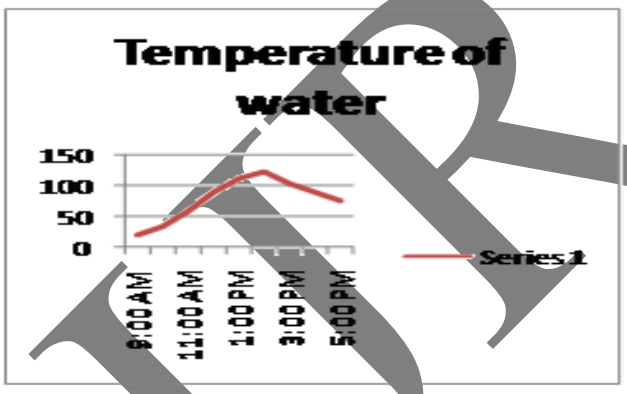
Time	Temp. of water
9 am	20^0c
10 am	35^0c
11 am	58^0c
12 pm	89^0c
1 pm	109^0c
2 pm	121^0c
3 pm	101^0c
4 pm	87^0c
5 pm	75^0c

2. OBSERVATIONS:

1) Time taken for drop to come to channel = 1hr
2) Time taken for drop to come out of channel = 0.5 hr
3) Amount of brackish water poured initially = 4 ltr
4) Amount of pure water obtained at the end of the exp. = 2 ltr
5) Temperature of the condensate = 300c
6) TDS of purified water = 81 ppm

3. GRAPH:

Represents the temperature variation in the solar still during eight hours. The maximum temperature in the system is of 1150c obtained at 01:30pm.



Graph 1: Temperature Variation in Solar Still.

4. EFFICIENCY OF STILL:

The theoretically obtained amount of pure water = 2 litre.
The practically obtained amount of pure water = 1.5 litre.
Efficiency= (actual amount of pure water)/ (theoretical amount of pure water)*100 = (1.5 / 2) *100 = 75 %

IV) CONCLUSION:

There is an urgent need for clean potable water in many parts of our nation including Karjat. While most urban populations have access to clean potable water, many people in rural areas do not. There are many ways that can be used to improve the quality of water and one way is through distillation. A number of methods that utilize sources of energy other than solar are used to purify water to (be safe for drinking). Our study found that painting the internal surfaces of the walls of the still white improves the distillate output of the still. 1:30 pm. then the temperature decreases. The aim of our experiment was to get pure water from the experiment was carried out in summer season. The TDS level of purified water obtained is 81 PPM and standard is below 250 PPM.[3] So the water obtained is potable. Theoretically, the experiment should fetch out 2 litres. So the efficiency of the system is 75%. brackish water available. The brackish water we have supplied was 4 litres and at the end of the experiment we got 1.5 litres. The From the graph 1, we can conclude that the increase in temperature and hence the evaporation is maximum in the period of 11:15 am to 1:30 pm. The maximum temperature achieved is 115^0c which is at 1:30 pm. then the temperature decreases. The aim of our experiment was to get pure water from the brackish water available. The brackish water we have supplied was 4 litres and at the end of the experiment we got 1.5 litres. The experiment was carried out in summer season. The TDS level of purified water obtained is 81 PPM and standard is below 250 PPM.[3] So the water obtained is potable. Theoretically, the experiment should fetch out 2 litres. So the efficiency of the system is 75%.

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