

LOW-COST DISTILLED WATER PRODUCTION FOR AUTOMOBILE WORKSHOPS

¹Prof. Mudit Saxena, ²Rahul Mishra, ³Harshil Thakar, ⁴Ajay Patel, ⁵Apurva Pandey

¹Professor, Department of Mechanical Engineering, IITE, INDUS UNIVERSITY, Ahmedabad, India

²⁻⁵Students, Department of Mechanical Engineering, IITE, INDUS UNIVERSITY, Ahmedabad, India

Abstract - The goal of the water distiller project is to provide purified water to all hospitals and laboratories for daily use. As per WHO standards, purified water is a great necessity in these facilities for DNA sequencing, protein research, among others. Available water is not always clean because it is transported through pipes and can get into contact with organisms thereby causing the spread of waterborne diseases. Water distillation processes remove 99.9% of contaminants and water chemicals like fluorine and calcium to produce pure water. For every use, the distiller mechanism uses an electric current as the source of energy which is run into a heating element located in the contaminated water (in the boiler) through transferring heat, causing it to boil to steam. The evaporated water (steam) leaves behind 99.9% of the contaminants in the boiler producing mostly uncontaminated vapor. The steam created then enters into the condensing coil where heat transfer takes place and the result is purified water which is directed to the storage container. To construct the distiller unit, individual parts components are first developed in SolidWorks drawings and then assembled based on design calculations and dimensions. Purchased and manufactured parts are then assembled to a complete distiller unit. The system is designed to efficiently transmit heat to the water, heating it to steam thereby providing 1 pint of purified water per hour. All components of the unit are cost efficient making it affordable to everyone. The machine is easy to operate and requires minimal maintenance.

Index Terms - Distilled water, Solar Hybrid, Cost Effective, Equipment Used, Performance of Distiller, Eco Friendly

I. INTRODUCTION

In automobile workshops the water used in battery is very expensive to buy so we decide manufacture a plant to produce affordable and quality distilled water. To provide pure and quality distilled water at low cost. It is also useful in other field. Distilled water is water that has been boiled into vapor and condensed back into liquid in a separate container. Impurities in the original water that do not boil below or near the boiling point of water remain in the original container. Therefore, distilled water is one type of purified water. Distilled water is a type of purified water that has had both contaminants and minerals removed. The demand for distilled water required for battery charging is of considerable value. Preparation of distilled water for battery charging seems to be one of the most prospective venture in

small cities. Distilled water is a more specialized type of purified water, but much easier and cheaper to produce at home. Purified water has had chemicals and contaminants removed, but it may still contain minerals. Distillation boils the water, and then condenses the steam back into a liquid to remove impurities and minerals. Cost is one of the main reasons why few bottlers use distillation. The major cost factor is equipment used. The cost of energy required to heat the water to boiling in the distillation process has made even the cost of producing a gallon of distilled water a lot more expensive. In distilled water plant electricity cost is very high. HYBRID SOLAR & ELECTRICITY to produce distilled water at low cost. Hybrid solar is system that uses both solar and grid electricity whenever it needs. This project is based on hybrid of solar and electricity. It will lower the cost and will be eco-friendly.

II. WHY IT IS IMPORTANT TO BUILD IT.

In current scenario we all are generally depend on the automobile Vehicle and We also uses Inverter for electricity. And we know in Inverter battery and automobile battery uses Distilled water which is highly costly. Due to high cost of distilled water the cost of whole battery and chemical cosmetic product goes high.

So, our aim is to reduce the cost and make the distilled water generation plant successfully at optimum cost.

III. OBJECTIVE OF THIS PROJECT

These are the following Necessary objective of our project which is needed to be completed Successfully completion of our project:-

- To Setup up a Water Distillation plant Prototype Successfully
- To achieve Distilled Water through this plant system.
- To achieve Distilled Water At low cost.
- To Distilled water with the help of Solar Energy and Convention energy source like battery.

3.1 Scope of this Project

Here is some necessary point which will Discussed our project scope:

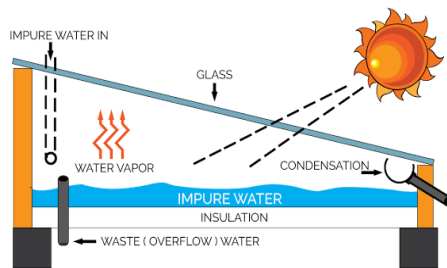
- It will be Reduce the Cost of Distilled water.

- It will reduce the overall cost of Automobile Battery and Inverter battery etc.
- It will Help in Research to find some path to invention some new ideas to increase distilled water quality at low cost.

3.2 Constraints

The constraint of Distilled water is given below.

- Lack of Taste. When all the minerals are removed from the water, it could leave it tasting flat.
- Impaired Metabolism.
- Mineral Replacement Failure.
- Changes to Mineral, Electrolyte, and pH Levels of Tissues and Blood.



- Environmental Effects.
- Possible Contamination.

Fig 1. Old Method

IV. LITERATURE SURVEY

International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 7, Issue 1, January 2018. The hybrid system will bring enormous benefit to the rural and remote areas of India where there is severe crisis of reliable supply of electricity. The study clearly shows that the optimized wind-PV-diesel hybrid system is more cost effective in terms of Cost. The system will reduce the CO2 emission by several percentage thus bringing a local as well as a global carbon benefit. The potential of the system will promote socio-economic development to the local people by getting longer hours of electricity supply after sunset which will help the students to study more as well as local businessman to earn more.

A Review Paper on Hybrid Power System with Different Controllers and Tracking Methods by Dr. Ashok Kumar Pandey Associate Professor Department of Electrical Engineering Madan Mohan Malviya University of Technology Gorakhpur . In this paper review of the power quality improvement of hybrid power system is discussed. By using various

types of FACTS devices. The Fuzzy logic controller is used for controlling the power in system and by making system stable.

Demand Management Centre of Expertise, Eskom Research, Testing, and Development, Private Bag X40175, Cleveland, 2022, South Africa This research sought to investigate the impact of scale formation due to total water hardness on the power consumption of hot water technologies such as geyser heating elements. In this research it was shown that scale formation of heating elements increased power consumption by approximately 4% to 12%, depending on the type of material of the heating element and scale formation layer. Moreover, it was found that scaling altered the set temperature of thermostats, ultimately having an impact on the overall performance of heating elements.

Njunge, Duncan, "Laboratory Water Distiller project" (2019). All Undergraduate Projects . 111. <https://digitalcommons.cwu.edu/undergradproj/111> The allocated time for this test was approximately 3.5 hours. This is because the test involved 3 trials with each trial taking approximately an hour. The remaining time was used to set up the test and data recording. The allocated time for this test was 1.5 hours. The test involved 1 trial taking approximately one hour and the remaining 30 minutes was used for set-up, electrical energy calculation and data recording. he allocated time for this test was 30 minutes. The test involved determining the weight of the unit, dimensions and data recording.

The research was done on a numerical simulation of solar distillation for installation in Chabahar Iran by Masoud Afrand, Amin Behzadmehr and Arash Karimipour[13]. They presented a theoretical study of solar distillation in a single basin under open environment of Iran. They inclined glass cover at 25 degree. They computed the temperature of glass cover, seawater interface, moist air and bottom using numerical method. Calculate still productivity in July was higher than December scented. They estimated maximum output in the month of March and April.

A theoretical analysis of water distillation using solar still was researched by D.W Medugu and L.G Ndatuwong at department of physics, Adamawa state University, Mubi -Nigeria[15]. They did theoretical analysis of heat and mass transfer mechanisms inside the still. They experimented on distillation performance of the solar still. Their system had distillation efficiency of 99.67% as compared to the theoretical analysis.

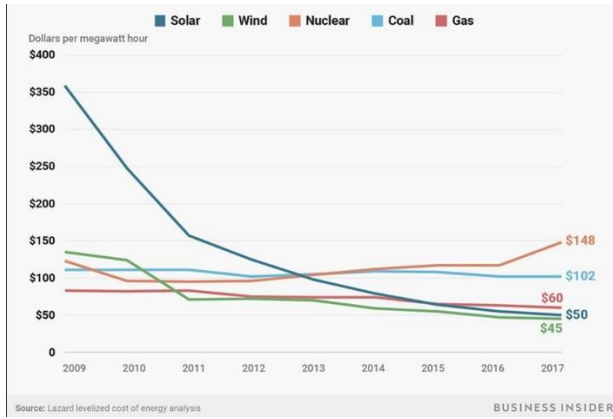


Fig.2 Solar Energy Cost

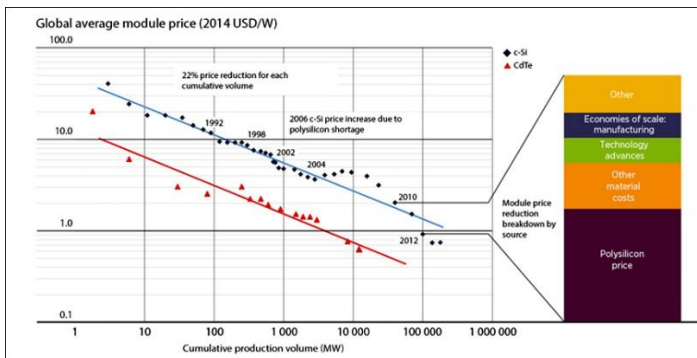


Fig 3. Cadmium Telluride Vs. Crystalline Silicon

V. CONSTRUCTIONAL DETAILS

5.1 Selection of Materials

Sr. No.	Part Name	Material Specification	Reasons
1	Solar Panel	Poly-Crystalline Silicone	Low cost Low Maintenance Max Output Lower Heat Tolerance
2	Battery	12V 80Amp	Runs the Distiller for 1hr 30mins
3	Heating Element (500W)	Copper	Thermal conductivity of copper is better. Good Corrosion Resistance
4	Boiling Chamber	Stainless Steel	Resistance to corrosion - Durability - Good thermal conductivity - Good ductility - Good machinability - Resistant to chemical attack
5	Water Tank	Plastic	Light weight
6	Condenser	Copper	Thermal conductivity. Corrosion resistance.

VI. BASIC DESIGN CONCEPT

For better understanding of different parts of our project firstly we prepared sketches on paper. So, we can understand different component of our project and get idea how we will make the project model.

VII. DESIGN IN PARAMETRIC SOFTWARE

For design of final product, we made a 3d model in SOLIDWORKS software, in which we made different individual component and the put all components together.

For production of any machine, it is important to make individual parts with the desired dimensions. Then we should assemble the to make the final machine.

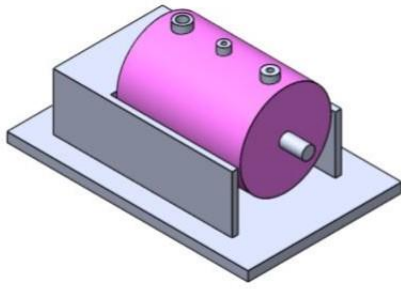


Fig 4. Boiling Chamber

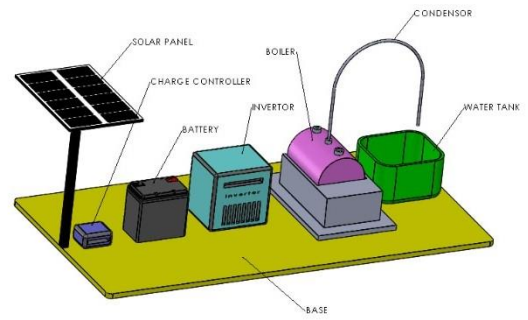


Fig 4. Final Assembly

VIII. WORKING MODEL

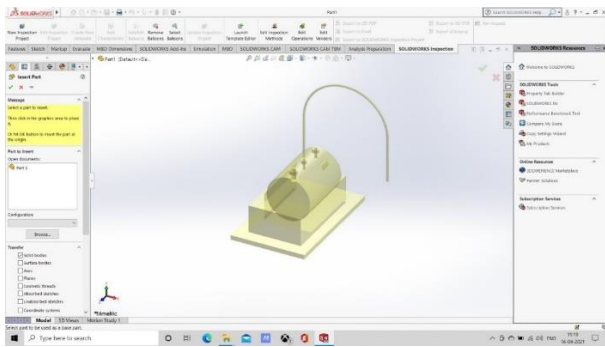


Fig 5. Boiling Chamber with condenser

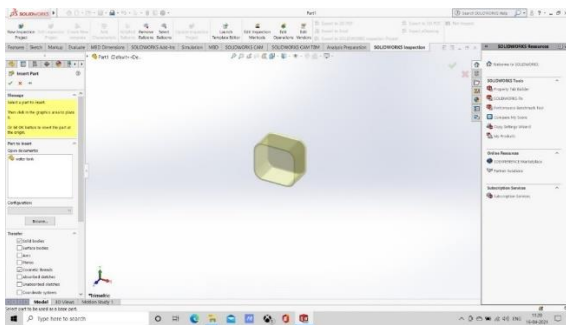


Fig 4. Side view of Storage Tank

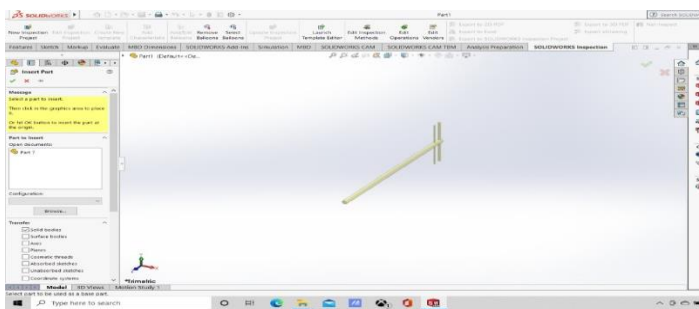
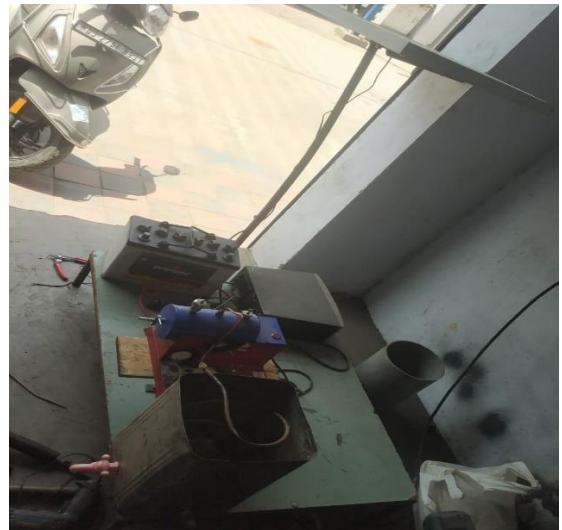


Fig 4. Solar Stand



IX. CALCULATIONS

Required Heat Transfer energy

$$Q_t = E_1 + E_2$$

E1 = Energy required to boil the water

E2 = Energy required for vapor

transfer

$$E_1 = m(C_p)(\Delta T)$$

$$= m(C_p)(T_2 - T_1)$$

Cp = specific heat = 4.2 KJ/KG.K

M = Mass of water

T2 = Boiling Temperature of water

$$= 100^\circ\text{C}$$

T1 = Surface Temperature

$$= 24^\circ\text{C}$$

$$E_1 = 1 \times 4.2 (100 - 25)$$

$$= 315 \text{ KJ/KG}$$

$$E_2 = m(H_g - H_p)$$

$$= 0.7 \times (2675 - 417.5)$$

$$= 1580.25 \text{ KJ/KG}$$

Hg = Saturated Vapor Energy = 2675 KJ/KG

Hp = Saturated Liquid Energy = 417.5 KJ/KG

$$E_2 = 1 \text{ kg} \times (2675 - 417.5)$$

$$= 2257.5 \text{ KJ/KG}$$

$$Q_{\text{total}} = E_1 + E_2$$

$$= (315 + 2257.5)$$

$$= 2572.5$$

Required Power/ Demand per hour

$$Q_{\text{total}} = 2572.5 \text{ KJ/KG}$$

Max power required per hour for the unit.

$$2572.5 \text{ KJ/Kg} (1 \text{ hr} / 3600 \text{ sec}) (1000 \text{ s/Kg})$$

$$= 714 \text{ Watt on higher side}$$

With 714 watt max current draw

$$V = 12 \text{ v}$$

$$P = IV$$

$$V = 12 \text{ V}$$

$$I = 59.5 \text{ amp}$$

For this we required 59.5 amp. For that we have used 12V & 80amp battery

Heater Unit Conversion Efficiency

Heater is predicted to have efficiency of 90%.

This means it is able to utilize 90% of incoming heat energy heat water to steam.

$$\text{Predicted Qutilized} = \text{energy input} \times \text{efficiency}$$

$$= 2572.5 \text{ KJ/KG} \times 90 / 100$$

$$= 2315.25$$

X. COST ANALYSIS

10.1 COST OF MATERIALS

Sr. No	Material Name	Cost
01.	Water heater	2500
02	Solar panel	5000
03 .	Battery	5000
04 .	Inverter	4500
05 .	Wire Cable	300
06.	Boiling Chamber	1500
07.	Other Accessories	1500
Total cost	Rs.20300 /-	

X. CONCLUSION

The main reason for this project is to put vast engineering knowledge and skills gained from Mechanical Engineering Course into application of solving problems. Nowadays the cost of distilled water is very high. So, to deal with this problem we built a water distillation unit which will be running with solar-hybrid and will provide enough energy to heat the water into steam.

Analysis

- Determine required heat transfer energy, Q total
- Determine required power demand per hour
- Determine heater unit: conversion efficiency
- Cooler materials: heat transfer specifications
- Material selection

This analysis will give the success of this project by calculating the energy require to convert the water into steam. With known energy, power demand per hour and current required in the circuit are determined. The design of the distiller unit has eventually succeeded although numerous challenges have emerged resulting to design change. Some of the design calculations has been adjusted to fit the new design calculations which have led to a successfully construct a working distiller unit.

REFERENCES

- [1] Prof. Alpesh Mehta, Arjun Vyas, Nitin Bodar and Dharmesh Lathiya "Design of Solar Distillation System" International Journal of Advanced Science and Technology Vol. 29, April 2011.
- [2] Pankaj Kalita, Anupam Dewan and Sangeeta Borah "A review on recent developments in solar distillation units" Indian Academy of Sciences Sadhana Vol. 41, No. 2, February 2016.
- [3] Masoud Afrand, Amin Behzadmehr and Arash Karimipour "A Numerical Simulation of Solar Distillation for Installation in Chabahar-Iran" World

Academy of Science, Engineering and Technology,
International

- [4] Md. Zargistalukder, Avizitbasak Foisal, Ahmed Siddique and Dr. Mohd. Rfiqulalambeg “Design And Performance Evaluation Of Solar Water Distillation Plant” Global Journal Of Researches In Engineering General Engineering Vol.13 Issue 1 Version 1.0 Year 2013.
- [5] Cengel, Cimbala & Turner Fundamental of Thermal Fluid Sciences,5th Edition McGraw Hill, Education.
- [6] Beer, Johnson, DeWolf and Mazurek: Mechanical of Materials, 7th Edition McGraw Hill Education.
- [7] Anwarul Islam Sifat and Md. Milon Uddin “Water Distillation Method Using Solar Power” International Conference on Mechanical Engineering and Renewable Energy 2015 (ICMERE 2015) 26-29 November,2015, Chittagong, Bangladesh.