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# Water Purification by Solar Energy under natural circulation mode

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**Abstract -** *The motivation for this project is the limited availability of clean water resources and the abundance of impure water available for potential conversion into potable water. Our project goal is to efficiently produce clean drinkable water from solar energy conversion. To achieve this goal, a system was designed incorporating a parabolic solar trough coupled with a custom designed distillation device. The incoming solar radiation from the sun is focused and concentrated onto a receiver pipe using a parabolic trough, heating the incoming impure water, at which point it is sprayed into our custom designed distillation device where it evaporates and is re-condensed into pure potable water. Future goals for this project include calculation refinement, material research/testing, and fabrication.*

***Key Words*: parabolic solar trough, *potable water*, *solar radiation*, *distillation* , *solar energy conversion***

## 1.INTRODUCTION

Water is a basic necessity of man along with food and air. Fresh water resources usually available are rivers, lakes and underground water reservoirs. About 71% of the planet is covered in water, yet of all of that 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps and 0.001% in the air as vapor and clouds, Only 2.5% of the Earth's water is freshwater and 98.8% of that water is in ice and groundwater. Less than1% of all freshwater is in rivers, lakes and the atmosphere.
Distillation is one of many processes available for water purification, and sunlight is one of several forms of heat energy that can be used to power that process. To dispel a common belief, it is not necessary to boil water to distill it. 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.

Solar Distillation is by far the most reliable, least costly method of 99.9% true purification of most types of contaminated water especially in developing nations where fuel is scarce or too expensive. Solar distillation is used to produce drinking water or to produce pure water for lead acid batteries, laboratories, hospitals and in producing commercial products such as rose water. Conventional boiling distillation consumes three kilowatts of energy for every gallon of water, while solar distillation uses only the free pure power of the sun. Expensive filtration and deionizing systems are even more expensive to purchase and use and will not totally purify the water by removing all contaminants. No additional heat or electrical energy is required in our still and even after the sun sets, distillation continues at a slower pace into the night.

## 2. LITERATURE REVIEW

Experimental Verification and Analysis of Solar Parabolic Collector for Water Distillation by Mr. Mohd. Rizwan , Mr. Md. Abdul Raheem Junaidi The paper is concerned with an experimental study of parabolic trough collector with its sun tracking system designed and manufactured to facilitate rapid diffusion and widespread use of solar energy. The paper focuses on use of alternative source of energy (through suns radiation) which is easy to install, operate and maintain.The development of a solar thermal water purification, heating, and power generation system: A case study.by Jerome E. Johnson Water was the working fluid and was pumped from a reservoir to an array of 2- 4 foot by 8 foot parabolic solar troughs. A flow control valve adjustable for temperature and pressure, allowed the pressure within the troughs to build, thus increasing the boiling point of the water. At a temperature greater than 100 degrees Celsius, a saturated liquid stream passed through the valve into a vessel that was positioned at the focal point of sunlight within an 8 foot, 9 inch parabolic dish. The flash evaporation occurred, caused by a reduction in pressure on the downstream side of the flow control valve.

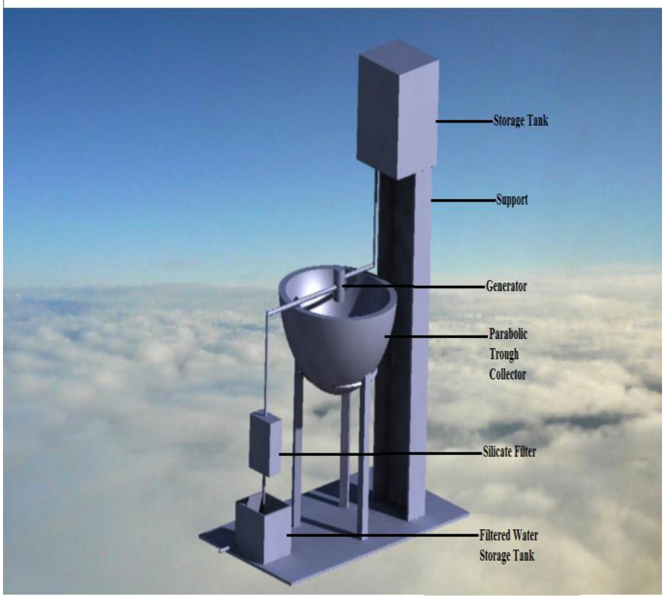
## 3. OBJECTIVE

1. Efficiently produce at 2 gallons of potable water per day minimum

2. Able to purify water from virtually any source, included the ocean
3. Relatively inexpensive to remain accessible to a wide range of audiences
4. Easy to use interface
5. Intuitive setup and operation
6. Provide clean useful drinking water without the need for an external energy source
7. Reasonably compact and portable

Our aim is to accomplish this goal by utilizing and converting the incoming radioactive power of the sun's rays to heat and distill dirty and undrinkable water, converting it into clean drinkable water. A solar parabolic trough is utilized to effectively concentrate and increase the solid angle of incoming beam radiation, increasing the efficiency of the system and enabling higher water temperatures to be achieved

## 4. CAD Model




## 5. Working Of Parts

### 5.1 Parabolic Trough Collector

A parabolic dish collector is similar in appearance to a large satellite dish, but has mirror-like reflectors and an absorber at the focal point. It uses a dual axis sun tracker. A parabolic dish system uses a computer to track the sun and concentrate the sun's rays onto a receiver located at the focal point in front of the dish. In some systems, a heat engine, such as a Stirling engine, is linked to the receiver to generate electricity. Parabolic dish systems can reach 1000 °C at the receiver, and achieve the highest efficiencies for converting solar energy to electricity in the small-power capacity range.

### 5.2 Silicates

Laboratory and field experience has shown that silicate corrosion inhibitors are effective in many different types of water. Protection is provided in both acidic and alkaline water. In harder water slightly more silicate is needed to achieve the same degree of corrosion inhibition, since some of the injected silica may react with hardness ions before it has a chance to bond on to metal surfaces. Soluble silicates are economical, effective, and environmentally responsible chemicals which have been used for more than 70 years to protect metals from the corrosive effects of water.1 They are classified as corrosion inhibitors because they can deposit protective films onto various metal surfaces, isolating the metal from any further corrosive attack, and because they raise water pH which can make it less corrosive to metals. Silicates do not contribute zinc or phosphorous to treated water. These soluble silicates are produced by fusing high purity silica sand and sodium carbonate (or potassium carbonate) at temperatures of 1000 - 1500oC. The resulting product is an amorphous glass that can be dissolved in water to produce silicate solutions, sometimes referred to as "waterglass." The silicain a silicate solution is present as both monomeric and polymeric anionicspecies that exist in equilibrium with each other.2Ratio and silicate concentration are two important factors that influence what species are present in solution. At concentrations typical for corrosion control,the silica monomer predominates. The proportion of silica to alkali in a sodium silicate is expressed as the weight ratio $SiO2/Na2O$. It is one of the main characteristics that influences product properties and distinguishes one product from another. PQ manufactures liquid sodium silicates which range in ratio from 1.60 to 3.22. Typically, 2.00 or 3.22 ratio sodium silicate solutions, containing 25 to 30% $SiO2$, are used for municipal water treatment.

## 6. CONCLUSIONS

Complete and satisfactory working was achieved using the parabolic trough collector under conditions of strong continuous sunlight or of intermittently sunny/cloudy conditions. However, completely overcast conditions accompanied by periods of rainfall may result in incomplete inactivation even after 2 days exposure. The exposure time required to obtain fully treated water (safe drinking water) with use of the collector does not depend on seasons but on daily weather conditions. The use of this technology is suitable for treating drinking water both at household level and institutional level in any climates if careful consideration of the cloud cover and rainfall is taken into account.

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