

# Design and Fabrication of Desalination Plant

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**Abstract** – In today's times millions of people face water shortage crisis on daily basis. Still almost half of world's population live within 50-100 kms of coasts, hence in such cases desalination of water for household use can be one of the best solutions to water scarcity problems. The existing desalination technologies are based on non-renewable energy sources which are not sustainable in mere future. At the same time, the facilities are not accessible by the people staying in rural areas. Another reason is facilities are expensive when comes to initial capital and maintenance costs. Thus, majority of population can't afford a proper means of water purification system in their households. To combat such problems like impure water and lack of inexpensive water treatment plants we have decided to make the use of solar energy for desalination of water.

**Key Words:** Desalination, Non-renewable energy sources, Solar energy, Cost efficient, Green Energy, Parabolic trough.

## 1. INTRODUCTION

Research by the World Health Organization in 2007 revealed that 1.1 billion people failed to gain the benefit of enhanced drinking water supply. The study acknowledges that 1.8 million people die every year due to diarrheal disease caused by contaminated water, poor sanitation and hygiene. The report stated that 95 per cent of diarrheal diseases can be prevented only by the consumption of clean water. In many areas, it is very difficult to gain access to clean drinking water.

The two major sources of water are Surface water and Groundwater. Surface water is obtained from the river and freshwater wetland were as Groundwater is collected from the subsurface pore space of soil and rocks. As the water gets polluted due to bacteria and dissolved solids it becomes unsafe. Thus, we need cost-efficient, easy to use and naturally functioning water purifying technology. The process on which we are studying proves to be very much efficient which is called as Desalination.

Desalination is defined as a process in which the salts and impurities from the water are removed and is made fit for consumption also it takes away mineral components from it.

Various methods are used through which desalination is performed. One of those methods is solar distillation. Solar distillation's basic working principle is the purification of water by first evaporating it and then condensing the same using a cool surface.<sup>[7]</sup>

## 2. LITERATURE REVIEW

Studying from research paper of "SciVersa ScienceDirect" titling "Solar Energy for Water Desalination." <sup>[1]</sup> we came to the idea of using Solar energy to achieve our final aim of producing fresh water. We studied various ways to produce potable water with the help of Desalination Technologies. The commonly used technologies are Reverse Osmosis, Multistage Flash Distillation and Multi-Effect Distillation. We also studied that desalination will be a great success in areas which receive a huge intensity of solar radiation. We came to know about various technologies like Concentrating Solar Power (CSP) Technology and Photovoltaic (PV) Technology. We are mainly into Concentrating Solar Power in which Solar radiations are concentrated to obtain desired output. These Technologies include Parabolic trough, Linear Fresnel reflector system and Central Tower receiver. The major point that we studied is that, the solution lies between the combination. Combination which leads to green future and low-cost impact. A Research report on Desalination in Australia by Jomo Kenyatta University of Agriculture and Technology <sup>[2]</sup> brought our attention towards the lack of other sustainable water sources due to the expected expansion of population in future. It highlighted the water scarcity in Australia due to less rainfall which drained most of Australia's water harvesting units. Desalination will be the best option that can help people to reach their domestic, public and industrial demands. According to the research paper by "International Journal of Advanced Information in Engineering Technology" titled as "Design, Fabrication and Working of Solar Distillation System"<sup>[3]</sup> gave us an idea about how actually the system looks and how does it actually works and forced us to think about ways to make it easier. A Paper published by "International Journal of Environment and Sustainability" titled as "Solar Stills for Desalination of Water in Rural Households" enlightened us with various Solar Still techniques that were very easy to construct from

locally available materials, no operation cost and also no hard maintenance. These Solar Stills would have helped the people gain fresh water for their basic needs. These Solar Stills Can be classified into various types such as Horizontal and Inclined Basin Solar stills as well as Regenerative effect, Vertical and Spherical condensing Solar Stills. A paper published by "BioResource and Agricultural Engineering Department California Polytechnic State University" titled as "Design, Construction and Evaluation of a Multi Layered Solar Distillation Prototype" [5] acquainted us with the combination that we were in search of. We studied about unique designs which combined Solar Stills and energy recycling unit, Multi stage Still. From this paper we actually got the idea of our project model. A Model which contained combination of a parabolic trough coupled with condenser unit. A Paper Published by "International Journal for research in Applied Science & Engineering Technology" titled as "Design and Fabrication of Solar Desalination Unit" [6] equipped us with all the necessary terms and fundamentals which we were lacking. The paper provided us the important calculations and terms that should be taken care of.

### 3. PROBLEM DEFINITION

The motivation behind the project was to tackle at least one of the problems faced by a common man regarding his or her daily needs. Water being the essential need of humans is an important natural resource and any solution to solving the problems faced due to water is welcomed and valued by society. Through our project following were the 4 problems that are being tackled which will benefit the society:

#### a. Water Scarcity

Climate change, such as altered weather patterns, deforestation, increase pollution, greenhouse gases and wasteful use of water causes insufficient supply.

#### b. Use of Non-renewable resources

Majority of existing desalination plants uses non-renewable sources such as coal and electricity which causes environmental destruction.

#### c. Marine Disposal

When the waste content of desalination plants are poured into the water it increases the salinity of sea water as well as increases the temperature causing harm to aquatic life such as coral reefs.

#### d. Expensive costing

Most of the desalination plants are expensive and have high maintenance and setup cost. Hence, these benefits are not affordable by developing countries.

### 4. OBJECTIVES

Our primary objective is to construct a device which helps in purification of water by desalinating it using Solar Distillation. Secondly while developing such device we have to make sure that the user is completely capable of utilizing the device to its maximum potential. The user should maintain the device and even repair it when needed. Keeping all the points in mind we have to design and develop the system in such a way that it is easy to use, assemble, and easy to maintain using locally available materials.

The project is primarily aimed at the people whose basic water need aren't being fulfilled and thereby providing them with such device that will benefit them with pure water.

- To produce clean water which can be used not only for drinking purposes but also for other activities like agriculture, daily chores etc.
- To use renewable, safe and green energy in desalination processes.
- To treat the waste produced during desalination, which will help for the betterment of mankind.
- With the help of non-conventional energy resources and some modifications in structure we can minimize the cost.

### 5. WORKING

The contaminated water enters the vacuum tube and reaches the T joint through the float valve. When the vacuum tube gets half-filled the float valve locks of the water inlet. The acrylic mirror sheet is bent in a form of parabolic trough. It is assembled in such a way that the water inside the vacuum tube starts to boil in minutes as the mirror sheet reflects solar radiation and concentrates it on the vacuum tube.

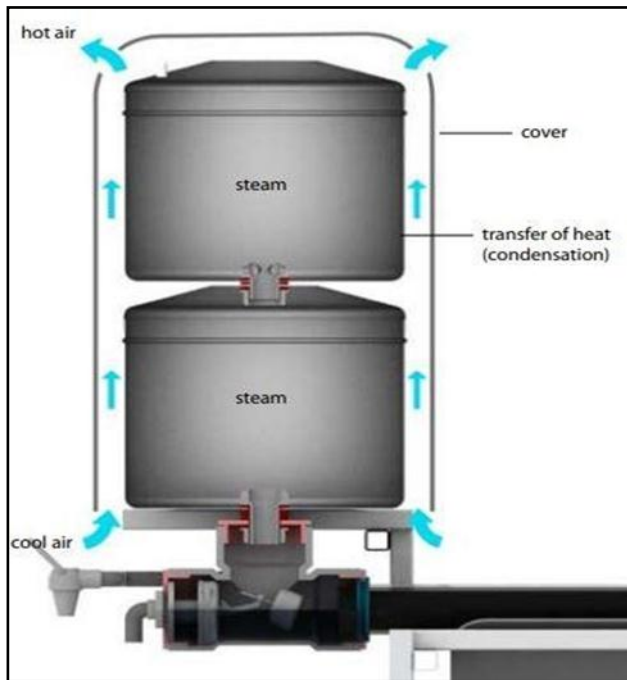


FIG NO. 1: CONDENSATION PROCESS DIAGRAM

Steam is produced inside the tube and it travels from the top of the vacuum tube and reaches the T-joint where condenser is coupled. This steam then travels and enters the steel vessel where condensation takes place as the vessel walls and steam undergoes heat transfer. Thus, resulting into pure distilled water settled on the walls of the vessel. The water then flows downwards and gets filled up. This water can be used by dispensing it from the water dispenser tap. A Shell is present outside the vessel which is open from top and bottom. The bottom opening draws cool air from the atmosphere. The vessel's walls heat up the ambient air which is present inside the shell. The heated air inside the shell gets evacuated as it gets lighter. As the shell is open from the bottom a conventional current is observed which continuously cools down the vessel also called as the Chimney effect.

## 6. CAD MODEL



FIG NO. 2: CAD MODEL OF DESALINATION PLANT

## 7. CONCLUSION

Thus, our project will be able to successfully purify the water by implementing the parabolic trough solar distillation system. Our primary objective of providing clean water in the areas like remote villages and rural areas will be achieved. Moreover, such areas often have interrupted electricity supply and lack resources to provide pure water. Our project will solve those problems as it only uses solar energy for its working which is abundant in nature. We have made our device easy to assemble and maintain or repair which is the most important feature as it makes it easily accessible to majority of population.

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## BIOGRAPHIES



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