



## DESALINATION OF WATER BY USING SOLAR ENERGY

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### ABSTRACT :

Access to easy and secure consuming water is vital for all people. However, in lots of regions, the available water is brackish (salty) or contaminated with dangerous microorganism and viruses, making it dangerous for intake. Clean water is also important in environments which include hospitals, schools, and factories where hygiene is crucial.

One effective method for purifying water is distillation. In this procedure, water is heated till it becomes steam, leaving at the back of salts and impurities. The steam is then cooled and condensed again into smooth, purified water.

This mission utilizes sun strength to energy the distillation technique, making it both price-powerful and environmentally friendly. A specialised tool known as an Evacuated Tube Collector (ETC) is used to take in and keep more warmness from the solar, thereby growing the performance and velocity of the distillation.

To similarly beautify the first-class of the purified water, the system consists of extra additives:

ultrasonic transducer, which aids in the removal of first-rate particles and improves the general purification method.

A UV (ultraviolet) mild, which successfully eliminates any final bacteria and viruses.

This incorporated technique consequences in a sustainable and dependable solution for producing secure consuming water using renewable solar power.

**Keywords:** Solar distillation, solar still, Evacuated Tube Collector

### INTRODUCTION

Water is critical for lifestyles, however it's miles turning into increasingly more polluted due to human sports like industrialization, urbanization, and overuse of groundwater. Currently, much less than 1% of Earth's water is to be had for human intake, and regardless of this, over 1.2 billion humans nonetheless lack access to smooth ingesting water. In many nations, particularly developing international locations like India, groundwater is over-exploited to meet the growing demand of urban populations.

About 50% of the world's population now lives in cities, and nearly half of the mega-towns with populations over 10 million depend closely on ground water. Moreover, many humans, specifically in rural regions, are ignorant of the dangers posed by using waterborne sicknesses that have an effect on their fitness. In India, 70% of infectious sicknesses are because of contaminated water. As groundwater is overused and other sparkling water sources deplete, easy water is turning into harder to find.

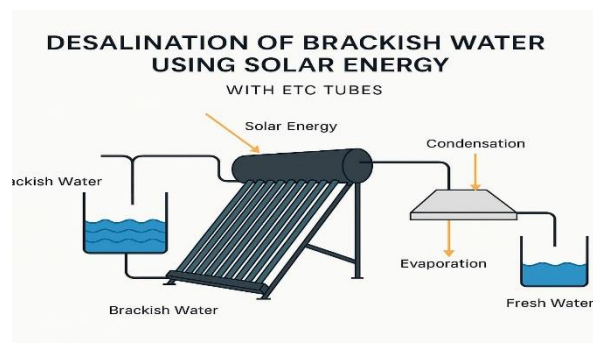
To resolve this problem, sun-powered water purification is a promising solution. India, with its 300 sunny days a yr, has the potential to harness this renewable electricity correctly. Solar strength is smooth, price-powerful, and sustainable. Additionally, we use UV mild to kill bacteria and viruses and an ultrasonic transducer to interrupt down contaminants. This aggregate ensures that water is purified correctly, with out counting on harmful chemical substances or high priced fossil fuels. This system is a important step towards imparting clean consuming water to the ones in need.

For high efficiency the solar nevertheless must preserve: A high feed (undistilled) water temperature

- a. A massive temperature distinction between feed water and condensing floor

A high feed water temperature may be completed if:

- b. A high percentage of incoming radiation is absorbed by means of the feed water as heat.



**Figure 1: Schematic diagram of solar still**

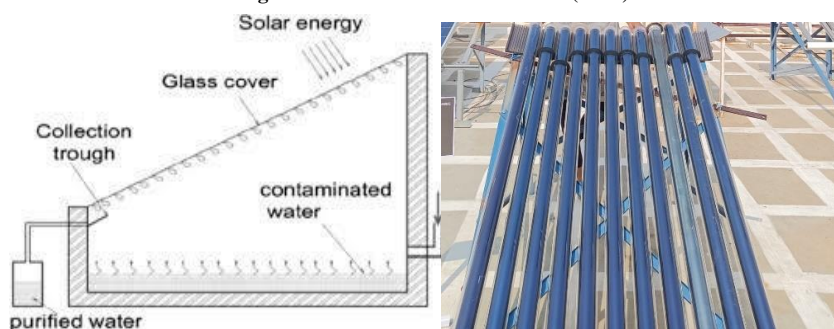
### *Solar Still*

A solar still is a simple and powerful tool used for purifying water via utilising solar electricity. The system works further to the natural water cycle, related to evaporation and condensation. In a solar still, impure water is placed in a basin, and daylight is passed through a glass cover to warm the water. As the water heats up, it evaporates, leaving behind contaminants, salts, and microbes. The vapor then rises and condenses on the inner side of the glass cover, wherein it is amassed as purified water. This manner offers a clean, safe supply of ingesting water by getting rid of dangerous materials.

Solar distillation structures are categorised into passive and active solar stills. In a passive solar still, the water is heated best via the direct solar radiation, that's the sole source of electricity for evaporation. This ends in a lower productivity charge because the evaporation method is slower. The primary problem of a passive solar still is its decrease efficiency.

To overcome this trouble, active solar stills are designed with additional energy enter. In those systems, more thermal power is furnished to the basin, frequently through an Evacuated Tube Collector (ETC), which increases the evaporation charge and improves the general productivity of the still. We use eleven ETC tubes in our device, which drastically enhance the warmth absorption from the solar. This improved heat energy results in a quicker evaporation method, leading to higher water manufacturing. The use of eleven tubes guarantees that the solar still operates more effectively, making it a more reliable and effective solution for purifying water, mainly in regions with restricted water access to easy ingesting water.

**Figure 3: Evacuated Tube Collector (ETC)**



### **Experimental Setup**

A solar water desalination unit was designed, fabricated, and examined between July to April 2025. The setup consisted of a primary solar still coupled with 11 evacuated glass tubes to increase heating performance and improve the production of easy consuming water.

The basin of the solar still was made from mild metallic and painted black on the interior to maximize solar warmth absorption. Hooked up at a 30° tilt angle facing south to capture maximum sunlight during the day. A silicon rubber sealant ensured leak-proof touch between the glass and the steel body.

The device used 11 evacuated tubes, every 160 cm long, with an outer diameter of 5.4 cm and an inner diameter of 4.4 cm. These tubes have been related to a 20-liter water storage tank. The evacuated tubes, made from borosilicate glass, trap heat correctly thanks to the vacuum between the internal and outer layers. Using the thermo-syphon impact, water in the tubes heats up and moves to the basin, whilst cooler water flows into the tubes. This movement will increase the evaporation rate within the solar still.

A float valve maintained a regular water level. As water evaporated, easy vapor condensed on the internal floor of the glass cover and slid down into a set channel, ultimately flowing right into a measuring jar through a pipe.

To reveal system overall performance, temperatures had been recorded every hour the use of thermocouples ( $\pm 1^\circ\text{C}$ ) related to a virtual temperature indicator. Solar radiation turned into measured using a solarimeter. Additionally, the first-rate of the distilled water become assessed the usage of a TDS meter (Total Dissolved Solids). The TDS meter become used to compare the impurity degree of brackish water before distillation and the purity of the amassed water after distillation, confirming effective purification.

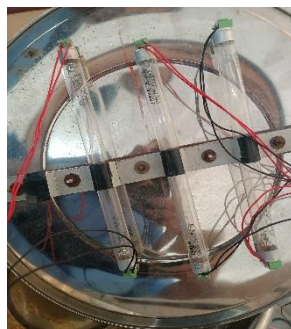
In addition to solar distillation, our setup additionally integrates ultrasonic transducers and UV-C lighting fixtures to decorate the purification technique. We used 5 ultrasonic transducers with strength ratings of 50W to assist ruin down impurities and disrupt the cellular partitions of bacteria and viruses. These transducers perform with the aid of generating high-frequency sound waves inside the variety of 20 kHz to forty kHz, which create microscopic bubbles inside the water. When these bubbles disintegrate, they produce severe power that facilitates in breaking apart contaminants and postponing debris, making the purification process extra powerful.

To make certain entire disinfection, we also added three UV-C lighting fixtures of 254 mm length, which emit ultraviolet rays at 254 nm wavelength. This wavelength is fairly powerful in destroying the DNA and RNA of harmful microorganisms, preventing them from reproducing. The UV-C lighting were located strategically wherein the distilled water is gathered, ensuring that although any microorganism survived the sooner ranges, they're completely neutralized earlier than intake. The aggregate of ultrasonic treatment and UV-C disinfection notably boosts the general water first-rate via concentrated on each physical and organic contaminants. This multi-level purification technique guarantees the water is secure, clean, and fit for consuming.

## MODELING AND ANALYSIS

**Table 1: Design parameters of ETC**

Length	160 cm
Outer diameter	5.4 cm
Inner diameter	4.4 cm
Storage Tank	20 liter
Number of tubes used	11
Transducer	No of 5 and 50 w
Uv light	No of 3 and c type



**Figure 5: UV light**



**Figure 4: Transducer**

## RESULTS AND DISCUSSION

- The temperature at distinct factors of desalination unit is measured after every 1 hour time of day time from 9:00A.M to 4:00 P.M. Various parameters has giant effect on the productivity of still. Basin water temperature and inner glass cowl temperature are the maximum influential parameters at the yield of still.

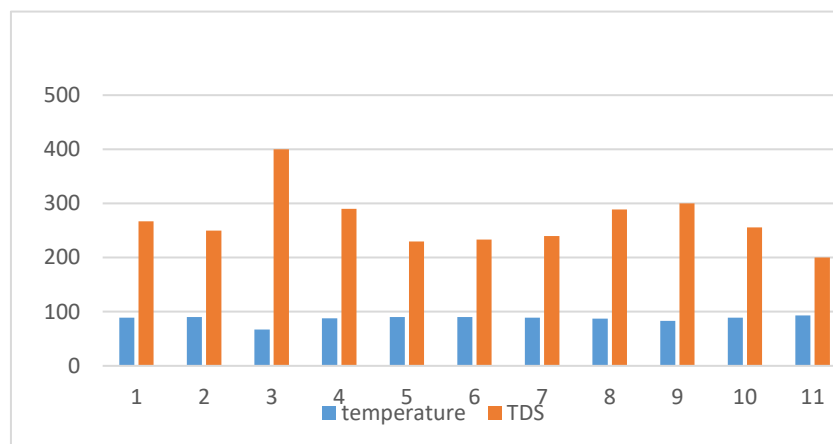
- Besides this, the depth of solar radiation is a key parameter in determining the performance of still. For each experimental case, readings were taken for three consecutive days in order that foremost analyzing may be selected from the 3 to make certain that all parameters are measured beneath most clear sky conditions and to any negative weather circumstance .

To make certain microbial safety, each a UV mild supply and an ultrasonic transducer have been employed. The UV mild disrupts the DNA of bacteria and viruses, while the ultrasonic transducer emits excessive-frequency sound waves that spoil microbial cell systems. Together, these techniques provide effective, chemical-unfastened water sterilization, improving both the quality and safety of the distilled water.

#### Temperature and TDS measurement

At 12 : 00 PM (04-10-2024)

tube	temperature	TDS
1	89	267
2	90	250
3	67	400
4	88	290
5	90	230
6	90	233
7	89	240
8	87	289
9	83	300
10	89	256
11	93	200



#### Temperature and TDS measurement

At 12 : 00 PM (04-10-2024)

## CONCLUSION

A water desalination unit become advanced with the aid of integrating a unmarried-slope, single-basin sun nonetheless with Evacuated Tube Collectors (ETCs) and an ultrasonic transducer to improve performance and water quality. The machine operates at the thermo-syphon principle, where water circulates certainly via the ETCs due to temperature differences—hot water rises, and cold water sinks. The ETCs efficiently soak up and preserve solar electricity due to their vacuum insulation and selective coatings. This increases the water temperature in both the tubes and the basin, improving the evaporation rate and distillate output of the sun still. The thermo-syphon impact become discovered to function effectively, keeping a continuous flow and solid thermal overall performance. To in addition improve the quality of distilled water, an ultrasonic transducer became used to kill bacteria and viruses. It emits excessive-frequency sound waves that disrupt microbial cells, imparting chemical-free water sterilization. This hybrid device is simple, strength-efficient, and value-effective, making it notably suitable for rural and far flung areas with constrained electricity get entry to. The integration of ETCs with ultrasonic sterilization demonstrates a practical and dependable answer for stronger sun desalination.

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