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# Fabrication of Solar Water Purification System using UV Light Filter

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## ABSTRACT

***Every year, around one lakh people die in India because of water-borne diseases. It has been noted that so much groundwater is now unsuitable for drinking purposes due to the excessive concentrations of fluoride and ions, and the water in the environment is also unfitted to drink due to the prevalence of several kinds of bacteria and chemicals since many companies decompose wastewater or industrial waste in rivers and stream reservoirs. The scarcity of water supply has become more apparent as the population grows. The project is motivated by the scarcity of freshwater resources as well as the abundant supply of unclean water available for prospective conversion into potable water. Our project's goal is to convert solar energy into clean, drinkable water as efficiently as possible. Distillation is among the methods that can be used to purify water. This necessitates an energy input, which can be provided by heat, electricity, or solar radiation. Solar water distillation is a process of using solar energy for this reason. Solar distillation is an appealing method for producing portable water that uses free solar energy. The proposed solar RO water purifier model can be allowed potential, expanding its application area. The use of solar PV cells in conjunction with appropriate control system circuits for RO water purification. The control system circuit consists of a charge controller that increases solar efficiency and has numerous protections. This equipment is powered by renewable energy. Solar energy is a clean renewable energy system that can help to reduce pollution while also providing a reliable source of potable water. In the absence of external energy, we rely on electricity supplied by the utility company. The above system was created specifically to meet the needs of individuals in various regions. The fundamental idea behind this project is filtration. Sunrays are captured by a solar panel. This energy is then captured and stored in a battery. The purification system is made up of a high-pressure motor, a filtration system, and a water tank. It also has TDS, salinity, and mineral cattle sensors. The equipment of the solar water purification system using UV light filter is fabricated and an experiment is conducted for Tap water, Ground water, Municipal and water at JNTUA are compared***

***KEYWORDS:Solar Panel, Inverter, UV Lamp, Dirty Tank, Ro, TDS, Salinity, Mineral Cartridge, Comparator, LED.***

## 1. INTRODUCTION

Humans, like food and breath, require water to survive. Freshwater is commonly obtained through rivers, lakes, and groundwater reservoirs. And although 96.5 percent of the water in the world is found in the ocean, 1.7 percent in groundwater, 1.7 percent in

ice caps and glaciers, and 0.001 percent in the air as vapor and clouds, the ice and water supply contain only 2.5 percent of the Earth's freshwater resources and 98.8 percent of that moisture. Only 1% of all freshwater resources are found in ice and subsurface water. Only 1% of all freshwaters is found in rivers, lakes, and the environment. The planet is running out of resources, which are nearly all tainted with diseases and poisonous substances. As a result, water purification is crucial. Furthermore, natural or man-made disasters can quickly disrupt or compromise traditional purification systems. Individuals striving to prepare for such disasters and safeguard themselves and their families from the myriad of diseases and harmful compounds prevalent in filthy wastewater face a challenging scenario. Everyone wants to find a solution to the aforesaid dilemma by obtaining pure water using the available energy sources. Fortunately, these problems can be remedied. It's a breakthrough that not only eliminates a wide spectrum of contaminants in a single step, but it's also simple, cost-effective, and environmentally friendly. The sun's energy is used in this way. Drinking water contamination is one of the most common causes of major health problems, accounting for nearly 90% of all illnesses. Solar clean water is the process of purifying water for drinking and domestic use using solar energy in a variety of ways. Solar energy, or water purification, has gained favor as a more cost-effective approach to capturing heat and solar energy to make water cleaner and healthier for human use and consumption. The sun treatment procedure is especially beneficial to rural areas that lack alternative types of water purification facilities and, more critically, electricity to power such buildings. The fact that solar water filtration does not require any fuel is its most enticing feature. Because sunlight applications do not generate pollution (global warming, acid rain, ozone depletion) or the health issues associated with contaminated air, they are less expensive than traditional energy sources due to scarcity of supply.

Solar water purification is the process of purifying water for drinking and residential use using solar energy in a variety of ways. Solar energy is becoming more popular for water purification since it is a low-tech, practical approach for harnessing heat and solar energy to clean and disinfect water for human use. The solar treatment technique benefits rural areas the most because they lack alternative forms of water purification infrastructure and, more significantly, electricity to power such structures. The fact that solar water filtration does not require any fuel is its most enticing feature. Due to the lack of fuel, solar applications are less expensive than traditional sources of energy, and they do not produce pollution (global warming, acid rain, ozone depletion) or the health risks associated with pollution. Solar water disinfection (SODIS), solar distillation, solar water pasteurization, and solar water treatment systems are the four main types of solar water treatment systems. While some of these technologies are not new to the solar energy concept, the bulk is. These technologies are simple and easy to understand, require little financial investment, and are effective.

**2.LITERATURE SURVEY :**

The rate of distillate water generation is estimated to be between 100 and 590 l/d based on the system's efficiency in this study. The water in the potable water tank should be bacteriologically and mineralogically safe, posing no health risks. During the mixing with reclaimed water, the distillate is expected to re-mineralize slightly. However, during the trial phase, precise water quality monitoring is recommended. The bacteriological and mineral notified amounts for this project's water tank, which uses drinking water, are expected to be within the notified amounts with no adverse health effects. During the mixing process with reclaimed water, the distillate is expected to re-mineralize to some extent. Nonetheless, accurate water quality analysis and evaluation are recommended during the pilot project. It is preferable to use low-cost, maintenance-free technology to increase the amount and quality of available water.

1. Department of Science and Technology (DST): DST has partnered with Coimbatore-based KG Design Services (KGDS) and the National Institute of Ocean Technology (NIOT) to develop and demonstrate a solar thermal desalination plant that captures solar energy, concentrates it, and produces steam, which is then used to desalinate seawater using Linear Fresnel Reflector (LFR) systems.
2. Developing Indigenous Resources (DIR): DIR is working on a small-scale water purification pilot

project in Punjab that will benefit about 270 households. The goal of their pilot experiment is to see which kind of water purification the people in the 'bustee' prefer. Solar, chemical, and filtration are three of their approaches.

3. Solar Water Disinfection (SODIS) is a reduced technique of purifying water through the absorption of solar radiation and light. In 1980, AftimAcra et al. from the American University of Beirut sought for the first time to introduce SODIS as a technology. Wastewater is collected and placed in transparent PET or glass bottles that are then exposed to the light for six hours. The sun's UV rays kill the germs that cause diarrhea, rendering the water safe to drink.

Solar Water Distillation: Solar water distillation uses a solar still to condense the pure vapor and separate harmful chemicals, resulting in clean, pure drinking water. When the water is brackish and contains hazardous bacteria, as well as for settling heavy metals and seawater recycling, the above approach is applied.

## 3. OBJECTIVES:

1. Our project intends to use solar thermal energy for pasteurized water and milk filtration.
2. Using a solar RO system to educate people about renewable energy resources
3. Sediment and particulate matter removal from water
4. The elimination of pathogens, viruses, and other diseases remove elements from water, thereby purifying it.

## 4. SOLAR ENERGY:

Solar energy has the potential to be a significant source of energy. It has a potential of 178 billion megawatts (MW), which is over 20,000 times the global demand. It, however, cannot be developed on a large scale.The solar power generated when the sun strikes the atmosphere is 1017 watts, whereas the solar power on the earth's surface is 1016 watts. The overall global power consumption for all civilization's demands is 1013 watts. As a result, the sun provides us with 1000 times more energy than we require. On a bright sunny day, the sun emits about 1 kW/m2 of energy, which can be used to power prime movers for the creation of electrical energy.

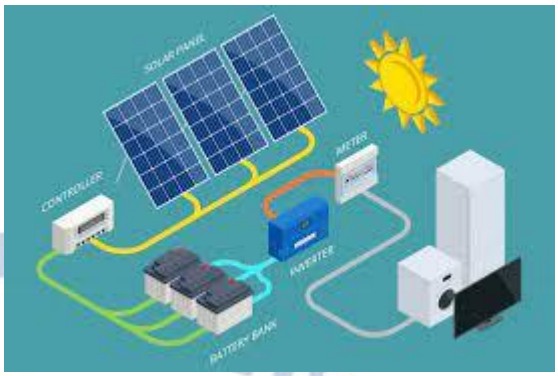


Fig:1. Solar energy

### 4.1 Solar panel:

A solar panel is used in this study to capture solar energy. The battery collects and stores solar energy. This stored energy can be utilised to purify water in rural and remote places, as well as areas affected by natural disasters where electricity is scarce. In this situation, the charge controller controls the amount of solar energy that must be stored in the battery.

**Fig:2.Solar Panel**

## 5. METHODOLOGY :

Several technologies are used in the water purifying system. Solar water purification entails using solar energy to filter water for a variety of purposes in the home. Because it is a more cost-effective technique to harness the sun's energy and heat to clean water for human consumption, its use for water treatment has gained in favor. The solar water filtration system will be particularly beneficial to rural communities that lack other water purification devices and, more importantly, electricity to power such structures. Solar water filtration also saves money because it doesn't use any fuel. Because of the scarcity of gasoline, solar apps

outperform traditional energy sources. The major goal of this project is to use solar energy to purify water in rural areas using two methods: reverse osmosis (RO) and ultraviolet (UV). We use solar energy even though energy is scarce in rural areas. In our country, solar energy is available, and we will use it to generate electricity.

**Fig : 3. Experimentation set up**

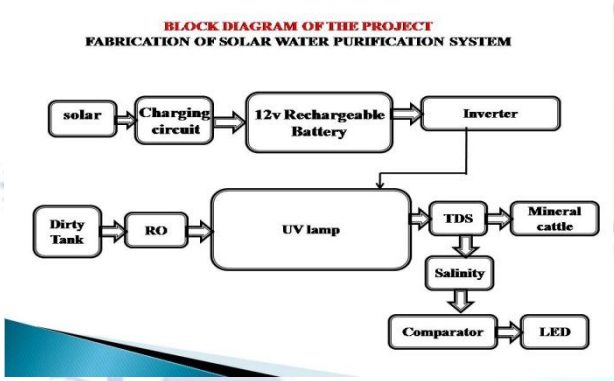


**Fig:4.Block diagram of solar water purification**

The above solar water purification block diagram shows several components, including RO, UV Lamp, TDS, Mineral Cattle, Salinity, Comparator, and LED. The energy from the solar panel was harvested and stored in a battery using a charging circuit. We took a sample of the dirty tank's water and filtered it with a RO filter. Unwanted bacteria were removed from the regenerated water in the RO purifier. The RO purifier is linked to bacteria. The UV lamp is attached to the RO purifier. There was also a TDS, salinity, and mineral livestock sensor placed. It's a simple water filtration system that uses sunlight to eliminate harmful bacteria and viruses in the water (UV-A light and temperature). The ability to kill protozoa is influenced by the water temperature obtained during solar exposure, as well as climatic and weather conditions.

The total dissolved combined content of all inorganic and organic substances in water is measured by total dissolved solids (TDS). As more items dissolve in water, the TDS value rises. As a result, higher TDS levels may indicate that the water contains more pollutants that could be harmful to one's health. When the sensor detects higher levels of TDS, the device's led illuminates.

The salinity sensor calculates the total soluble sodium levels in the water fast and precisely. Mineral cartridges improve the quality of clean water by introducing minerals that humans need to thrive. The filter, which is commonly found in many mineral water drinks, adds beneficial minerals including calcium, magnesium, sodium, potassium, and others.

**5.1 Total dissolved solids:**

The total dissolved solids (TDS) level refers to the number of dissolved particles in a volume of water. Water is recognized as a universal solvent because of its ability to dissolve and absorb molecules from a wide range of substances. Organic and inorganic total dissolved solids (TDS) are both possible. The amount of total dissolved solids (TDS) in your water, as well as the types of TDS present, can help you determine how good your water is. The sections that follow explain the many types of total dissolved solids, how to measure them, and how to reduce total dissolved solids in your water.

TDS is the amount of organic and inorganic compounds dissolved in a given volume ofwater, such as metals, minerals, salts, and ions. TDS is a measurement of anything that isn't an H2O molecule dissolved in water. When water meets water, soluble material particles are absorbed into the water, resulting in total dissolved solids. TDS can be found in a variety of water sources, including natural springs, municipal water treatment chemicals, road and yard runoff, and even your house plumbing system.

Total dissolved solids can come from both natural and artificial sources. TDS is found naturally in springs, lakes, rivers, plants, and soil. When water flows underground in a natural spring, it pulls minerals like calcium, magnesium, and potassium from the rocks. Human activity, on the other hand, can cause total dissolved solids in water. Pesticides and herbicides may be present in agricultural runoff, lead from old plumbing lines may be present, and chlorine from water treatment plants may be present. Total dissolved solids

are occasionally purposefully added to water, since store-bought mineral water may contain mineral additives.

**Fig:5. Set-Up of TDS**

**5.2 Ultraviolet purification:**

Ultraviolet water purification is the most effective approach to disinfect water and eliminate bacteria. UV rays penetrate hazardous pathogens in your home's water and kill bacteria that cause illness by targeting their genetic center (DNA) (DNA). This is a pretty effective means of keeping them from reproducing. Ultraviolet light is an exceedingly simple, effective, and environmentally friendly approach to clean your water. UV systems destroy 99.99 percent of hazardous germs without adding chemicals or affecting the taste or aroma of your water. UV water purification is often used in conjunction with other filtration processes, such as reverse osmosis or carbon block filters. UV (ultraviolet) radiation is an unseen sort of electromagnetic radiation having a shorter wavelength than visible light. It contains greater energy than visible light and can disrupt bonds between atoms and molecules, affecting the chemistry of materials exposed to it. Fluorescence is a phenomenon that happens when UV radiation causes some compounds to create visible light.

**5.3 Solar battery functioning principle:**

Solar battery chargers work by transforming energy from the sun into power that can be stored in a battery. This is done by a photovoltaic solar panel, which uses the same basic technology used in residential and commercial buildings. A solar battery charger works by exploiting photons in the sunlight to make electrons in solar cells flow in a circuit, thereby creating current and charging a battery in the solar power bank.

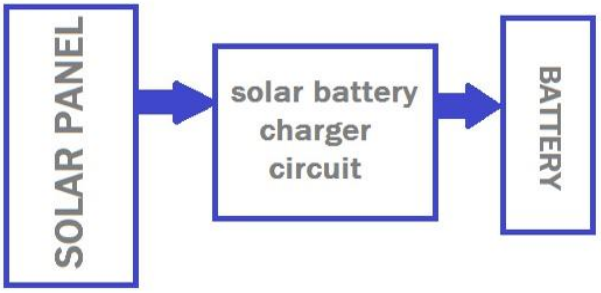


**Fig:6. Function of battery**

| Tap water | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.N.O** | **Quantity (lit)** | **Before purification (lit)** | **After purification (lit)** | **PH value(after)** | **TDS(mg/L) (after)** | **PH value (Before)** | **TDS(mg/L) (Before)** |
| 1 | 3 | 3 | 1.8 | 6.9 | 98 | 7.2 | 101 |
| 2 | 6 | 6 | 4.5 | 6.9 | 98 | 7.2 | 101 |
| 3 | 9 | 9 | 7 | 6.9 | 98 | 7.2 | 101 |

**Table No:1.Tap Water**

| Groundwater | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.N.O** | **Quantity (lit)** | **Before purification (lit)** | **After purification (lit)** | **PH value (after)** | **TDS (mg/L) (After)** | **PH value (Before)** | **TDS(mg/L) (Before)** |
| 1 | 3 | 3 | 1.5 | 6.3 | 150 | 6.5 | 135 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 6 | 6 | 3.5 | 6.3 | 150 | 6.5 | 135 |
| 3 | 9 | 9 | 6.5 | 6.3 | 150 | 6.5 | 135 |

**Table No:2.Ground Water**

| JNTUA college Water | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.N.O** | **Quantity (lit)** | **Before purification (lit)** | **After purification (lit)** | **PH value (After)** | **TDS(mg/L) (After)** | **PH Value (Before)** | **TDS(mg/L) (Before)** |
| 1 | 3 | 3 | 2.3 | 6.5 | 113 | 6.6 | 115 |
| 2 | 6 | 6 | 4.8 | 6.5 | 113 | 6.6 | 115 |
| 3 | 9 | 9 | 7.5 | 6.5 | 113 | 6.6 | 115 |

**Table No:3.JNTUA College Water**

| Municipal water | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.N.O** | **Quantiy (lit)** | **Before purification (lit)** | **After purificatin (lit)** | **PH value (After)** | **TDS(Mg/L) (After)** | **PH value (Before)** | **TDS(mg/L) (Before)** |
| 1 | 3 | 3 | 2.1 | 6.8 | 113 | 6.9 | 115 |
| 2 | 6 | 6 | 4.6 | 6.8 | 113 | 6.9 | 115 |
| 3 | 9 | 9 | 7.2 | 6.8 | 113 | 6.9 | 115 |

**Table No: 4.Municipal Water**

### 6.1 After and Before purification of PH value :

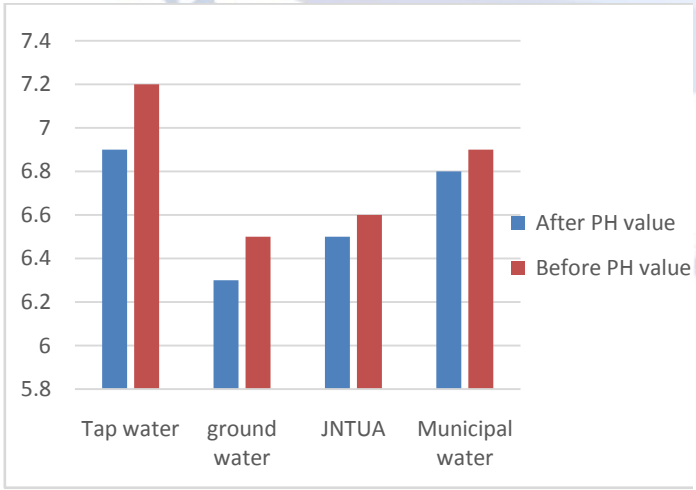


**Fig: 7. After and Before Purification of PH value**

It is another important chemical parameter that is used to determine the number of minerals present in the form of calcium and magnesium cations. It can be represented as the summation of calcium and magnesium both in the form of calcium carbonate. The value of PH is low in Tap water compared to other sampling results. So, it is best for drinking water. It is a chemical parameter that represents the capacity of water to neutralize the acids present in it.it is due to the presence of salts of weak acids and strong bases. The alkaline matter such as bicarbonate, hydroxides constitute of total alkalinity of water. The value of pH is low in tap water compared to other sampling results. So, it is best for drinking water

### 6.2 After Purification and Before Purification of TDS :

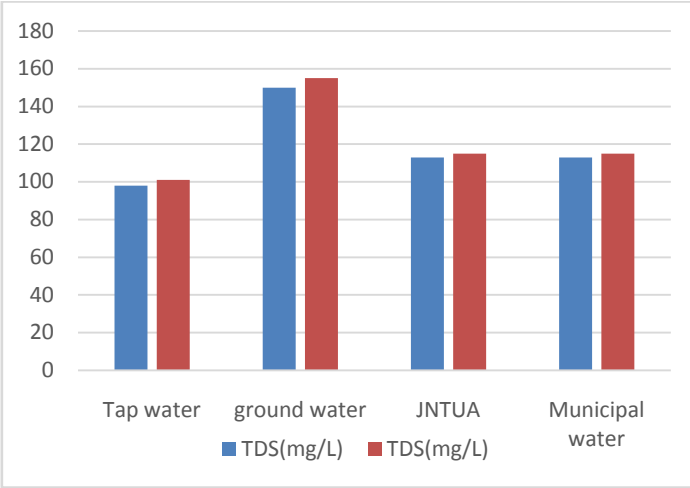


**Figure: 8.After and Before Purification of TDS**

It works based on an optical phenomenon where the light is passed through the fluid that needs to be tested and when the light is incident on the fluid then the particles present in it reflects the light. This quantity is measured by the equipment called TDS. The higher value is recorded at groundwater. (Before purification).It works based on an optical phenomenon where the light is passed through the fluid that needs to be tested and when the light is incident on the fluid then the particles present in it reflects the light. This quantity is measured by the equipment called Tds. The higher value is recorded at groundwater(before purification).

## 7. CONCLUSION

Solar water purification system using UV light filter has been fabricated, the experiment is conducted and the results for groundwater, tap water, municipal water, and water at JNTUA have been compared. The results for before and after purification of TDS and $P^H$ values are also compared. The TDS and $P^H$ values are better after purification. Hence, this water purification system is used for domestic water purposes. The equipment has extremely low capital and operating costs.

### Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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