

# Portable Solar Water Purifier with Heating and Cooling Effect

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## ABSTRACT

*Water is the most important element for all living organisms on the earth. Without water nothing can survive. As a matter of fact there is only 1% drinking water available on earth. Specially for human being pure water for drinking purpose is very essential as contaminated water cause number of diseases. In this project we have fabricated a device which can not only pure the water but produces the required effect of cooling and heating as per season requirement.*

*Our project is basically to purify water for drinking purpose which is based on ultrafiltration method along with cooling and heating based on Thermoelectric Peltier effect using the Solar panel. We have used Activated carbon filtration and Ultrafiltration (UF) method to purify water which is the most useful technique for water purification. We are using solar panels for charging the battery and used the RC circuit for controlling Peltier module and the pump.*

*As we know that solar energy is a renewable source of energy and It does not affect the environment. In current scenario one of the major issues is power consumption. Refrigerators and air conditioning units using Freon, Ammonia for cooling purpose leads to harmful gas emission, global warming and other environmental hazards. These problems can be overcome by using Peltier modules. A cooling system based on Peltier Effect uses very less power and is portable. It uses a very thin Peltier module through which the required heat transfer can be achieved. These modules are compact in size, light in weight, highly reliable and without working fluid or moving parts, unlike conventional systems.*

**Keywords-** *Activated carbon filter, Ultrafiltration module, Peltier module, Peltier effect.*

## INTRODUCTION

In the present scenario basic need of human being in various areas in this world is pure water. Without pure water, no one can survive. Pure water is a major concern for the health of human being because there are number of impurities present in the water which cause many harmful diseases. In different weather condition like in winter season people need warm water and in summer season cold water. So, we have designed such a system which first purifies the water and then perform the function of heating or cooling as per requirement. For purification, we have used carbon filter and ultrafiltration membrane. This filter filtrates the contaminants present in the water. We have achieved a good quality of water by using this method. This purification system is run manually and remove the impurities up to a certain required range of TDS. After purification, it performs the function of heating and cooling. For heating and cooling effect, we have used the "Peltier Effect". Solar energy is used to supply power to run the pump and Peltier plate. By means of pump water from the purified tank is pumped to cooling or heating tank. Peltier plate works on Peltier thermoelectric principles. The initial cost of solar panel is high but running cost is almost zero so it can be recovered in a short span of time. As we know that Solar energy is a renewable source of energy. There is no moving part in this system so it is free from noise and vibration.

## METHODOLOGY

By this system, first of all, we purified water then applying heating and cooling process by the Peltier effect.

### Water purification process

The water purification system comprises of the Carbon filter, UF membrane, and sediment filter. Ultrafiltration will remove organic and inorganic material polymeric molecules and high molecular weight substance. Carbon filter is used for removing chlorine, an organic compound from water. After applying all filtration process we find purified water.

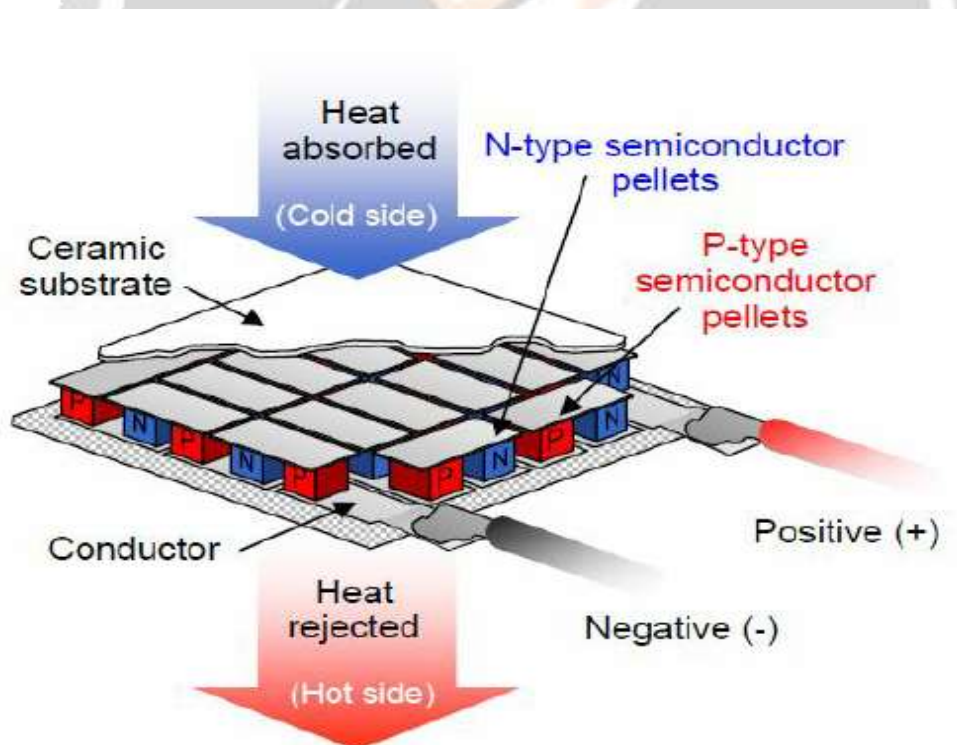
### Peltier cooling and heating

The goal was to supply power to the thermoelectric modules using the solar energy and converting it into dc power. By this effect, we direct converted temperature difference into an electric voltage and vice versa. This effect can be used for heating and cooling purpose. The cooling effect is more effective than heating effect.

### Cooling process

The heat is taken from the water by the Peltier and that generated by the hot junction of the Peltier needs to be rejected. A heat sink and fan assembly are used to take up the rejected heat. Proper heat rejection is important or else the cold junction of Peltier would not reach the required low temperature.

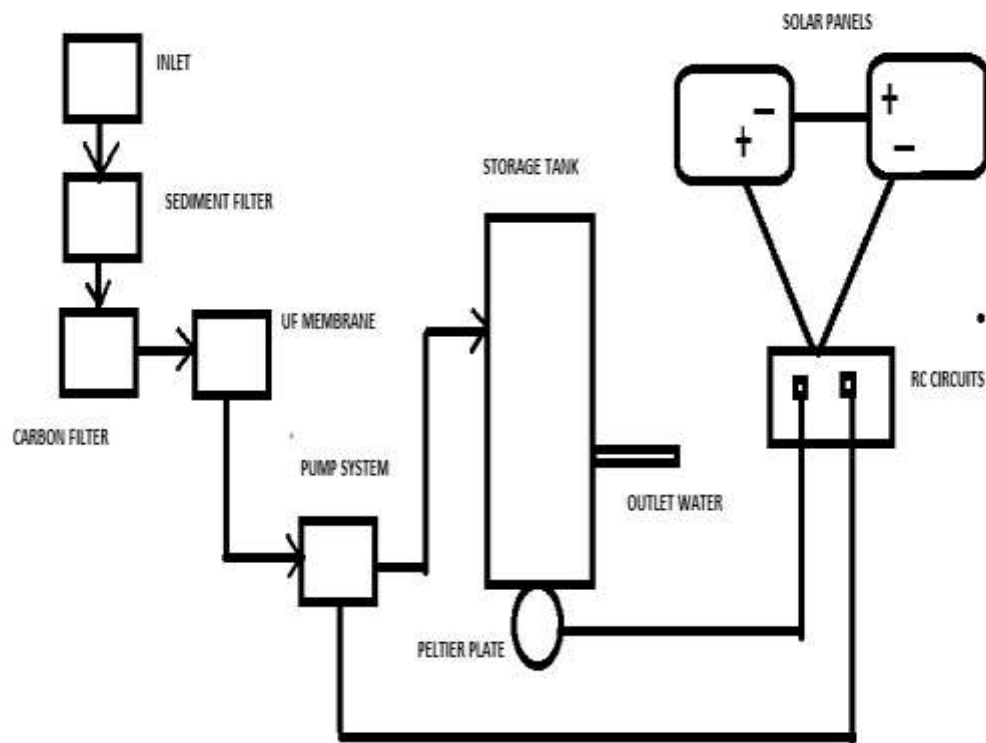
When the current applied between the two conductors, heat is removed at one junction and cooling occurs and other junctions become hot. Evaporative cooling (open circuit) is used to lower the temperature and increase the humidity of air by using latent heat of evaporation, changing liquid water to vapor.



## Heating process

However, the Peltier effect can also be used for heating or control of temperature. The heating effect comes into picture when dc current is applied across Peltier module is reversed. The heating effect is obtained by Peltier is less as compared to cooling.

## EXPERIMENTAL SETUP



Firstly we are set up sediment filter and activated carbon filter. They are a primary filter of our purifier. The secondary filter is UF membrane filter. After this system water is purified up to a drinkable level. Purified water is sent to heating and cooling tank with the help of water pump. The water pump is working with help of solar panel and battery. In the heating and cooling tank heat and cool water with help of Peltier module. These Peltier modules are work with help of solar panel and battery. In the daytime, water pump and Peltier plate is work with solar energy and in the night they are work with help of battery. RC circuit arranges all the function of the water pump and Peltier plate.

There are two methods to use the Peltier effect-

- 1- Integrated use of Peltier effect
- 2- Direct use of Peltier effect

we have used Peltier module directly.

## ANALYSIS

### 1- Purification of water –

Amount of water supply for purification= 1 lit.

Type of water	Quantity	Time for purification	TDS Measurement of the primary filter		Secondary Measurement of the secondary filter
			Before	After	
Normal water	1 lit.	30 min.	210	188	154
Colour water	1 lit.	50 min	220	200	180
Mixing water	1 lit.	40 min	440	404	250

### 2- Cooling process-

Amount of water supply for cooling process = 1 lit.

Quantity of water	Time	Water temperature before supply (*C)	Water temperature after Cooling(*C)	Temperature Difference(*C)
1 lit.	30 min.	34.3	29.6	4.7
2lit.	45min	35.4	30.6	4.8

## CONCLUSION

Ultrafiltration technology used in water treatment as the new generation technology. The ultrafiltration membrane technology can be used in large scale depends largely on the membrane material itself, also depends on the membrane production conditions and process.

Thermoelectric Peltier cooling and heating effect is a simple and low-cost method. Peltier modules are best suited for minor applications. It is eco-friendly process. By comparing Peltier modules to different conventional heating/cooling devices, Peltier module has better power saving capability. Also, it is possible to control the output of a Peltier module by adjusting the voltage supply which is a requirement in case of human use. Although Peltier modules have a lesser lifetime and reliability it overcomes major shortcomings of most of the conventional heating/cooling devices such as power consumption and portability and the same module is capable of both heating and cooling, it therefore serves as a convenient option for various heating and cooling applications.

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