PORTABLE SOLAR WATER PURIFIER WITH COMPACT SIZE

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Abstract: In this paper, we are making a water purifier which works on solar energy. The basic principle behind this project is reverse osmosis. In India there are plenty of non - remoting areas, where people are struggling to get a proper drinking water. In many slum areas people are suffering from many diseases caused by dirty water, like Dysentery, Diarrhoea, Cholera, Typhoid fever, Trachoma, Polio etc. and also nowadays dangerous virus called corona virus entered our nation, dirty water is also one of the major cause for it, therefore we should take more care and precautions to prevent such kind of dangerous diseases. Even though there is water resources, but which is not suitable for drinking and their daily household activities.
Therefore, by keeping all these factors in mind we have come up with an idea of implementing a product which is "Portable Solar Purifier with compact in size". However, we have wide range of solar energy as a source in our country with free of cost. So, by using Renewable Energy we can implement a solar purifier. This is a device, which converts impure, dirty water into clean, pure water suitable for drinking and household activities. Our main intention to implement a portable solar water purifier is to provide good pure water to slum, rural, urban and sub urban areas people in order to maintain their health conditions with less prize compared to market availability. Which is also helps to the people those who are doing trekking, soldiers, and many more. Also, we are planning to add few more features like charging, torch.

***Index Terms* – Reverse Osmosis, Alkaline filter, Contaminated water, Solar Panel, Filtration and Disinfection.**

I. INTRODUCTION

Water purification comprises various processes such as removing suspended solid particle, undesirable chemical, and gases, from contaminated water. Most water is purified for human consumption (drinking water), but water purification may also be designed for a variety of other purposes, including meeting the requirement of medical, pharmacological, chemical, and industrial applications [1].

Purification of water mainly consists of two processes, i.e., filtration and disinfection. The solar water purifier presented here does both the processes. Water filtration is carried out using pre-filter (washable debris filter), activated carbon filter where solid particle like sand, debris, fine particles presented in the dirty water are removed from water. Water disinfection is carried out using UV filtration. As UV light from the sun is known for its ability to destroy micro-organisms, in recent year's equipment's producing UV light have been manufactured for residential use. UV energy is produced by low mercury vapor enclosed in a tabular lamp. Energy produced by the UV lamp has the ability to destroy micro- organisms such as parasites, bacteria etc. [2].

II. SYSTEM ANALYSIS

In this paper we are presenting a Portable solar water purifier with compact size. Obviously a common question arises to mind is that, what is the difference between this solar purifier and already existed the market? Since there are many technologies available in market for purifying the water. But the main disadvantage is that whatever the purifier available in market is not portable and the people who are economically week cannot by the purifiers from the market availability and also they are not designed to purify the dirty water from pond, lake etc. means which are completely dirt and not suitable for the drinking. The main purpose of designing this solar purifier is, irrespective of the water condition the output will be pure and clean water suitable for drinking as well as their daily household activities with compact in size as well as with less price. And also, which is a variable type, can be carry to any needy places [3].

2.1. Solar Panel

Solar energy is being collected by using a solar panel. The collected solar energy is being stored in the battery. In case of rural and remote areas and the areas affected but natural disasters where electricity is a big problem, this stored energy can be used for the purification of water. The charge controller used here controls the required amount of solar energy to be stored in the battery.

Fig. 1 Solar Panel

2.2. Solar Water Pump

Specifications:

- Material used: Acrylonitrile Butadiene Styrene (ABS) + Stainless steel.
- Overall size: Approx. 80x48x63mm/ 3.15x1.89x2.48''.
- Pump inlet diameter: 16mm (outer), 12mm(inner)
- Pump outlet diameter: 12mm (outer), 6.9mm (inner)
- Inlet/ outlet: 1/2" male thread
- Voltage capacity: 6V-12V DC
- Maximum rated current: 1.2A
- Power: 16.8W
- Maximum flow rate: 10L/min
- Maximum water head: 5M
- Max. water circulating water temperature: 60° C

Fig.2 Solar Water pump

Uses advanced electronic components and high-quality wear-resistant shaft.

- Smooth operation, high efficiency, good performance, long service life.
- Can be a long time continuously work, low noise, safety and environmental protection.
- Widely used in industry, scientific research, aerospace industry.
- Brushless Magnetic submersible water pump.

2.3. Booster (DC-DC)

Description:

5V/12V/24V adjustable voltage regulator is a high-performance DC-DC adjustable power supply module, switching regulator.

Fig.3 Booster (DC-DC)

Specifications:

- Input voltage: 3.2-40V ((input must least high 1.5V than output)
- Output voltage: 1.5-35V (adjustable)
- Conversion efficiency: 92% (output voltage higher, the higher the efficiency)
- Rated Output current: 2A
- Max. Output current: 3A (need to add heat sink)
- If the output power greater than 15W combined heat sink is proposed
- Voltage regulation: ± 0.5%
- Dynamic response speed: 5% 200μs

- Operating temperature: industrial grade (-40 to+85)
- Output power 10W load regulation: ±0.5

2.4 UV lamp tube

Description:

- Ultra Violet lamp UV rays cause immediate death for organisms and wipe out their ability to survive and reproduce, hence making water pure and safe for drinking.
- UV chamber made from stainless steel with 2 elbows compatible with all kind of domestic RO water purifier.

Product details:

- Model name: UV lamp tube 11W TUV 8" electronic germicidal filter for RO water purifier spare part for solid filter cartridge.
- Philips original UV lamp.
- Type: solid
- Filter material: polypropylene (PP)
- Micron rating: 0
- Application: UV
- Suitable for: UV
- Filtration stages: 1
- Shelf life: 24months
- Height: 5cm
- Weight: 0.2Kg
- Diameter: 0.1cm

Fig.4 UV lamp

2.5 Alkaline Filter

Descriptions:

- Mineral cartridge are also known as alkaline filter & is installed after RO membrane filter, to give soothing &sweet taste to the pure drinking water.
- This mineral filter also makes the water healthy for drinking by increasing the pH value of drinking water to above 7 and imparting essential Bio minerals to the drinking water.
- Recommended for those suffering from Acidity problem.
- The mineral cartridge can be used as substitute of post carbon filter.
- You can install this filter yourself without the help of any technician.
- This filter is manufactured through high precision injection moulding process from certified food grade plastic and contains filter media of good quality.
- Fully transparent black silica balls normalize pH value, antibacterial balls saves water from bacteria.
- Product dimensions: 15x6x6 cm
- Weight: 499g

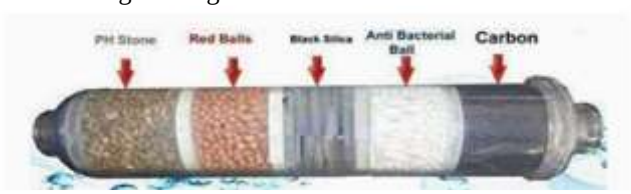

Fig.5 Alkaline Filter

Process:

Through the alkaline process oxygen increases up to 20% more in your drinking water. Supply's body with essential minerals such as Ca, Mg, Na. provides excellent source of Antibacterial to maintain long term health.

2.6 RO Purifier

Description:

- The UF membrane 4 inches fibre ultra-filtration membranes are used for removal of micro-organisms and turbidity.
- This UF membrane of a micro-scale pore size has selective function filtering unwanted chemicals and micro-organisms for example algae, bacteria, fungi, cyst etc.
- 4" hollow fibre ultra-filtration membrane.
- Weight: 100g
- Diameter: 6.5*4.5 cm

Fig.6 RO Purifier

2.7 Battery

Description:

- 12V DC rechargeable Lithium ion battery.
- 6000mAh high capacity.
- 60% lighter than equivalent Sealed Lead Acid (SLA) batteries.
- 5 times longer life (2000 charge cycle, 400 on SLA)
- 75% higher effective capacity than SLA batteries.

Fig.7 Battery

2.8 Adaptor

- AC Power choke.
- Input 220V AC.

Fig.8 Adaptor

2.3. Methodology

When two solutions of different concentrations are separated by a semi-permeable membrane, solvent (water) flows from a region of lower concentration to higher concentration this process is called osmosis [4]. This driving force in this called osmotic pressure. If a hydrostatic pressure in excess of osmotic pressure is applied on the higher concentration side, the solvent flow is reversed i.e., solvent flows from higher concentration to lower concentration. This process is called reverse osmosis. Thus, in the process of reverse osmosis pure water is separated from salt water.

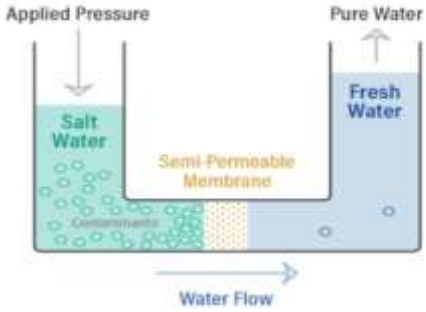

Fig. 9 Reverse Osmosis

2.3.1 Block Diagram

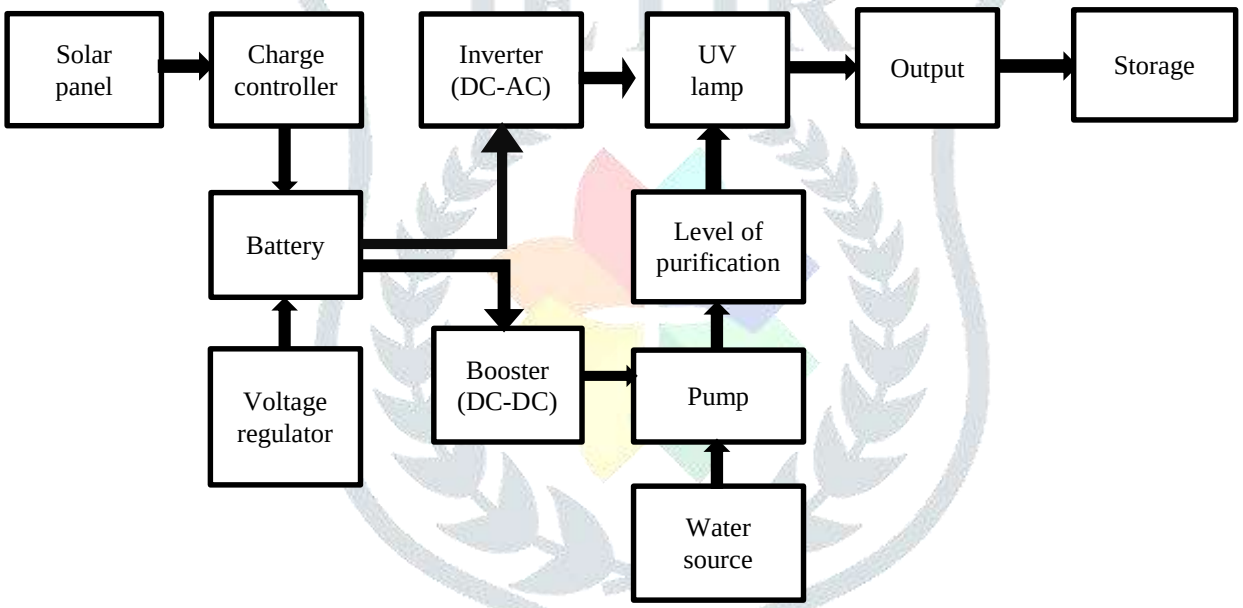

Fig.10 Block Diagram

Solar modules absorb the solar energy and stored it in a battery through charge controller. This charge controller avoids the overloading of battery. The battery is connected to the purification unit through an electromagnetic relay. The battery is also connected to a voltage regulator. The voltage regulator converts 24V to +5V which is required by the microcontroller [5]. The purification unit consists of high-pressure motor reverse osmosis system and the water tank. The high pressure creates the necessary pressure required to carry out reverse osmosis. A 12V pump sucks the required water to be purified. Between this, there will be levels of purification processes. In this stage water under go various levels of purification as shown in the Fig. 8 in chapter 4. Initially which has a mesh like structure which removes solid particles present in the impure water. Then there will be pH stones in order to remove still more fine particles present in the water, next this water is passed to black balls zone, which helps to normalize pH value of the water.[6]

III. ASSEMBLING OF THE PROJECT

Fig.11 Assembling

VI. EXPECTED OUTCOME

Water from any kind of sources like pond, lake, river, etc., Irrespective of the water condition, the output will be pure, clean water suitable for the drinking and other household activities.

VII. CONCLUSION

In this paper we used basic principle of reverse osmosis. As solar energy is being used for the purification of water, which is cheap and abundant, it can be used everywhere where electricity is not available. Here, the microcontroller which is used also prevents the water from overflowing. Moreover, reverse osmosis is a good disinfectant process [7].

VIII. FUTURE SCOPE

This project has only capital cost and almost no running cost. Hence, it will prove to be useful in the near future. Due to human activity we might face the problem of water scarcity ow water pollution therefore in such crises this solar water purifier will helps us in future.

IX. ACKNOWLEDGMENT

The authors are grateful to Dr. Srinivas Mayya D, Principal, Srinivas Institute of Technology, Valachil Mangalore for the opportunity and Prof. Lokesh B, HOD, Department of Electrical and Electronics Department for the support. The authors are also immensely grateful to Mr. Vinay B K, Assistant Professor Dept. of Electrical and Electronics Engineering for his guidance and comments that greatly improved the paper.

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