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Review on Design and Development of Solar-Powered Water Purification Systems of Rural Areas

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Abstract: We're developing a solar-powered water filter as part of this project. The basic principle of reverse osmosis serves as the foundation for this project. Solar radiation is captured by solar panels. This energy is then stored in a battery. The purification unit and battery are connected by means of an electromagnetic relay. The purification unit is composed of a high-pressure motor, water tank, and reverse osmosis system. The pressure produced by the high pressure makes reverse osmosis possible. The control board keeps an eye on the water level in the tank and prevents overflow. Using this method, the cleaned water is delivered to the water tank.

Keywords: water purification, solar energy, Battery, RO system etc.

I. INTRODUCTION

The need to find clean, fresh sources of drinking water has arisen from the diminishing supply of fresh water. Many parts of the nation lack access to clean, brackish, or salted water. One of the main issues in Gujarat's and Kutch's coastal regions is saline water.

In India's rural and tribal communities, getting access to clean drinking water is a major problem. Reverse osmosis systems, pot chlorination of wells, rapid and slow sand filters, fluoride removal, and chlorine tablets are some of the ways used to purify water in rural India.

In this project, we're building a solar-powered water filter. Reverse osmosis is the fundamental mechanism by which this project operates. We use inexpensive, plentiful solar energy as a renewable resource. In this instance, a solenoid valve is used to stop the water from overflowing. It is acceptable to use this purifier in isolated and rural locations without electricity. It must be utilized in areas hit by natural calamities. It offers a water purifier free of pollutants.

To supplement the village's water distribution system, this system has been developed with a water filtration system. As tainted well water is pumped to the village reservoir, the system efficiently filters and sanitizes it using sediment filtration enhanced by UV radiation.

The project's objectives were to supply the hamlet with a long-term water treatment solution and to suit its demands. This report aims to provide a comprehensive summary of the project, including the design solution, project cost, construction and maintenance details, testing and evaluation outcomes, and a schedule for upcoming field testing.

II. PROBLEM IDENTIFICATION

The need to find new sources of drinking water has arisen from the diminishing availability of water. Many parts of the nation have brackish, saline, or polluted water supplies.

In our nation, the lack of clean drinking water in rural and tribal areas is a serious issue.Reverse osmosis facilities, chlorine pills, pot chlorination of wells, fast and slow sand filters, fluoride removal, and other methods are available for purifying drinking water.

In this project, we're building a solar-powered water filter. This project is based on the fundamental idea of reverse osmosis. We use solar energy, which is inexpensive, plentiful, and renewable.

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Water Born Diseases

TYPE	CAUSE	DISEASES
Chemical	Lead	Infants and Children: Delays in Physical or mental development. Adults: Kidney and High B.P
	Arsenic	High risk of getting Cancer. Skin damage or circulatory system problems
	Fluoride etc.	Bone diseases (pain and tenderness of bones). Mottled teeth in children
Microbial	Bacterial infections	Typhoid, Cholera, Bacillary dysentery
	Viral infections	Infectious Hepatitis (jaundice)
	Protozoa infections	Amoebic dysentery

Water Purification Issues

COMMUNITY WATER	BOTTLED WATER
1. Quality at the treatment different from quality at discharge	1. Unavoidable Cost of bottling and transportation
2. Uncontrolled dosage of chemicals	2. Non-biodegradable waste
3. Common Supply for Drinking and bulk household usage	3. Not all bottled water is verified by independent agency
4. Not a cost effective supply for drinking	4. Wait for bottled water delivery or go to the market for buying

III. OBJECTIVE

• My project's goal is to use solar energy to cleanse water. Similarly, I have chosen two procedures for purification; these are RO Processes.

•The benefits of this initiative will be greatest in rural areas when energy supplies are insufficient. And in such places, clean water is undoubtedly overlooked. As a result, a large number of elderly children suffer from water-borne illnesses. The project's primary goals are to create filters that:

1. Can efficiently remove impurities and bacteria from drinking water.
2. Are simple for users to operate,
3. Are simple for neighbourhood potters to make;
4. Offer a reasonable flow rate (so users won't become impatient);
5. Come at little or no cost to consumers;
6. Easily implementable with a strong educational foundation
7. Encourage users to maintain proper hygiene;
8. Encourage economic growth through the development of jobs and healthy lifestyles.

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IV. LITERATURE REVIEW

In 1990, Hasan investigated the removal of iron through contact aeration, leveraging the catalytic properties of ferric iron. The study theoretically demonstrated that the volume of the aeration tank could be significantly reduced by maintaining a high concentration of ferric iron, as indicated by the oxygenation rate equation. Ferric iron proved to be particularly effective at minimizing reactor volumes at lower pH levels. To sustain high concentrations of ferric iron in the reactor, the recycling of ferric sludge is being considered.

In 2003, Wang and associates studied the cost-effective use of various adsorbents to remove heavy metal ions from aqueous solutions. They employed a range of low-cost adsorbents, including Fe_2O_3, Fe_3O_4, FeS, steel wool, magnesium pellets, copper pellets, zinc pellets, aluminium pellets, iron pellets, coal, and GAC, to extract heavy metal ions such as cobalt and zinc from groundwater.

In 2006, Gupta conducted studies on non-conventional, inexpensive adsorbents for dye removal. He examined a variety of adsorbent materials for filtration, providing a thorough review of their characteristics, advantages, disadvantages, and adsorption processes. The materials used included activated carbon from agricultural solid waste, industrial wastes, silica-containing minerals, and clay.

In 2011, Ganvir et al. investigated the removal of fluoride from groundwater using rice husk ash (RHA) coated with aluminium hydroxide. The RHA surface was activated with aluminium hydroxide, which forms a complex with fluoride ions in water, accelerating the removal process. To create RHA, crushed and dried rice husk was carefully burned and then treated with hydrochloric acid prior to activation.

In 2012, Chaturvedi conducted studies on the removal of iron from drinking water. He explored various methods, including electrocoagulation, oxidation filtration, ion exchange, lime softening, activated carbon adsorption, BIRM media, green sand, pebble and sand mixtures, ultrafiltration, and other techniques.

V. EXPERIMENTAL BLOCK DIAGRAM

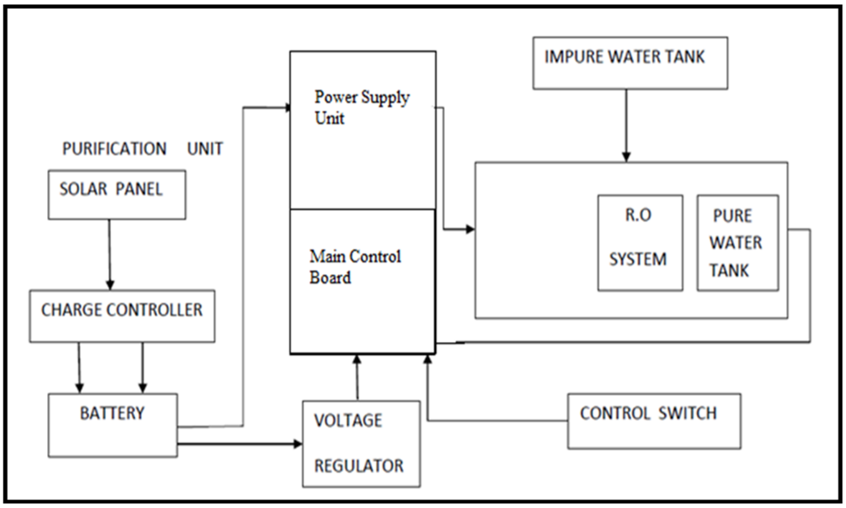

Fig. 1. Block Diagram of system

VI. WORKING PRINCIPLE

• The water purifier's design is divided into seven phases. Sand slit, dirt, garbage, rust, and all suspended particles are eliminated before the water enters the sediment filter.

• After that, water passes through a carbon filter, which uses adsorption to remove impurities like chemicals, chlorine, odour, and unpleasant taste.

• After that, a portion of the water is routed to an ultrafiltration filter and a portion is injected by a Ro booster pump into the membrane. A centrifugal pump having impellers to draw water in and raise pressure as it goes through is the RO booster pump.

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• The water inside the pump is drawn in and forced further by the impeller's rotation on an axis. water entering, the centrifugal force of the impeller's curved vanes pushes the water outward.

• The reverse osmosis method uses pressure to force unfiltered water, or brine, across a semi-permeable membrane, reducing total dissolved solids or suspended pollutants in water by 70–80%.

• Because the reverse osmosis system can prevent pollutants, clean water, or permeate, can flow through to the less concentrated side of the membrane.

• The diameter and length of a reverse osmosis membrane housing are normally 2.5 and 4 inches, respectively, and 14, 21, 40, 80, or 120 inches.

VII. CONCLUSION

Water may be purified using the sun's free solar energy, which is abundant and inexpensive, and can be utilized anywhere electricity isn't available. In this case, the controller also keeps the water from overflowing. Reverse osmosis is also an effective method for eliminating hardness in water. Thus, in addition to designing the photovoltaic system and battery system, we also created the water purification system's structural layout and evaluated the system's advantages for the environment and case studies. We have also listed the numerous kinds of solar cells that are on the market, evaluated them against several criteria, and chosen the best one. There are essentially no running costs for this project—just initial costs. As so, it will prove to be beneficial soon.

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