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Purification of Ground Water into RO Purified Water by Using Solar Power

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ABSTRACT:-

In our world *access to clean drinking water is a* fundamental human right, yet many regions *face challenges due to groundwater contamination. This study proposes a solar-powered purification system to address this issue, focusing on the conversion of contaminated groundwater into portable water by using reverse osmosis (RO) technology.* The proposed system harnesses solar energy to power the purification process, offering a sustainable and environmentally friendly solution. Solar panels are employed to generate electricity, providing the necessary energy for the RO filtration system. This approach reduces reliance on conventional energy sources and minimizes the system's carbon footprint.

The purification process involves several stages, including pre-treatment to remove larger contaminants, membrane filtration through RO to eliminate dissolved impurities, and post-treatment to ensure water quality meets drinking standards. By leveraging solar power, the system operates efficiently even in off-grid areas, making it suitable for remote or underserved communities. The effectiveness of the solar-powered RO system is evaluated through laboratory experiments and field trials. Parameters such as water quality, purification efficiency, and energy consumption are monitored to assess performance and optimize system design.

The results demonstrate the viability and efficacy of the proposed approach in purifying groundwater into safe drinking water. Furthermore, the use of solar energy enhances the system's resilience and sustainability, contributing to long-term water security and public health improvement in affected regions.

Keywords:-Solar power, Groundwater purification, Reverse osmosis, Drinking water, Sustainability.

I – INTRODUCTION

Water is essential for life. The amount of fresh water on earth is limited, and with the rapid industrialization, its quality is under constant pressure. Preserving the quality of raw water is important not only for the drinking-water supply, but also for food production and other water uses. Water quality can be compromised by the presence of infectious agents, toxic chemicals, and radiological hazards.

Reverse Osmosis is extensively applied in the water treatment industry as well as residential purposes. These applications include both the industrial sector as well as (to a lesser extent) the municipal sector. Reverse osmosis for the production of drinkable water is still not widely applied despite high feed TDS and low flow rate requirements being the prevailing characteristics for drinkable applications. The exception is of course the production of drinkable water from seawater by reverse osmosis, but this has thus far found limited application in India.

Here's a basic introduction of the system:

Solar panel:

Solar panels, also known as photovoltaic (PV) panels, are devices that convert sunlight into electricity through the photovoltaic effect. These panels are made up of multiple solar cells, typically composed of silicon, which absorb photons from sunlight and generate an electric current.

The basic structure of a solar panel consists of several layers:

1. **Solar Cells:** These are the heart of the panel. Solar cells are made of semiconductor materials, such as silicon, which generate electricity when exposed to sunlight. When sunlight strikes the solar cell, it excites electrons, creating an electric current.
2. **Anti-reflective Coating:** This layer reduces reflection and increases light absorption, maximizing the efficiency of the solar cells.

3. **Front Contact:** Typically made of a thin layer of metal, this contact layer collects the electrons generated by the solar cells and transfers them out of the panel as usable electricity.
4. **Encapsulation:** Solar cells are encapsulated between layers of protective material, usually tempered glass on the front and a durable polymer on the back, to shield them from environmental damage and ensure longevity.
5. **Back Sheet:** The back sheet provides insulation and protection against moisture, ensuring the durability of the panel.
6. **Frame:** A sturdy frame surrounds the solar panel, providing structural support and facilitating installation.

Battery:

A 24-volt battery is a type of rechargeable battery that provides a nominal voltage of 24 volts when fully charged. These batteries are commonly used in various applications, including automotive, marine, renewable energy systems, and industrial equipment.

Reverse Osmosis (RO) pump:

A Reverse Osmosis (RO) pump is a critical component of a reverse osmosis water filtration system. It is responsible for pressurizing the feed water and forcing it through the semi-permeable membrane to separate impurities from the water. Here are some key points about RO pumps:

Function: The primary function of an RO pump is to create the necessary pressure to overcome the osmotic pressure and push water molecules through the RO membrane. This pressure forces water through the membrane, leaving behind contaminants such as dissolved solids, salts, heavy metals, and microorganisms.

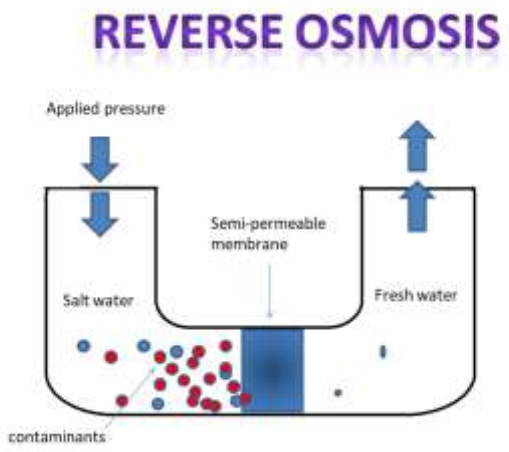

FIG: 1. process of reverse osmosis

Types: There are two main types of RO pumps: electric and non-electric. Electric pumps use a motor to generate pressure, while non-electric pumps rely on hydraulic power, typically from water pressure in the incoming feed water line or from a separate pump.

Pressure: The pressure generated by an RO pump is typically measured in pounds per square inch (psi) or bars. The required pressure depends on factors such as the quality of the feed water, the type and condition of the RO membrane, and the desired flow rate and rejection rate.

Efficiency: The efficiency of an RO pump is important for the overall performance and energy consumption of the RO system. High-efficiency pumps can deliver the required pressure with minimal energy consumption, reducing operating costs and environmental impact.

Installation: RO pumps are typically installed downstream of pre-filtration stages in an RO system. They may be integrated into the system's pressure vessel or installed as a separate component, depending on the system design and configuration.

Maintenance: Proper maintenance of an RO pump is essential to ensure reliable operation and longevity. This may include periodic inspection, cleaning, lubrication (for electric pumps), and replacement of worn or damaged parts. Regular maintenance helps prevent downtime and ensures the continued effectiveness of the RO system.

Overall, the RO pump plays a crucial role in the operation of a reverse osmosis water filtration system, enabling the production of clean, purified water for various applications, including drinking water, industrial processes, and wastewater treatment.

Carbon Filter:

A carbon filter, also known as activated carbon filter or charcoal filter, is a type of filtration system that utilizes activated carbon to remove impurities from air or water. Here are some key points about carbon filters:

1. **Activated Carbon:** Activated carbon is a highly porous form of carbon with a large surface area, which makes it effective at adsorbing (not absorbing) various impurities. The activation process involves treating carbon with steam or chemicals to create a network of pores that can trap contaminants.
2. **Filtration Mechanism:** Carbon filters work through a process called adsorption, where contaminants adhere to the surface of the activated carbon. The porous structure of the carbon provides a large surface area for impurities to adhere to, effectively removing them from the air or water passing through the filter.
3. **Removal of Contaminants:** Carbon filters can remove a wide range of contaminants, including volatile organic compounds (VOCs), chlorine, odors, taste, and some dissolved gases. They are commonly used to improve the taste and odor of drinking water and to remove chemicals and odors from indoor air.
4. **Types of Carbon Filters:** There are different types of carbon filters designed for specific applications:
    - **Granular Activated Carbon (GAC):** Consists of loose granules of activated carbon, commonly used in point-of-use water filters and whole-house filtration systems.
    - **Carbon Block Filters:** Compressed blocks of activated carbon, offering higher filtration efficiency and longer lifespan compared to GAC filters. They are often used in under-sink water filters and refrigerator water filters.
    - **Impregnated Carbon:** Carbon filters may be impregnated with other substances, such as silver or potassium permanganate, to enhance their ability to remove specific contaminants or inhibit bacterial growth.
5. **Maintenance:** Regular maintenance is important to ensure the effectiveness of carbon filters. Over time, the pores of the activated carbon may become filled with contaminants, reducing filtration efficiency. Depending on usage and water quality, carbon filters may need to be replaced every few months to a year.
6. **Applications:** Carbon filters are used in various applications, including residential water filtration, commercial and industrial air purification, aquarium filtration, automotive cabin air filters, and respiratory masks.

Overall, carbon filters offer an efficient and versatile solution for removing impurities from air and water, improving both quality and safety for various applications.

Processes of drinking water purification:

Around the world, household drinking water purification systems, including a reverse osmosis step, are commonly used for improving water for drinking and cooking. Such systems typically include a number of steps:

• a sediment filter to trap particles, including rust and calcium carbonate

• optionally, a second sediment filter with smaller pores

• an activated carbon filter to trap organic chemicals and chlorine, which will attack and degrade a thin film composite membrane

• a reverse osmosis filter, which is a thin film composite membrane

• optionally, a second carbon filter to capture those chemicals not removed by the reverse osmosis membrane

• optionally an ultraviolet lamp for sterilizing any microbes that may escape filtering by the reverse osmosis membrane The latest developments in the sphere include nano materials and membranes.

In some systems, the carbon prefilter is omitted, and a cellulose triacetate membrane is used. CTA (cellulose triacetate) is a paper by-product membrane bonded to a synthetic layer and is made to allow contact with chlorine in the water.

These require a small amount of chlorine in the water source to prevent bacteria from forming on it. The typical rejection rate for CTA membranes is 85– 95%.

FIG:1.model of the RO purifier with solar panel

Advantages:

• Water purification through renewable source like Solar

• High efficient system

• Low power consumption

• Easy installation

• Less maintenance issues

Applications:

• Domestic or Industry purpose

• Very useful in coastal area peoples

Result:

After the calculation and survey we design such system which fulfill our requirements and made solar powered water purifier (RO), this system consisting equipment such as solar panel, battery backup, charge controller, RO unit, cables, UV tube with DC UV choke.

This system does not require inverter because whole system works on DC that's why inversion losses are reduces also cost of inverter is reduced. This system works in whole day as well as night also because battery backup is given to the system. In this system input is given from solar panels and then fed to the charge controller. Battery also connected to the charge controller to set the references voltage of the system. Here our system is works on 24 Volt DC that's why we connect two 12 V batteries in series to set 24 V reference voltage, charge controller regulate the voltage of solar panel to the battery which varies in day due to position of sun. The main function of charge controller is to regulate the voltage which fed to battery and also prevent battery from over charging. In our charge controller protection is given such as short circuit protection, overload protection, overvoltage protection, polarity protection. The charge controller number of output terminals such as solar terminal, battery terminal and load terminal. The load terminal of charge controller is connected to RO Unit. Total system consume 30.2 W and operated at 12 V DC.

Conclusion:

This work of operating is simple assembly which is a good prototype to have a portable source of RO purified water this has less weight. And smaller size. And testing calculation showed that this is quite a good product to have in situations of floods and remote areas where the water purification is needed to be done. Future purifiers may be less costly and convenient to use. This paper conclude fully utilization of renewableenergy by using small RO unit which reduce energy cost and totally independent from grid network.