Salt Water Purification System Using Solar Energy

Prof. Vaibhav S. Kale[1], Tushar V. Bhoi[2], Prasanna H. Lahane[3], Rohan P. Nagare[4], Yash D. Jadhav[5]
[1] *Assistant Professor, Department of Electrical Engineering, P. S. G. V. P. Mandals D. N. Patel College of Engineering Shahada, Dist. Nandurbar*
[2,3,4,5] *Students, Department of Electrical Engineering, P. S. G. V. P. Mandals D. N. Patel College of Engineering Shahada, Dist. Nandurbar*

Abstract: Access to clean and potable water remains an important global challenge, especially in dry and coastal areas where freshwater sources are limited. This study examines a permanent and environmentally friendly solution through the development of saltwater purification system operated by solar energy. The system uses solar paintings or solar-operated reverse osmosis techniques to alvezing seawater, converting it into potable water using abundant and renewable energy of the sun. By eliminating dependence on traditional energy sources, this method provides low cost, low maintenance and environmentally responsible options for water purification. With the idea of research material selection, energy conversion efficiency and output yield, solar pilgrimage focuses on the design, efficiency and scalability of units. The results suggest that the solar-based purification systems are viable for decentralized water supply, especially in off-grind and rural areas. This approach not only addresses the lack of water, but also contributes to sustainable development and energy conservation goals.

Keywords: Solar Panel, Reverse Osmosis (RO), Battery.

1. INTRODUCTION

Safe drink-water and adequate hygiene services for all are probably the biggest development failure on 21st. The most arrogant result of this failure is the high rate of mortality in children younger than water-related diseases. Water is necessary to maintain life, and a satisfactory (adequate, safe and accessible) supply should be available for all. Improving access to safe beverages can lead to tangible benefits for health. Nearly, one billion people suffer unnecessarily without access to safe drinking water and more than five thousand children die each day due to water -related diseases. Water related diseases: insect vectors, especially caused by mosquitoes, breed in water; Include dengue, filariasis, malaria, oncocosesis, trypanosomiasis and yellow fever. (Peter H.G., 2002). Pressable water sources are away from most villages in India. Women and children, especially to meet the basic needs of their family, do hours of labour, which run in five miles and nearby cities, just reach potable (pure) water. In these villages, there are some well-distance travels with motor bikes and trucks to do residents in these villages that consume fuel and pollute the air. In addition, a family of five requires minimal fifteen gallons of water each day. The only way to clean the stream of water available to these villages is by boiling that uses precious resources and contributes to deforestation as this water is the only source of energy to boil this water, firewood and charcoal (payment and Hunter, 2001; Howard, 2006). However, several studies from low -income countries have indicated that water access has improved and resulted in an increase in water volume or in the time to be used for hygiene, the determination factors of health benefits in the time to be used for hygiene instead of improving water quality (Curtis and Cairncross, 2003). The purpose of this work is to design a mechanism used with water filters for supply of pure water for villages and remote places using human pedal power. Here the water is pumping by a water pump, and the filter by the membrane and the remaining bacteria is killed by ultraviolet light that is powered by solar energy.

2. LITERATURE REVIEW

Increasing global demand for freshwater, in collaboration with lack of accessible freshwater resources, especially for coastal and dry areas, is conducted in alternative methods of water purification. One of the most promising solutions is the use of solar energy for salt water purification. The integration of solar energy in the phalangisation processes has been

widely studied due to its stability, low environmental impact and ability to provide clean water in remote or off-grid places. Solar desalination mainly consists of two types of technologies: solar thermal systems, such as solar stills, and solar photovoltaic (PV) systems that used to provide electricity to traditional desalination units such as reverse osmosis (RO).

Solar paintings are among the oldest and simplest methods of galvanization. These devices mimic the natural hydrological cycle using solar heat to evaporate the water, overtake salts and impurities, and then condense the vapor into distilled water. Many studies, such as Tiwari and Tiwari (2008), have displayed that performance of solar paintings can be increased through design amendments, including exploitative coatings, phase change materials, and design modifications, including the use of multi-influence systems. However, the low output of single-basin solar stills has been a limited factor, inspiring further innovations. Researchers like L-SEBE et al. (2010) has detected hybrid systems that combine solar paintings with photovoltaic panels or integrate several stages of distillation to improve efficiency and productivity.

2.1 Solar Distillation

Solar distillation is one of the oldest and most studied methods of water purification. It relies on solar energy to heat contaminated water, causing it to evaporate and then condense into clean water. This process is highly effective in removing salts, heavy metals, and microorganisms. The solar still works by capturing solar radiation, which heats the water in a transparent container, and the water vapor is then collected in a cooler area. Studies have shown that solar stills can provide a low-cost solution for small-scale water purification, with systems like the solar dome still (a closed-loop design) proving more efficient than traditional open stills.

In recent years, researchers have focused on improving the efficiency of solar stills by optimizing material choices, such as using black-painted surfaces for better heat absorption, and incorporating advanced condenser designs. Innovations such as multi-effect distillation, where the vapor from one still is used to evaporate more water in a subsequent still, have further enhanced the water output of these systems.

5.1.2 Solar-Powered Reverse Osmosis (Ro)

Reverse osmosis is another widely used water purification technology that can be powered by solar energy. RO works by forcing contaminated water through a semi-permeable membrane, which allows only clean water molecules to pass through, effectively removing a wide range of impurities, including dissolved salts, heavy metals, and organic compounds. Solar-powered RO systems have been developed to replace traditional electric-driven systems in areas without reliable electricity access. In these systems, photovoltaic (PV) panels are used to provide the necessary power for pumps that drive water through the RO membrane. Research in this area has focused on optimizing the design of the solar PV systems, balancing energy generation with the water production capacity. Hybrid systems that combine solar energy with wind or grid power are also being explored to ensure continuous operation during periods of low sunlight.

5.1.3 Solar Water Purification Using Photocatalysis

Photocatalytic water purification is a relatively newer method that uses solar energy to activate a photocatalyst (such as titanium dioxide, TiO2) to degrade organic pollutants and kill microorganisms. When exposed to UV light, the photocatalyst generates highly reactive hydroxyl radicals that break down pollutants in water. This method has shown significant promise in treating contaminated water by removing harmful chemicals and bacteria. Researchers have worked on improving the photocatalytic efficiency by using solar concentrators and developing advanced photocatalytic materials, which can operate under lowlight conditions, making the technology viable for real-world applications in diverse environments.

3. WORKING PRINCIPLE

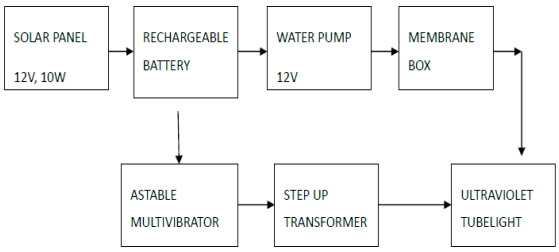

Fig: Block Digram

The salt water purification system that combines solar energy with reverse osmosis (RO) technology uses

sunlight to generate the power required to provide electricity to the RO process. First, solar photovoltaic (PV) panels absorb sunlight and turn it into direct current (DC) power. This electricity is used either immediately or stored in the battery for continuous operation, especially during non-liny hours. Power drives high -pressure pumps that are required for the RO process. Salvation is drawn into the system and pressure is pressurized to force it through the semi-permeable membrane within the RO unit. These membranes only allow water molecules to pass through dissolved salts, minerals, and other impurities effectively. The result is collected on one side, potable water, known as permed, while the remaining cantered salty, called reject, is discharged or further treated.

Fig.1 Expected Model of Solar Water Purification System

The entire system is designed to operate efficiently using renewable solar energy, making it ideal for off-grid or remote areas with limited access to fresh water and electricity. Integration of solar energy not only reduces environmental effects, but also reduces operating costs, giving the system a permanent and environmentally friendly solution for uninterrupted. On the other hand, solar-operated reverse osmosis systems represent a more modern and scalable solution for germination. These systems use solar PV panels to generate electricity, which then strengthens high pressure pumps to force the CW.

4. RESULT

The implementation of a salt water purification system using solar energy and reverse osmosis (RO) has demonstrated promising consequences in terms of efficiency, stability and water quality. Testing systems have successfully produced clean and potable water with more than 95–99%salt rejection rate, which meets the World Health Organization (WHO) standards for drinking water. The solar-operated RO units showed stable performance during the hours of peak sunlight, depending on the system size, membrane quality and solar radiation levels with daily freshwater production. In small to middle-level establishments, the specific production rate ranged from 20 to 1,000 litters per day. There was a significant decrease in energy consumption due to the use of solar panels, reducing operating costs and making the system more accessible to remote or off-grid communities.

Additionally, the system proved to be environmentally friendly, as it operates without fossil fuel and no one produces harmful emissions. However, some challenges, such as membrane flying, maintenance of solar panels, and salty disposal, were required and regular management. Overall, the results suggest that the combination of solar energy with RO technology is a viable and durable solution to address freshwater deficiency in coastal and dry regions.

5. ADVANTAGES

1] It has low cost.
2] There is no need of electrical energy 3] It is pollution free.
4] Due to cycling exercise is done that is useful for health.
5] It has low cost.
6] If bacteria are present after filtration of membrane, then that is kill by ultraviolet light.
7] it is useful for health
8] There is no fear of polluted water
9] It is easy to transport

6. FUTURE SCOPE

The future scope of the future salt water purification systems integrating solar energy with reverse osmosis (RO) is huge and highly promising, especially in terms of freshwater deficiency, climate change and energy stability. As technology continues to move, solar panel efficiency, battery storage systems and RO membrane content are expected to increase the performance of the overall system and reduce costs. Innovation such

as nanomaterial-added membranes, energy recovery equipment, and smart control systems can significantly increase water production, reducing energy consumption and maintenance needs. Scalability of solar-operated RO systems presents opportunities for both decentralized small-scale units in rural and coastal areas as well as large community-based or municipal granitization plants. In addition, integration of Internet of Things (IOT) technologies and automation can lead to smart monitoring, future maintenance and more efficient resource usage.

With increasing investment in renewable energy and water infrastructure, governments and NGOs are likely to adopt such systems for disaster relief, distance water supply and sustainable development projects. Over the long term, solar-ru uninterrupted can become an important component of global water management strategies, which contributes to water security, climate flexibility and energy-skilled development.

7. CONCLUSION

By making this project we conclude that this project is very useful for water purification by solar energy. It is easy to transport. Also, it is useful where electricity is absent. It is pollution free and billing free. By this project we learn how to make water purifier by using solar energy. Here we learn connection of solar panel, water pump and battery. By this we give more practical knowledge that is useful for us in future.

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