IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125265

WATER PURIFICATION SYSTEM USING SOLAR ENERGY

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Abstract: Drinking water is important need for daily life as there is scarcity of water in many regions worldwide. Across the world approximately 780 million people do not have access to pure water for drinking, cooking or washing. Consumption of untreated industrial water exposes human beings to a range of contaminants including faecal borne pathogens and chemical pollutants. But the quality of water should be such that it can be used by human being for drinking purpose. There are already lot of filters present in the market that can do purifying process, as the available filters made water safe to drink, but they did not decrease its saltiness, so the drinking water is still salty and eroded pots and pans, that providing little awareness to use these filters. In desalination process the removal of salt and other minerals from the ground water is carried out to make it suitable for human and animals use and industrial use. RO is mostly used domestic filtration system that removes even all the impurities. RO is required if the Total Dissolved Solids (TDS) exceeds a value of TDS of 500. The ultimate objectives of this project are to use the conventional source of energy, make a device/equipment which provide water for drinking purpose and designed a village level water purification system that runs on solar power.

Keywords: water purification, solar panel, drinking water

I. INTRODUCTION

When there is a shortage of pure water supplies or other environmental calamities, having access to clean drinking water in rural areas becomes a major issue. The population of these places frequently has health problems as a result of the lengthy transport times for fresh water. In this project, a solar-powered water filtration system employing Internet of Things-based water purification is proposed to create clean drinking water in those impacted locations where pure water is difficult to obtain. The purification process used by this water purification system uses an automated valve that fills a purifier with purified water. The contaminated water is collected and directed into a purification system with storage. This initiative might be a viable way to supply those areas with clean drinking water.

1.1 Problem Statement

Many people in rural areas are getting sick and dying from waterborne diseases due to not drinking pure water. Therefore, we want to develop a renewable energy-based water purifier and based water purification and power monitoring. This system purifier uses an existing market purifier kit because we can't make an RO Purifier kit in a short time. We will assemble the kit purifier kit for water filtering. This system is powered up using a Solar system. This Solar system uses a 20W solar panel. The battery uses a 9 Ah battery for backup power. This backup power is used for nighttime or cloudy weather. Since this system will be far away from us, so it is not possible to see the device everyday by going there.

1.2 Objectives

- This project vision is in rural area water purification which is impurity
- Development low-cost water purification system
- Using Renewable energy because of reduces cost and no harm for people and environment
- Every one used it easily and understand how the device working

1.3 Innovation

To ensure the accountability of the solar energy facilities, IoT system maintenance is crucial. New information collecting technologies are required because of the plants' growing length to increase their maintenance efficiency.

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Unmanned craft with tailored equipment result in a decrease in operational risks and maintenance costs. This project's biggest contribution might be a fresh method for boosting rural areas' productivity, ensuring that all equipment is measured with the necessary accuracy, and consuming less time and energy. This method depends on the determination of the reading area and the inspection goal for electrical equipment. The sites of examination are found using an explicit optimization model. The method is validated and proved by a real solar panel. Although the concept has been prototyped, the system will eventually be implemented for commercial use.

II. LITERATURE REVIEW

In developing nations, waterborne infections are responsible for up to ten million annual fatalities and several billion cases of illness, at least half of which are in children. Boiling is the method most frequently employed in rural areas of developing nations to clean water for use in cooking and drinking. Boiling, however, is rather expensive, uses a significant quantity of fossil fuels, and the associated wood harvesting depletes forests. One of the most promising options for an energy-efficient, cost-effective, durable, and trustworthy solution to these problems is star water sterilization. There is a valid and pressing need to provide environmentally responsible technology for the provision of drinking water in rural areas. One of the many valuable and necessary natural resources for humanity is water. However, the rapid societal growth and diverse human endeavors accelerated pollution and harmed the water resources. The most prevalent liquid on earth is water. Drinking pure liquids is crucial to human life. Water or surface water is the beverage installation. Sediments and other materials are present in all water supplies.

The commercial viability of MSF and RO as large-scale desalination techniques has been demonstrated. The cost of pre-treatment is significantly influenced by the type of seawater intake. For open channel intake, more rigorous measures are taken for MSF or RO. Strict measures have been implemented to reduce deep water pipe inflow. The MSF product water is bitter and caustic since the salt content is virtually zero [1]. A photovoltaic-powered reverse osmosis (PV-RO) desalination system's construction and testing are given. The device runs on seawater and doesn't need batteries because the amount of freshwater produced changes throughout the day depending on the amount of solar energy available. With the UK's meager solar resource, the system initially tested out at 1.5 m3/day of freshwater production. With a PV array only 2.4 kWp closer to the equator, a software model estimates year-round output of more than 3 MW/day. In combination with a variable water recovery ratio and a Clark pump brine-Stream Energy recovery mechanism, the system achieves a specific energy consumption of less than 4 kWh/m3 over a wide range of operation [5]. To boost the effectiveness of the entire system, a maximum power point tracking (MPPT) derivation is being used to power the reverse osmosis facility. A specific set of rules is used to merge feedforward and feedback voltage control systems in the control technique. Comparable to other algorithms, the MPPT method proved cost-effectiveness, simplicity, and good efficiency [6].Jordan uses a photovoltaic-powered reverse osmosis (RO) desalination system. The components of the RO unit include a polypropylene sediment filter with a 5-micron pore size, two active carbon filters with holes that are 1-2 micrometers in diameter, and a polyamide TFC membrane. A series of two PV arrays with a 32° southward slant is connected to one another. A one-axis east-west tracking flat plate photovoltaic is built in order to investigate how tracking affects the system's performance. Results analysis reveals that adopting this tracking system in comparison to a fixed flat plate could result in gains of 25 and 15% in electrical power and pure water flow, respectively [7].

In Asian countries, waterborne diseases are terribly common due to the insufficiency of pure water. Most of the population endures unsafe water. The energy crisis is another vital issue. Standard energy sources are restricted, and they cause environmental pollution. By employing a solar energy supply as an alternative energy source to purify water, these issues will be avoided. Solar power and based water purification setups are an advancement of the current water purification system. The methodology of the solar-powered water setup is imparted during this project. IoT based using solar energy water setup takes alternative energy as energy supply and stores energy in a well battery. Main parts of based using solar power water purification setup are solar panel, battery, purifier, filtering chalk, double layer condenser and a number of other water vessels. This setup uses a filtering mechanism to get rid of dirt from water and a purifying mechanism to kill organisms. Through this method, pure water is achieved.

III. METHODOLOGY

The World Health Organization (WHO) estimates that by 2025, half of the world's population will live in water-stressed regions. To ensure clean and secure access to potable water, alternative energy water purification may be a healthy and profitable option. Water evaporation is one of the main processes in the majority of alternative energy-driven chemical process systems. Due to their improved thermo-physical properties and optical tunability, we incline to suggest that adding nanoparticles to water may significantly boost the evaporation rate and, thus, the supply of clean water.

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3.1Working principle

Because we are unable to produce RO Purifier kits quickly, purifiers in this system use pre-made purifier kits from the market. We'll put together the water filtering kit purifier kit. Solar energy is used to power this system. A 8W solar panel is used in this solar system. For backup power, the battery employs a 10 Ah battery. In the event of bad weather or at night, this backup power is used. Since this system will be far from us, it won't be possible to watch the device move there every day.

A solar powered water purification system is a water project that utilizes sustainable environmental technology to capture solar energy to purify water, making it safe for domestic purposes particularly drinking. The project goal was to provide safe and inexpensive drinking water systems for use, which have the capacity to treat water making it safe for human consumption. The purification system consists of two main parts: a solar cell module and a water purification unit. The solar cell module unit has that provide clean electrical power for pump, solar disinfection lamp and charging the batteries. The water purification unit cleans water using proven ultra violet (UV) disinfection technology. The process is a chemical free. The system eliminates bacteria, virus and protozoa, thus providing clean and safe drinking water.

The project carried out by us made an impressing task in the field of water purification through RO method using renewable energy resource such as solar energy is constantly replenished and will never out. This work of operation is a simple assembly which is a good prototype to have a portable source of RO purified water. This has less weight and smaller size. By using solar power, we could able to purify the water with no running cost.

Specifications of the Equipment:

1. Solar Panel : 12v
2.High pressure pump: 0.5HP (80 PSI)
3. Battery : 2-series (12v)
4. Membrane Capacity: 4-5 ltr/hr
5.. Calculations

The Electricity Generated in Output of a Photovoltaic System is:

$$E = A \times R \times H \times PR$$

were,

E =Energy (Kw/h)
A =Total Solar Panel Area (M^2)
R = Solar Panel Yield or Efficiency (%)
H = Annual Average Solar Radiation on Tilted Panels (Shadings Not Included)
PR = Performance Ratio, Coefficient for Losses (Range Between 0.5 And 0.9, Default Value = 0.75)
E = (0.2×0.25) × 0.23 × 35 × 075
E = 0.3018 Kw/h
E = 300 W/h.

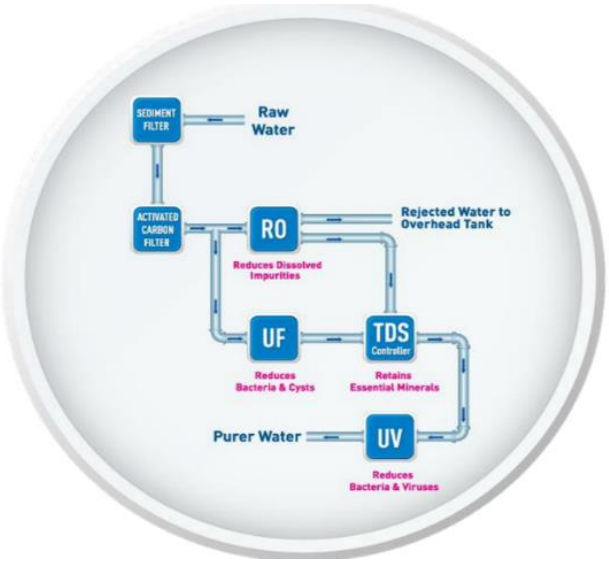

Figure 3.1 Water Purification System

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IV. CONCLUSION

The project's philosophy and purpose were both successfully realized. To get the most of our technology, we put in a lot of effort and conducted extensive research. The suggested project effort is in line with current science's and technology's mission to make life easier and more comfortable for the less fortunate. The main objective of this project is to provide people freedom and autonomy. The structural designs for this project were modeled using programs like hardware has been used to implement the design. The suggested configuration combines a number of useful elements to produce a real-time system.

REFERENCES

[1]. Nada, N. A., Al Zahrani, and B. Ericsson. "Experience on pre-and post-treatment from sea water desalination plants in Saudi Arabia." Desalination 66 (1987): 303-318.
[2]. Bian, David W., et al. "Optimization and design of a low-cost, village-scale, photovoltaic-powered, electrodialysis reversal desalination system for rural India." Desalination 452 (2019): 265-278.
[3]. Verma, Sujit Kumar, Piyush Singhal, and Durg Singh Chauhan. "A synergistic evaluation on application of solar-thermal energy in water purification: Current scenario and future prospects." Energy conversion and Management 180 (2019): 372-390.
[4]. Albloushi, A., et al. "Renewable energy-powered membrane systems for water desalination." Current Trends and Future Developments on (Bio-) Membranes. Elsevier, 2019. 153-177.
[5]. Thomson, A. Murray. Reverse-osmosis desalination of seawater powered by photovoltaics without batteries. Diss. Loughborough University, 2003.
[6]. De Carvalho, P. C. M., et al. "Control method of a photovoltaic powered reverse osmosis plant without batteries based on maximum power point tracking." 2004 IEEE/PES Transmission and Distribution Conference and Exposition: Latin America (IEEE Cat. No. 04EX956). IEEE, 2004.
[7]. Abdallah, S., M. Abu-Hilal, and M. S. Mohsen. "Performance of a photovoltaic powered reverse osmosis system under local climatic conditions." Desalination 183.1-3 (2005): 95-104.
[8]. Khawaji, Akili D., Ibrahim K. Kutubkhanah, and Jong-Mihn Wie. "Advances in seawater desalination technologies." Desalination 221.1-3 (2008): 47-69.
[9]. Villalva, Marcelo Gradella, Jonas Rafael Gazoli, and Ernesto Ruppert Filho. "Comprehensive approach to modeling and simulation of photovoltaic arrays." IEEE Transactions on power electronics, 24.5 (2009): 1198-1208.
[10]. Khan, Jameel R., et al. "Diffusion Driven Desalination for Simultaneous Fresh Water Production and Desulfurization." Journal of Thermal Science and Engineering Applications 2.3 (2010).
[11]. Mezher, Toufic, et al. "Techno-economic assessment and environmental impacts of desalination technologies." Desalination 266.1-3 (2011): 263-273.
[12]. Summers, Edward K., John H. Lienhard, and Syed M. Zubair. "Air-heating solar collectors for humidification-dehumidification desalination systems." Journal of solar energy engineering 133.1 (2011).

