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SOLAR ENERGY BASED WATER PURIFICATION SYSTEM USING ELECTROLYSIS OF WATER

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ABSTRACT

As an energy storage medium, hydrogen has drawn the attention of research institutions and industry over the past decade, motivated in part by developments in renewable energy, which have led to unused surplus wind and photovoltaic power. In this paper, we are making a water purifier which works on solar energy. The basic principle behind this project is reverse osmosis. The solar radiations are collected by solar panel. This energy is then stored in a battery. The battery is connected to the purification unit through an electromagnetic relay. 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. The microcontroller 8051 keep watch to the level of water in the water tank and prevents it from over flow. Through this process we obtain the purified water in the water tank. Water purification is the process of eradicating detrimental chemicals, biological poisons, suspended solids and gases from contaminated water. In this work we have reported an investigation of compact filter which is cost effective for developing countries and ease of maintenance. We have arranged a solar water disinfection system that improves the microbiological quality of drinking water at household level.

Keywords: Natural ingredients, Solar technique water purification, Green System, solar energy, Natural Ingredients, Solar water distillation**.**

I. INTRODUCTION

The world population is increasing day by day and also the demand for energy is increasing consequently. Oil and coal because the main supply of energy to day is predicted to finish up from the globe throughout the recent century that explores a heavy drawback in providing the humanity with a reasonable and reliable supply of energy. The requirement of the hour is renewable energy resources with low-cost running prices. Solar energy is taken into account jointly of the most energy resources in heat countries. Solar energy is incredibly giant inexhaustible supply of energy.

The reuse of water has been doubled as the greatest challenge of the 21st century (Asano, 2002), and, as such, great emphasis is being put into the development of new technologies for the treatment of wastewater for reuse. In general, the methods used include physical processes such as filtration, sedimentation and distillation, biological processes such as slow sand filters or biologically active carbon, chemical processes such as flocculation and chlorination and the use of electromagnetic radiation such as ultraviolet light. There are many parameters which can be used to measure the quality of water, of which a common one is turbidity, the purpose being to measure impurities in the water. In sense of physical, turbidity is a reduction in the clarity of water due to the presence of colloidal particles or suspended, and commonly it is used as an indicator of the general condition of drinking water. Furthermore, turbidity has been used for many decades as an indicator of the efficiency of drinking water filtration and coagulation processes, so that it is an important operational parameter for this reason. The high turbidity values refer to poor disinfection and possibly to fouling problem in the distribution network, so that it should be minimized.

1.1 Mechanism of water purification and disinfection:

The water purification and disinfection system is divided into two steps. First is the compact filter preparation and second is the solar collector preparation. In this system, the water is filtered by using physical process of filtration as well as solar energy. At first the water is filtered by using the compact water filtration. Then the pure water is reserved in an aluminum cylinder surrounding with the square glass, which is connected with the solar flat plate solar collector. The solar collector consists of aluminum cane that absorbs the solar heat energy and passes through the aluminum cylindrical chamber. The solar collector is an air tight chamber in which glass is used as surface cover. Then the reserve chamber obtained heat either directly from the sun or the solar collector so that no significant effect on the disinfection of E. coli bacteria. From this, some condensed water is collected from the reservoir which is considered as pure water. There are many parameters of measuring water are tested by

different instruments after and before treatment. Finally, we not only get the pure drinking water but also hot water from this system.

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. 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.

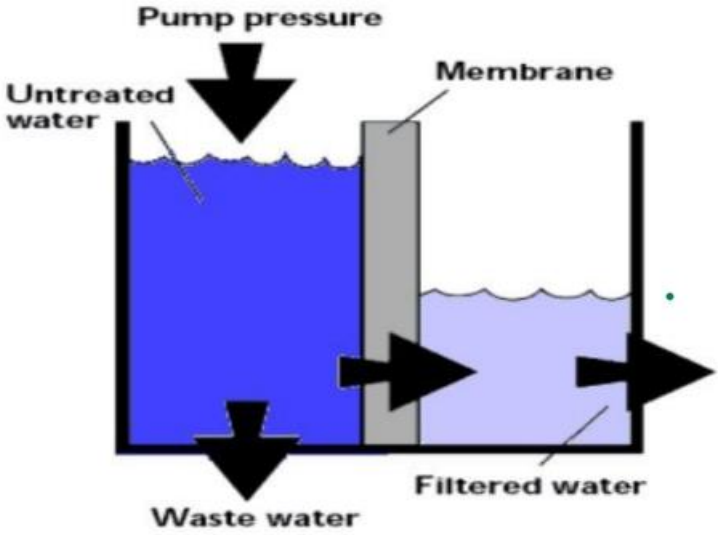


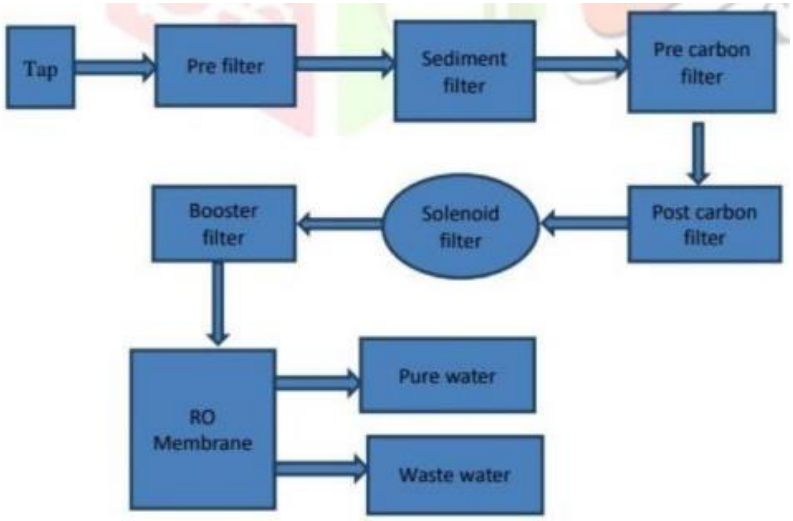
Figure1. Purification technique using solar

II. METHODOLOGY

The solar radiations are collected by solar panel. This energy is then stored in a battery through a charge controller. The charge controller prevents the battery from getting overcharged. 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. 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. The microcontroller 8051 keeps a watch to the level of water in the water tank and prevents it from over flow. Through this process we obtain the purified water in the water tank.

The methodology for a solar energy-based water purification system using electrolysis of water typically involves the following steps:

Water collection: The first step is to collect water from a source such as a well, river, or rainwater.
Filtration: The collected water is then passed through a series of filters to remove any large particles or impurities.
Electrolysis: The filtered water is sent to an electrolysis chamber, where solar panels convert solar energy into electrical energy to power the electrolysis process. The process separates the water into hydrogen and oxygen gases, with the hydrogen gas being used to reduce any contaminants present in the water.
Sludge removal: The reduced contaminants form a sludge that can be easily removed from the water.
Final filtration: The purified water is then sent through a final set of filters to remove any remaining impurities before it is collected in a clean container for drinking.
Maintenance: The system requires regular maintenance to ensure the solar panels, filters, and electrolysis chamber are functioning correctly.



Flowchart of water purification using solar

2.1 Process of Execution of Purification:

Planning: Determine the scope and requirements of the project, including the amount of water to be purified, the quality of the water, and the desired output. Identify the necessary components and equipment required to build the system.
Design: Create a detailed design of the water purification system, including the layout, the specifications for the components and equipment, and the electrical and plumbing connections.
Procurement: Purchase the necessary components and equipment, including solar panels, batteries, an electrolysis device, a fuel cell, a UV lamp, and storage tanks.
Construction: Assemble the system according to the design, connecting the components and equipment together. Ensure that all electrical and plumbing connections are secure and properly insulated.
Testing: Test the system to ensure that it is functioning properly, including testing the solar panels to ensure they are generating enough electricity to power the electrolysis device and fuel cell. Test the electrolysis device to ensure that it is effectively splitting water into hydrogen and oxygen gas.
Calibration: Calibrate the system to optimize its performance, including adjusting the flow rate of the water, the amount of electricity generated by the solar panels, and the settings on the fuel cell and UV lamp.
Operation: Operate the system according to the design, regularly monitoring its performance and making any necessary adjustments. Maintain the system by regularly cleaning the filters and storage tanks, and replacing any worn or damaged components.
Evaluation: Evaluate the performance of the system over time, including monitoring the quality of the purified water and the efficiency of the system in generating electricity. Make any necessary improvements or modifications to the system to optimize its performance.
Note: The methodology for a solar energy-based water purification system using electrolysis of water may vary depending on the specific design and requirements of the system.

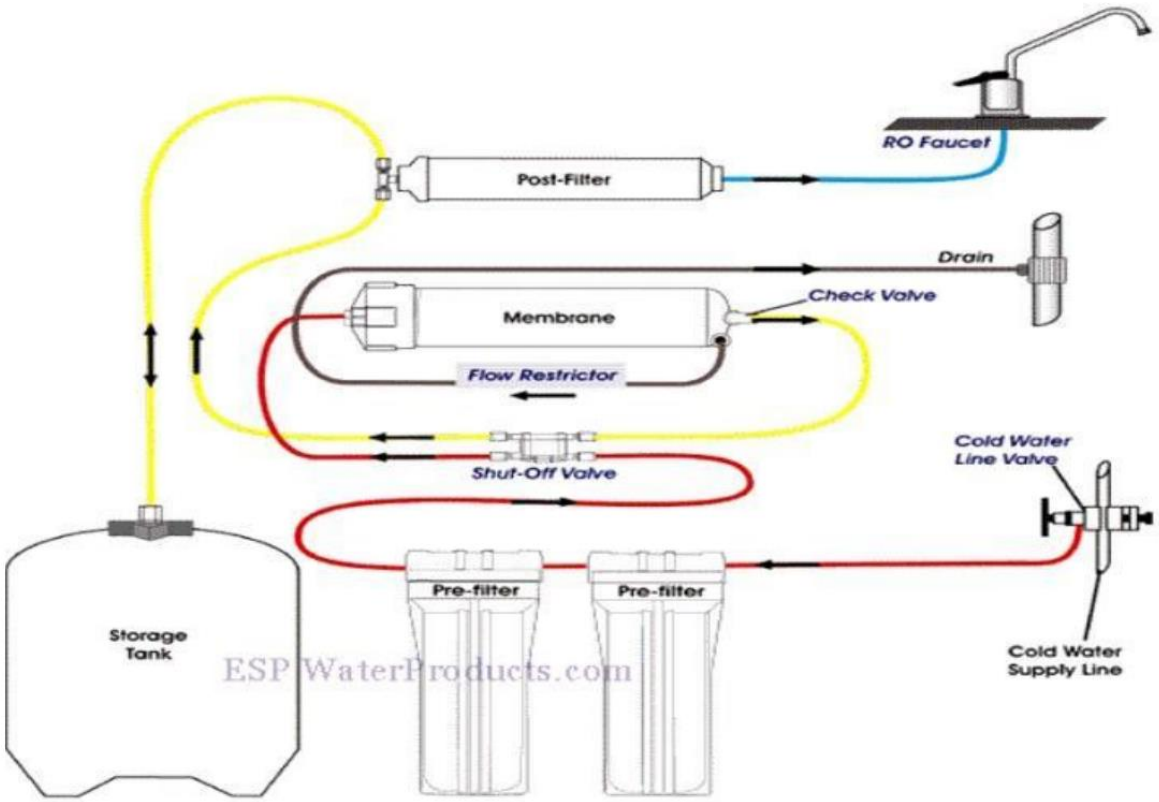


Figure 2: Filter Process

2.2 Solar Water Distiller:

Figure 3 shows the schematic diagram of the solar water distiller device. The water sample was transferred into the device and the solar water distiller was placed directly under the sun for 10 hours from 7 am to 5 pm. The production of treated water was recorded in a one-hour interval. The physical and chemical parameters for final production of water collected from solar distiller was tested and then, the data obtained was compared to Drinking Water Quality standard from MOH and drinking bottled water concentration regulated by RO Water Malaysia.

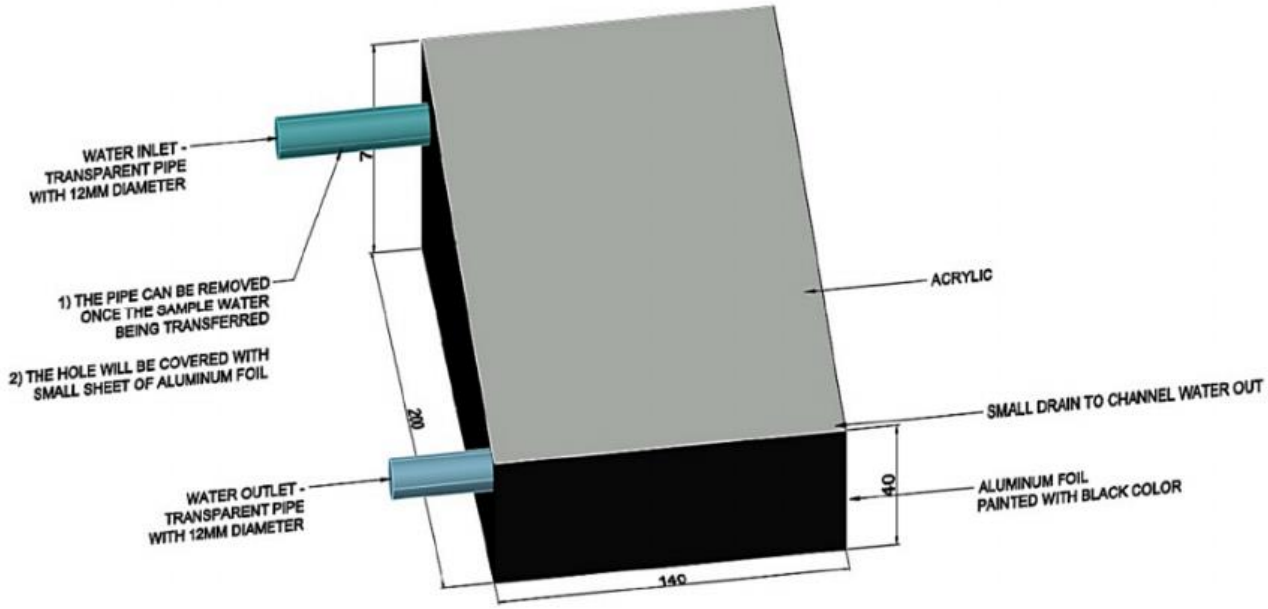


Figure 3: Schematic diagram of the solar water distiller

III. MODELING AND ANALYSIS

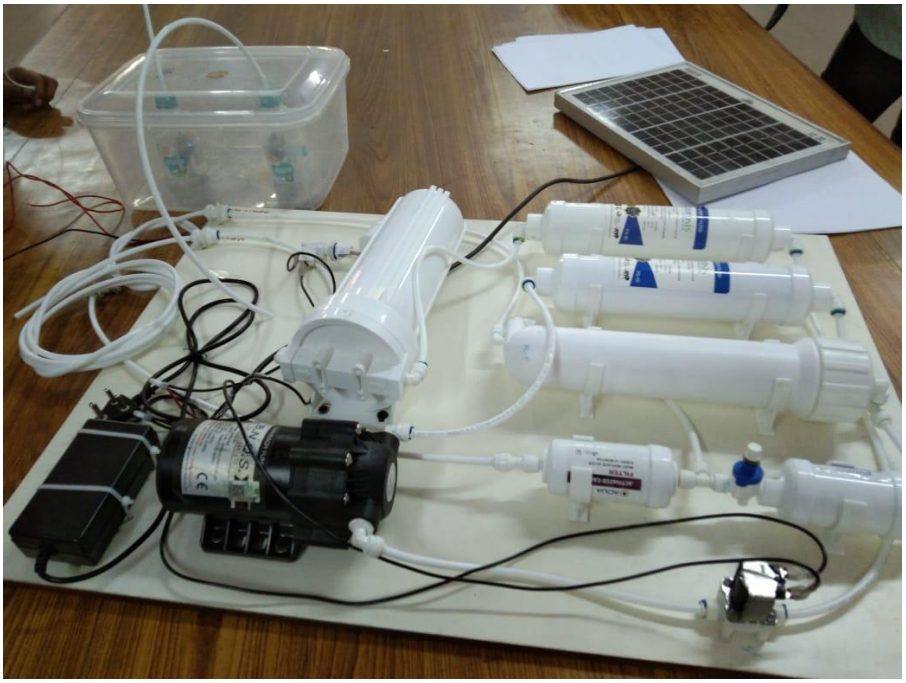


Figure 4: Model of Solar Energy Based Water Purification System Using Electrolysis of Water

LITERATURE REVIEW:

1. “A Novel Solar-Powered Water Purification System Using Electrolysis and Reverse Osmosis" (Xiaoyang Gao et al., 2020):

This study presents a solar-powered water purification system that uses electrolysis to produce hydrogen gas, which is then used to power a reverse osmosis (RO) system. The results show that the system can effectively purify water with a high salt concentration, and has a high energy efficiency.

2. “Solar-Driven Electrolysis for Water Treatment and Reuse" (Sanghyun Jeong et al., 2019):

This study investigates the use of solar-driven electrolysis for water treatment and reuse. The results show that solar-driven electrolysis can effectively remove contaminants from water and produce hydrogen gas, which can be used to power a fuel cell and generate electricity.

3. "Solar Energy-Powered Water Purification System using Electrolysis: A Review" (Asfaw Beyene et al., 2020):

This review article provides an overview of solar energy-powered water purification systems using electrolysis, including the different types of electrolysis devices and their applications in water purification. The article also discusses the challenges and future directions for this technology.

4. "A Solar-Powered Electrolysis System for Water Purification and Hydrogen Production" (Ming Chen et al., 2020):

This study presents a solar-powered electrolysis system for water purification and hydrogen production. The system uses a photovoltaic panel to generate electricity, which is then used to power an electrolysis device. The results show that the system can effectively purify water and produce hydrogen gas with a high energy efficiency.

5. "A Solar-Powered Water Purification and Hydrogen Production System Using Electrolysis" (Muhammad Naveed et al., 2019):

This study presents a solar-powered water purification and hydrogen production system using electrolysis. The system uses a photovoltaic panel to generate electricity, which is then used to power an electrolysis device. The results show that the system can effectively purify water and produce hydrogen gas with a high energy efficiency.

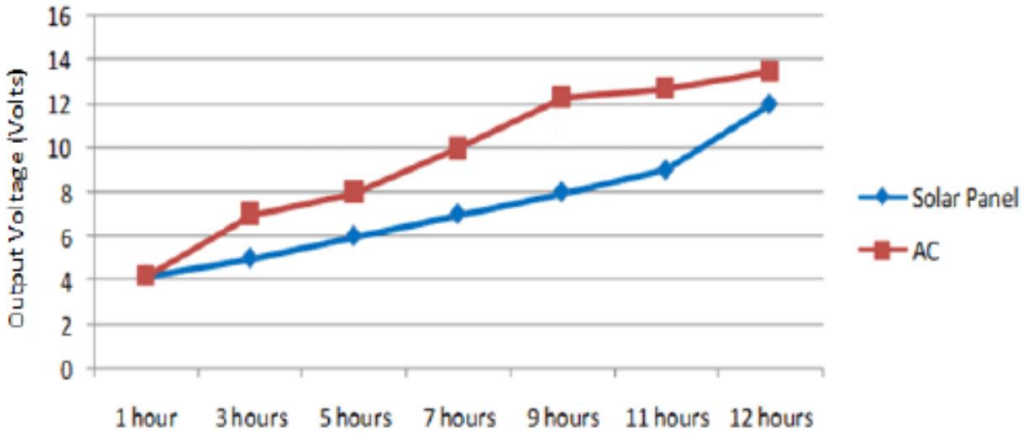
Overall, the literature suggests that solar energy-based water purification systems using electrolysis can effectively purify water and produce hydrogen gas with a high energy efficiency. However, there are still challenges to be addressed, such as the

scalability of the technology and the cost-effectiveness of the system. Further research is needed to optimize the design and improve the performance of solar energy-based water purification systems using electrolysis**.**

IV. RESULTS AND DISCUSSION

A solar energy-based water purification system using electrolysis of water is an innovative approach to producing clean drinking water. It uses solar energy to power an electrolysis process that separates water into hydrogen and oxygen gases. The hydrogen gas is then used to reduce the contaminants present in the water, while the oxygen gas is released into the atmosphere. This system can be a sustainable and cost-effective solution for providing clean drinking water in areas with limited access to electricity and safe drinking water sources.

Overall, a solar energy-based water purification system using electrolysis of water can be a sustainable and cost-effective solution for providing clean drinking water in areas with limited access to electricity and safe drinking water sources. However, the system's effectiveness will depend on several factors, including the quality of the water source, the efficiency of the electrolysis process, and the maintenance of the system.



Graph: Solar Panel and AC Charging Comparison

V. CONCLUSION

In conclusion, solar energy-based water purification systems using electrolysis of water have the potential to be a sustainable and efficient solution for providing access to clean water in areas with limited resources. The technology is based on the use of solar panels to generate electricity, which is then used to power an electrolysis device that produces hydrogen gas, which can be used to power a fuel cell and generate electricity or combined with oxygen gas to produce purified water.

The literature review suggests that the technology has shown promising results in terms of water purification and hydrogen production, with high energy efficiency and the potential for scalability. However, further research is needed to optimize the design and improve the cost-effectiveness of the system.

Overall, solar energy-based water purification systems using electrolysis of water offer a sustainable and renewable solution for water purification, particularly in areas with limited resources and access to clean water. With further research and development, this technology has the potential to play a significant role in addressing global water scarcity and promoting sustainable development.

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