"Review of Solar Powered Reverse Osmosis Water Purifier"

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Abstract:
This paper is intended true make use of solar energy by using solar PV cells for residential application. Also if modified the proposed model of solar RO water purifier can be made portable and extend its application area. The use of solar PV cell along with suitable controller circuits for RO water purification (small capacity). Controller circuit consisting charge controller which increase the solar efficiency which having various protection. it can be worked out only on DC eliminating the use of inverter, thus giving out more efficient system is discussed.

Keywords: **solar energy, solar still Distillation system, drinking water.**

1. INTRODUCTION

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. Reverse Osmosis has however found use in several small- town areas. Here, the treatment of brackish water, with typically high levels of hardness or Fluoride content, has been favored by Reverse Osmosis as opposed to Ion Exchange and other technologies. Typically the main water source for such towns is an active borehole or aquifer. Unfortunately, though there is an abundance of boreholes for possible treatment, these sites are often in remote areas with little or no infrastructure to install a reverse osmosis treatment unit. The Indian government has been especially active in the supply of water to township and rural areas, but the expansion of the electrical grid to supply electricity to all these areas is still lagging behind. Several alternative energy sources are being evaluated in the interim, with diesel, car batteries, LPG and paraffin power being the norm. However, these forms of energy can only be applied for low energy requirements, i.e. cooking and lighting requirements or at best the transport of drinkable water.

2. COMMON METHODS FOR SOLAR WATER PURIFICATION

2.1 SOLAR WATER DISINFECTION

Solar water disinfection is a low technology, simple process of purifying water using solar Energy and solar radiation. SODIS as a technology was first introduced in 1980 by Aftim Acra et al. from the American University of Beirut. The process involves contaminated water being filled in transparent PET or glass bottles which are then exposed to the sun for approximately 6hours. The UV rays of sun eliminate the diarrhea-causing pathogens, thereby making the water fit for consumption.

2.2 Solar Water Distillation

Solar water distillation uses a solar still to condense pure water vapor and settle out harmful substances to make clean, pure drinking water. This process is used when the water is brackish containing harmful bacteria, or for settling out heavy metals and also for desalination of sea water.

2.3 Solar Water Pasteurization

Solar water pasteurization involves the use of moderate heat or radiation to kill disease – causing microbes. This heat is provided from cookers that trap solar energy. This method has proven to kill bacteria, viruses, worms and protozoa.

2.4 Solar Water Purification

This method integrates electricity generated from solar energy for water purification. Solar panels generate power for a battery which is used for filtration and purification systems .These structures are generally mobile and are immensely helpful for disaster - relief efforts. They also come in various sizes meant for small scale use to commercial/community supply.

2.5 Block diagram of solar RO system

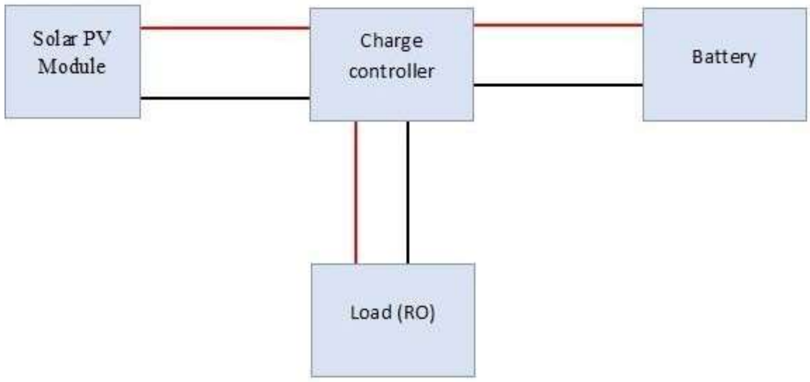


Figure : Block diagram of solar RO system

2.6 Circuit Diagram of Solar RO

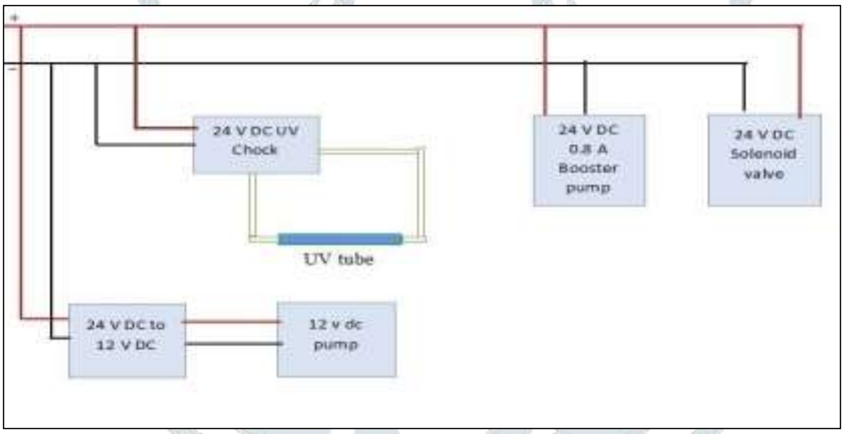


Figure:Circuit Diagram of Solar RO

3. RESEARCH METHODOLOGY

3.1 The method The research programme was formulated in such a way as to establish a study protocol in order to obtain results and conclusions for each of the project objectives.

The order, or project, execution was as follows:

- Determine solar panel production capabilities
- Design and construct pilot unit
- Laboratory tests and optimization of unit
- Laboratory tests – production vs. Time of day
- Field tests – continuous unassisted operation
- Laboratory tests – production vs. Conductivity of feed
- Field tests – daily optimized operation

The field trials included under the research program included the monitoring and logging of the following process parameters:

Level of Sunlight

Feed Conditions of Well Water

Permeate Product Quality and Production Latitude and longitude angle

Latitude angle -

Imagine the Earth was a transparent sphere (actually the shape is slightly oval because of the Earth's rotation, its equator bulges out a little). Through the transparent Earth (drawing) we can see its equatorial plane, and its middle the point is O, the center of the Earth.

In Jalgaon latitude angle is 21.0076578

3.2 Construction and Working:

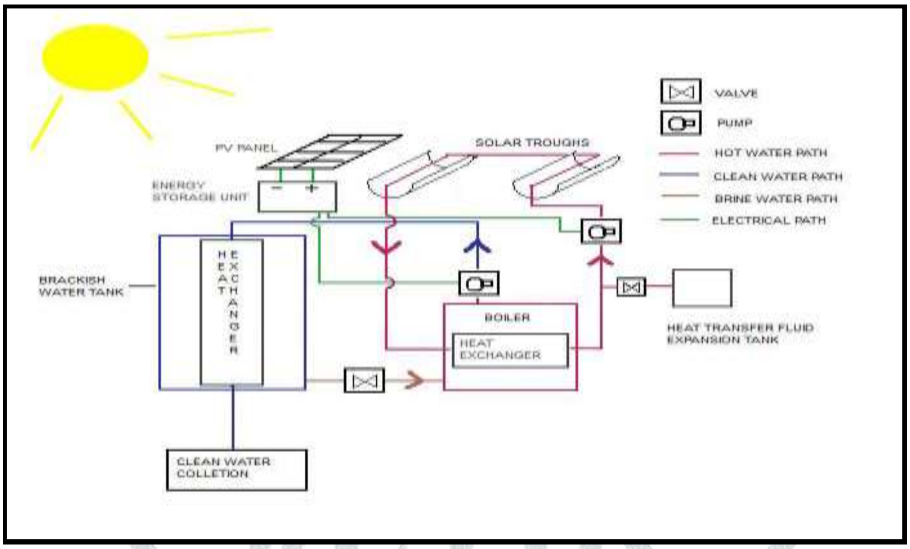


Figure : Block diagram of major subsystems of the design

3.2.1 Working:

The primary challenges for this project was completing tasks by their deadlines, as well as reaching the target temperature of 100 °C within the boiler. The team was given the task to improve the previous year’s system, but, after much discussion, the team decided to create completely new design. Many hours were spent trying to test and become familiar with the old system, which provided information regarding which components could be reused and which were to be replaced or redesigned. Unfortunately, many main of the components of the existing system, such as the flat plate solar collector, the vacuum pump, the vapor pump, and the condenser were ultimately removed from the system. The extent of efforts used to analyze the system, as well as extent of redesign of the overall system was much greater than anticipated. Therefore, the team had a late start in designing the new system. To return on schedule, the team worked through weekends and holidays to build the system. Also additional delays occurred during construction. For example, copper parts would become deformed during soldering, and the solar tracker would malfunction. To address these problems, additional tasks would be assigned as necessary to find efficient and cost effective solutions. Due to these unanticipated delays, the team did not get to do as much testing and make as many modifications as anticipated desired Initial testing showed that the system could not heat the salt water up to 100 °C, even when left out for six to eight hours. With only three weeks available for testing and modifications, there was insufficient time to make extensive changes to the design. However, the team was able to make minor changes, such as improving the focal length of the troughs, adding a convective envelope, and testing a new flow rate. Enough tests were conducted to draw conclusions regarding the impact of changes on the system performance, and are further discussed in Section 5. Completing tasks by deadlines was a challenge due to unexpected hurdles, but the team still managed to do a great job to complete main goals on time.

3.2.2 Calculation:

Ampere hours capacity Voltage Rating of load = 24

Total Hours Required = 8

Maximum Current = 1.12

Ah Capacity of battery = Maximum current × Total Hours

Ah Capacity of battery = 1.12 × 8

= 8.96

= 9 Ah (Approx.)

Hence here we use two battery having 12 V voltage rating connected in series. A higher voltage battery pack with a lower capacity (amp-hours) can deliver the same total energy as a lower voltage pack with higher capacity

4. RESULTS AND DISCUSSION

4.1 Results of Descriptive Statics of Study Variables

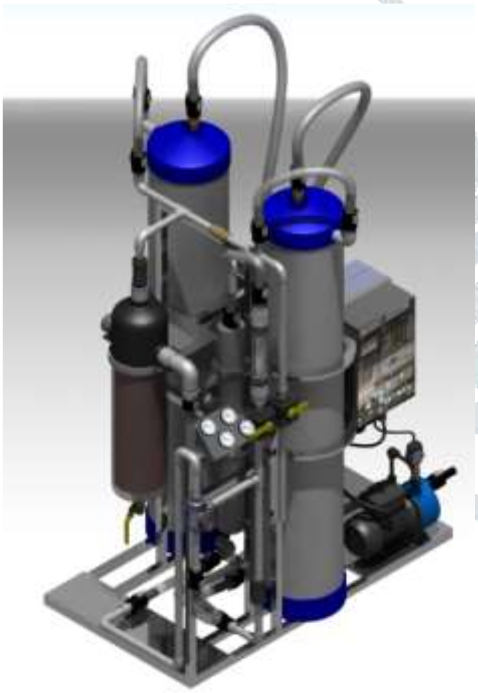
Figures and Tables

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. [4], [5].

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 24 V D.
In our system the storage tank capacity is 15 litre for its full tank require time is 1 hours 20 minute.

4.2 Figures:



4.3.1 Tables

1 Control Box
2 Flow Meter
3 Control Valves
4 Helix Disc Filter
5 UV Filter
6 Carbon Filter
7 UF Membrane Filter
8 Air Blower
9 Back flush Pump
10 Inline Pump

4. 3.2Tables

Applications	**suitable for purification of brackish / tap water**
purification capacity	up to 15 lph
body material	abs food grade plastic
Mounting	on the wall
dimensions(mm)	l 410 w 260 h 520
inlet water pressure/temp (min)	0.3 kg / cm^2 or 4.267psi / 10°c
inlet water pressure/temp (max)	3 kg / cm^2 or 42.67psi / 35°c
filter cartridges	sediment, carbon block filter, UF & post carbon
auto-flushing system	-
UV lamp wattage	11 watt
Weight	8.500 kg
storage capacity	15 l
power consumption	30.2
membrane type	thin film composite RO
booster pump voltage	24 v dc
Voltage	24 dc

4.3.3 Testing before finalizing the Solar RO unit

AC load test on RO -

Apparatus used:-

1) Voltmeter (0-300)V
2) Ammeter (0-2)A

Observation –

Voltage	**Current drawn by Purifier**	**Power consumption**
230V	0.15A	34.5 watts

Rated power consumption

1) Pump:-24 V × 0.8 = 19.2 watts
2) UV lamp:-11 watts

Total power consumption = 30.2 watts

4.3.4 AC & DC Measurement –

For AC Measurement –

VOLTAGE (V)	**CURRENT (I)**	**WATT (W)**	**Time Taken For One Litre Water (Minute)**
230	0.15	34.5	6:37

For DC Measurement –

VOLTAGE (V)	CURRENT (I)	WATT (W)	Time Taken For One Litre Water (Minute)
24	1.08	26.49	6:30

AC & DC Conversion Loss –

AC watt = 34.05 W

DC watt = 26.49 W

Total loss = 8.01 W

References:

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