Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 7, Issue 06, June -2020

Development of automatic change over controller for solar power RO water purification system

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Abstract —*This project makes use of AC supply as well as solar energy by using solar PV cells (DC supply) for residential application. Also if altered the planned model of solar RO water purifier can be made convenient and outspread its application area. The use of automatic change over controller circuits for AC and DC (solar power) RO water purification system (small capacity). Controller circuit involving charge controller which rise the solar efficiency which having various guard. It can work out only on DC eliminating the use of inverter, thus giving out more efficient system. This system quite a good product to have in situations of flood and remote areas where the water purification is needed to be done. Future purifier may be less costly and convenient to use [1,2].*

Keywords- *Solar Plates, Batteries, Charge Controller, Reverse Osmosis Water Purifier, cartridge fuse.*

I. INTRODUCTION

Reverse osmosis for the invention of drinkable water is still not broadly applied in spite of high feed TDS and low flow rate requirements being the usual characteristics for drinkable applications. The allowance is of course the invention of drinkable water from seawater by reverse osmosis, but this has thus far found limited application in India. The Indian government has been specifically active in the supply of water to community and rural areas, but the extension of the electrical grid to supply electricity to all these areas is still lagging behind. Quite a few alternate energy sources are being assessed 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 [3,4].

Fig.1.1: Block diagram of Proposed Controller

II.LITERATURE REVIEW

Manoj Phalak, Piyush Kurkure, Nikhil Bhangale, Vipul Deshmukh, Mayur Patil: This Author tells that intended true make use of solar energy by using solar PV cells for residential application. Also if changed the planned 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 involving charge controller which rise the solar efficiency which having various protection. it can be functioned out only on DC rejecting the use of inverter, thus giving out more effective system

. Ryan B. Anderson, Naomi J. Andrews: This author says that the paper from Santa Clara Universitys 2011-2012 Solar-Powered Water Purification System team is developing a solution to create a water distillation system, heated by solar troughs and solar powered by photovoltaic (PV) panels that can produce clean, drinkable water. This device would permanence cost and efficiency to be salable to lower-income

locations, such as developing countries that suffer from shortages of clean water. In accomplishing this, the team will ensure that the system is sustainable and requires minimal maintenance.

Jervin Paul Dhas: This author tells that design and analysis for application implemented on wastewater treatment plant to produce a comprehensive real-time management environment for a modern wastewater purification plant. The refinement of water is done by RO and UV process. The entire system is powered by solar panels to reduce the capital requirement.

Dr. S. Prakash, Deepak Toppo: This author says that, they are making a water purifier which works on solar energy. The basic principle behindhand this project is reverse osmosis. The solar radiations are collected by solar panel. This energy is then stored in a battery This project has only capital cost and almost no running cost. Hence, It will prove to be useful in the near future.

Sugiarto, Lulusi, Sofyan M Saleh: This author tells that paper they design a solar water treatment plant for household purpose. Water purification is the process of destroying harmful chemicals, biological poisons, suspended solids and gases from contaminated water. This is a compact filter which is cost effective for developing countries and ease of maintenance This simple solar hybrid system helps to remove turbidity as well as chemical contaminants from water sources.

III. OBJECTIVE OF PROJECT:

Main purpose of RO system is to give purified water, where the water contamination is high or the water is hard. popular of RO system are employed on ac 230 V 50 Hz supply in India because easy availability of AC supply but the basic structure of RO system comprising promoter pump or pressure pump and other electrical element is primarily raised to work on DC supply. So the working of RO is contains mainly change of AC 230 V to 24 V DC in popular of RO units. The system on which we are going to work is 12 liter RO water purifier system. Objective of this project involves:

Study of RO system.

- Eliminating use of inverter.
- To motivate the people for use of renewable energy.
- Development of controller based on auto change over from solar to AC supply and from AC to solar system.
- Analysis of each components of system.
- Analysis of RO system based on solar system output as well as AC system.
- Analysis of overall system with respect to its performance
- Output of solar panels on hourly basis.
- Analysis of RO system on AC supply as well as on solar (DC) supply.
- Comparative analysis of power consumption by RO system on AC and DC supply.
- Development of controller for supply changeover during voltage drop conditions.
- Analysis of controller voltages during operating conditions.

IV. SYSTEM DEVELOPMENT

4.1 Block diagram of solar RO system

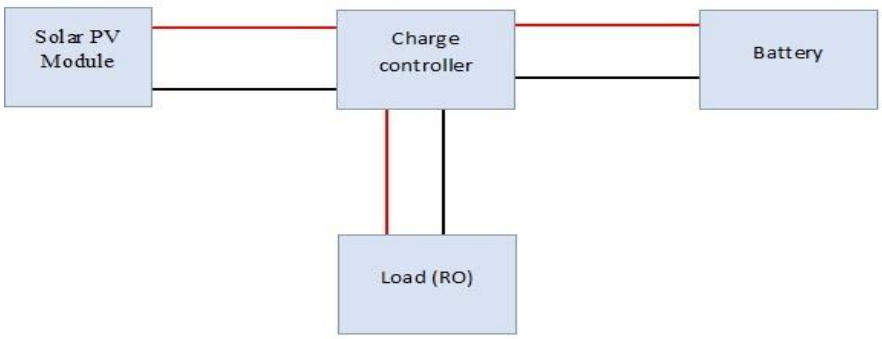


Fig. 4.1(Block diagram of solar RO system)

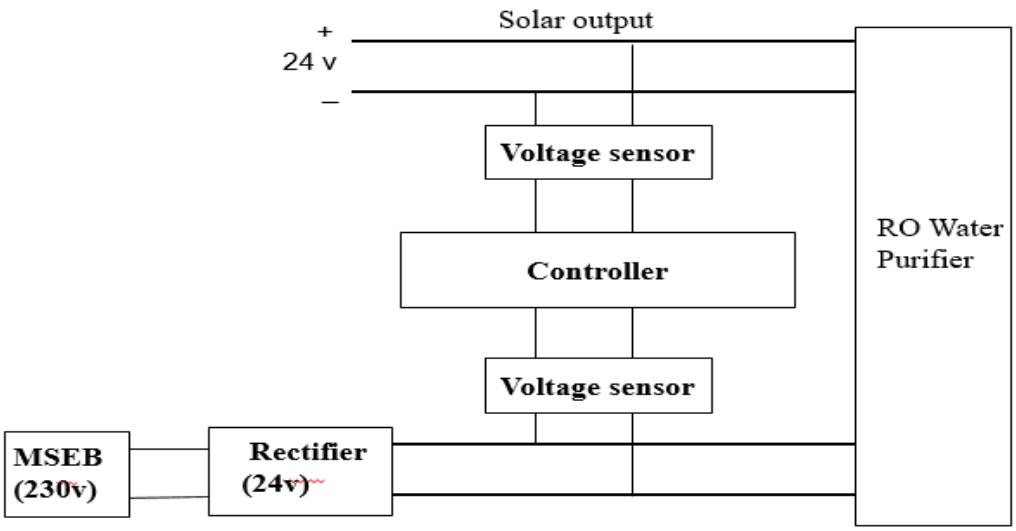
This block diagram gives instruction about actual working of solar RO system. In this system power is supplied from solar PV module, battery backup is given for night uses of solar RO system. The role of solar charge controller this is to regulate the charging voltage and it prevent battery from over charging the battery. An also increase the efficiency of whole system. Load consisting three different units such as Booster pump, Water feed pump and UV tube. The total power consumption of load is 40 watts. In battery section there are two battery having 9 Ah capacity of 12v voltage rating are connected in series to obtain 24v. Here SMF battery are used which having no maintenance and better reliability. Here we used polycrystalline Solar panel for maximum efficiency. To obtain 24v supply we used two solar panel are connected in series. The advantage of polycrystalline panel is it occupy less space than other solar plate material. This solar panel is absorbing 90% to 95% energy which is radiated by sun. The solar panel tend to have slightly lower heat tolerance than monocrystalline solar panels. The amount of waste silicon is less compare to monocrystalline [4,5].

4.2 operation:

- Main purpose of RO system is to give purified water, where the water contamination is high or the water is hard majority of RO system are working on ac 230 V 50 Hz supply in India because easy availability of AC supply but the basic structure of RO system containing booster pump or pressure pump and other electrical component is mainly built to work on DC supply. So the working of RO is involving mainly conversion of AC 230 V to 24 V DC in majority of RO units. The RO units we are discussing here are home RO system with limited capacity.
- The system on which we are going to work is 12litre RO water purifier system. Which is a separate unit working on DC. By doing so it gives us advantage of the system which is free from 230 V AC supply to DC supply conversion. So with DC system having batteries one can also mark it convenient
- Mainly portability with help the RO system to be available in remote areas or rural area where the water quality is not good and electricity is not available. But at the same time this needs to be continuously working even after the battery discharged so the concept of introduction of solar power will help to a great extent as power source for charging the batteries.

  This concept requires certain modification in existing RO system but once the modification is done it is highly usable in remote areas for rural application or for military or flood affected regions where obtainability of pure water is erratic and state are emergency.

4.3 proposed work:



In these system we are used two main supply AC(230v) as well as DC (solar 24 v) supply.AC supply is converted in to DC supply by using rectifier (230v AC into 24v DC). both AC and DC(solar) supply connected to the voltage sensor. 1st preference given to DC supply. voltage sensor is used to measure AC and DC voltage level and output given to controller. DC(solar) below 20v Then Ac supply used. Controller sense the connection and output given to the RO water purifier [6,7].

V.LIST OF EQUIPMENTS

Sr. no.	Name of components	specification
1	Aqua Fresh Swift Water Purifier	Up to 12ltr
2	Battery	9Ah,12V DC
3	Charge Controller	24V ,10Amp
4	Pump	24V DC
5	Cartridge fuse	2 Amp

(Table No.5.1 list of equipment)

5.1 Technical Specification:

Storage tank capacity-12ltr. (Approx.)
Purified water delivery rate- 8 to10 ltr per hour. Depending upon the feed TDS
Dimension-370 x 200 x 510
Net weight 11kg with accessories.
Power Rating- 40watt
Booster Pump Voltage-24v DC
Filter Cartages Pre-sediment, Carbon filter, RO membrane, Post carbon filter

VI.CALCULATION

Ampere hours' capacity

Voltage Rating of load = 24
Total Hours Required = 8
Maximum Current = 1.05

Ah Capacity of battery = Maximum current × Total Hours

Ah Capacity of battery = 1.05 × 8 = 8.4~9 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

VII.RESULT:

TESTINGS:

On AC Supply:

Sr. No.	Voltage (v)	Current(Amp)	Power(Watt)	Time taken for 1 ltr (min)
1.	230	0.24	55.2	8:00

On DC Supply:

Sr. No.	Voltage (v)	Current(Amp)	Power(Watt)	Time taken for 1 ltr (min)
1.	23.5	0.9	21.15	8:00

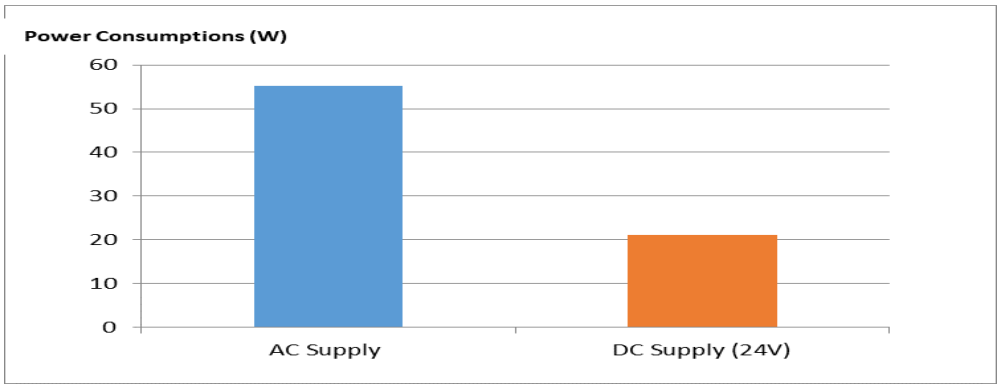


Fig. 7.1: Power consumption on AC and DC supply by RO System

Result for controller:

Case I: When power supply from Source I i,e from solar system falls during partial shading condition or when battery voltages falls below operating voltage of Ro i,e 24V then controller will shift the power supply from solar to regular AC supply through rectifier.

Case II: When supply from solar system is restored means voltage reached to operating voltage of RO, 24V then controller will shift supply from regular AC supply to DC supply through solar system**.**

	Source I (Solar Voltage) VS_1	Source II (Regular AC Supply) VS_2
Case I	Voltage drops to approx. 20V	24 V regulated DC from converted from AC supply
Case II	Voltage rises to 24V DC	Voltage drops to 0 V

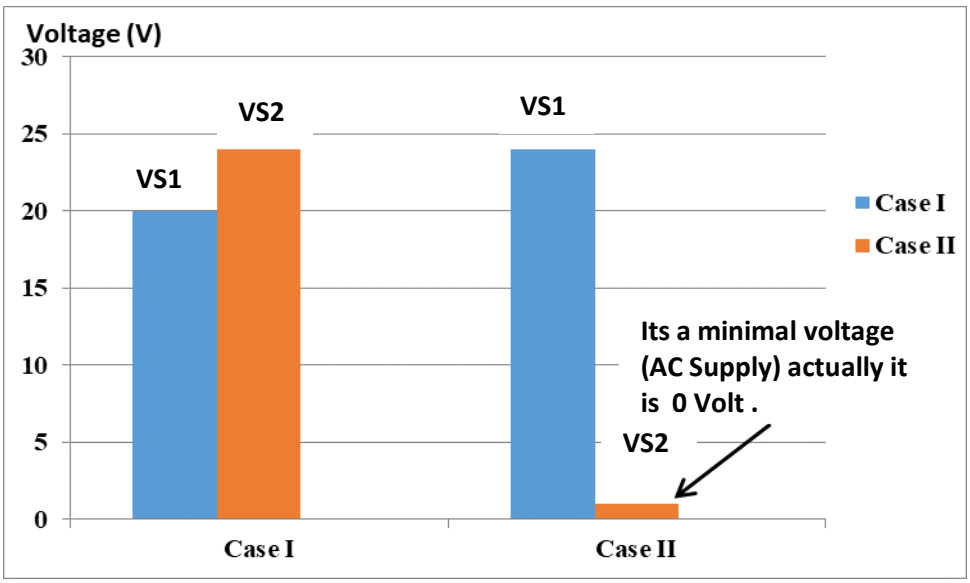


Fig 7.2: Controller output voltage for Case I and Case II

VIII. ADVANTAGES, DISADVANTAGES, APPLICATIONS

8.1 Advantages

- system should be in continue work even in battery discharge.
- lifetime unit.
- reduce weight of system.

8.2 Disadvantages

- high capital cost due to solar plate, charge controller and batteries.
- output get affected due to change in climatic condition.
- dust and dirt particles accumulated over the surface of solar plates.

8.3 Applications

- Flood affected area.
- Military area.
- Travelling purpose.
- hospital.

IX.CONCLUSION

This work of operating is simple assembly which is a decent prototype to have a portable source of RO purified water this has a lesser amount of weight and lesser size. Testing calculation presented that this is quite a good product to have in circumstances of floods and remote areas where the water purification is needed to be done. Future purifiers may be less costly and convenient to use and promote people to use renewable source. In these project we used automatic change over controller. It is designed to maintain continuous power supply. According to the given cases 1st preference given to the DC supply (solar panel). when DC is not available it will switch on AC. cost of these controller is less.

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