



PURIFICATION OF WATER USING SOLAR POWER AND RO MEMBRANE

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ABSTRACT

Renewable energy resources such as solar energy is constantly replenished and will never run out. Reverse osmosis is one of the processes that makes desalination (or removing salt from seawater) possible. Beyond that, reverse osmosis is used for recycling, wastewater treatment, and can even produce energy. Here in this project we use solar energy to actuate the reverse osmosis process. We use 18-24V solar panel and 24V battery (12V*4-series) to store the solar power. So that during night time we won't be running out of power. These solar ro water systems can purify water from any source. Water from river, pond or bore well, these solar ro systems can deliver safe drinking water anywhere you need; in addition, these systems are highly suitable for military camps, village areas and fairs and tourist places where arrangement of temporary drinking water is a prime requisite at minimal price. Since RO systems becomes cheaper and easier to handle the latest developments are to combine proven photovoltaic technology (PV) with proven RO technology. The result is an economical solution that provides always clean water on a decentralized and renewable basis.

I. INTRODUCTION

A. Overview

Renewable energy is generally defined as energy that is collected from resources which are naturally replenished on a human timescale, such as sun, wind, rain, tides, waves, and geothermal heat. Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services.

Based on REN21's 2014 report, renewables contributed 19 percent to humans' global energy consumption and 22 percent to their generation of electricity in 2012 and 2013, respectively. This energy consumption is divided as 9% coming from traditional biomass, 4.2% as heat energy (non-biomass), 3.8% hydroelectricity and 2% is electricity from wind, solar, geothermal, and biomass.

Worldwide investments in renewable technologies amounted to more than US\$214 billion in 2013, with countries

like China and the United States heavily investing in wind, hydro, solar and biofuels.

Renewable energy resources exist over wide geographical areas, in contrast to other energy sources,

Which are concentrated in a limited number of countries. Rapid deployment of renewable energy and energy efficiency is resulting in significant energy security, climate change mitigation, and economic benefits.

In international public opinion surveys there is strong support for promoting renewable sources such as solar power and wind power. At the national level, at least 30 nations around the world already have renewable energy contributing more than 20 percent of energy supply.

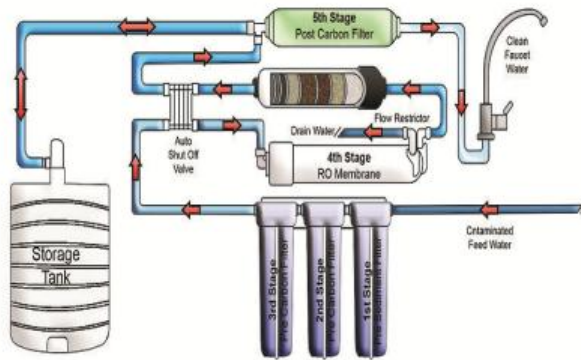
National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond. Some places and at least two countries, Iceland and Norway generate all their electricity using renewable energy already, and many other countries have the set a goal to reach 100% renewable energy in the future. For example in Denmark the government decided to switch the total energy supply (electricity, mobility and heating/cooling) to 100% renewable energy by 2050.

While many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas and developing countries, where energy is often crucial in human development.

United Nations' Secretary-General Ban Ki-moon has said that renewable energy has the ability to lift the poorest nations to new levels of prosperity. As most of renewables provide electricity, renewable energy deployment is often applied in conjunction with further electrification, which has several benefits:

For example electricity can be converted to heat without losses and even reach higher temperatures than fossil fuels, can be converted into mechanical energy with high efficiency and is clean at the point of consumption. In addition to that electrification with renewable energy is much more efficient

and therefore leads to a significant reduction in primary energy requirements, because most renewables don't have a steam cycle with high losses (fossil power plants usually have losses of 40 to 65%). [8] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV.



II. LITERATURE REVIEW

Mayuri P. Padole et al 2016 [1] – “Water Desalination System for Rural Areas using Solar Energy”- The authors has explained about the working of the ro system using the solar panel and he gave an schematic diagram of the purification system and also tested the water which was obtained by him to be used in rural areas

Deepak Devasagayam et al 2014 [2] – “Solar Water Purifier” - The authors has explained about the purification system using the filters which is to be fixed along with the solar panel and tried it out.

Moustafa Elshafei et al 2013 [3] – “Directly Driven RO System by PV Solar Panel Arrays” - The authors has explained about the RO purification system and he added the RO membrane to the purification system which separates the drain water and the purified water.

Anurag Swain 2016 [4] – “Solar Powered Drinking Water Purification & ATW System through CSR - He described about the various models of RO system which can be present and he also carried out various testing in order to provide better quality of water.

Selvi S. R et al 2014 [5] – “Desalination of Well water by Solar Power Membrane Distillation and Reverse Osmosis and its Efficiency Analysis – The authors has explained in detailed

about the ro membrane which is is to be present and about the solar panel and also gave a brief experimental setup and worked it out.

Jervin Paul Dhas 2015 [6] – “Solar Aqua Purifier; It is Water Quality Management – He studied about the water purification using a setup and laid out the block diagram and also gave the micro controller connection.

III. DESIGN CALCULATION

Solar Panel Calculation

The electricity generated in output of a photovoltaic system is:

$$E = A * r * H * PR$$

Where,

E =Energy (kWh)

A =Total solar panel Area (m²)

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)

$$E = (0.2 \times 0.25) \times 0.23 \times 35 \times 0.75$$

$$E = 0.3018 \text{ KWh}$$

$$E = 300 \text{ Wh.}$$

Pump Calculation:

The head of a pump can be expressed in metric units as:

$$h = (p_2 - p_1) / (\rho \cdot g) + v_2^2 / (2 \cdot g)$$

where,

h = total head developed (m)

p₂ = 30, pressure at outlet (N/m²)

p₁ = 70, pressure at inlet (N/m²)

ρ = 1000 density (kg/m³)

g = acceleration of gravity (9.81) m/s²

v₂ = velocity at the outlet (m/s)

$$v_1 = (4 \times \text{flow rate}) / 3.14 \times (\text{pipe diameter})^2$$

$$= (4 \times 0.85) / (3.14 \times 0.25)$$

$$v_1 = 4.3 \text{ m/s.}$$

$$P_1 V_1 = P_2 V_2$$

$$V_2 = 1.84 \text{ m/s.}$$

$$h = (70-30) / (1000 \times 9.81) + (1.79)^2 / (2 \times 9.81)$$

$$h = 1.6 \text{ m}$$

IV. REVERSE OSMOSIS

Reverse osmosis (RO) is a water purification technology that uses a semi permeable membrane to remove ions, molecules, and larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property, that is driven by chemical potential differences of the solvent, a thermodynamic parameter.

Reverse osmosis can remove many types of dissolved and suspended species from water, including bacteria, and is used in both industrial processes and the production of potable water.

The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side.

To be "selective", this membrane should not allow large molecules or ions through the pores (holes), but should allow smaller components of the solution (such as solvent molecules) to pass freely.

In the normal osmosis process, the solvent naturally moves from an area of low solute concentration (high water potential), through a membrane, to an area of high solute concentration (low water potential).

The driving force for the movement of the solvent is the reduction in the free energy of the system when the difference in solvent concentration on either side of a membrane is reduced, generating osmotic pressure due to the solvent moving into the more concentrated solution. Applying an external pressure to reverse the natural flow of pure solvent, thus, is reverse osmosis.

The process is similar to other membrane technology applications. The predominant removal mechanism in membrane filtration is straining, or size exclusion, so the process can theoretically achieve perfect efficiency regardless of parameters such as the solution's pressure and concentration. Reverse osmosis also involves diffusion, making the process dependent on pressure, flow rate, and other conditions. Reverse osmosis is most commonly known for its use in drinking water purification from seawater,

removing the salt and other effluent materials from the water molecules.



V. CONCLUSION

Thus by using Renewable energy resources-such as solar energy is constantly replenished and will never run out. Beyond that, reverse osmosis is used for recycling, wastewater treatment. By using solar power, we could be able to purify water with almost no running cost. Here in this project we use solar energy to actuate the reverse osmosis process. We use 18-24V solar panel and 24V battery (12V*4-series) to store the solar power. So that during night time we won't be running out of power. One time investment, value for money. Produces no pollution to the environment. This technology would enable hotels, schools, hospitals, governments, et cetera, to produce water at a greatly reduced price. Reverse Osmosis and solar technologies have been around for so many years now, they do not need to prove that they work. Technically, different solutions from different market players are readily available. It is now up to the market to understand its full potential and benefit from massive cost saving compare to current grid based solutions which are often costly, unreliable and CO2 intensive.

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