

Rural based Low Cost RO System by using Photovoltaic Cell

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Abstract— The World Health Organization (WHO) has certain standards for drinking water quality with regard to organic, inorganic and microbial species. Its range lies in between 20-100 TDS. Solar driven reverse osmosis desalination of brackish water reduces operational cost and improves environmental sustainability. Small-scale photovoltaic-powered reverse osmosis (PVRO) desalination plants can provide fresh water to remote communities that do not have sufficient natural sources. For these systems to be practical, they must be both technically and economically feasible. So, we are modifying the conventional RO system by using natural elements and at final stage we are going to make water alkaline by using various natural elements which is healthier for the human body. Photovoltaic solar energy powered reverse osmosis system can be the best option in the schedule and isolated areas at the world that are suffering from a shortage of electricity and pure drinking water. The efficiency of such system is more concern in the areas where the water sources are very limited so, we are focusing on the performance of the system to increase system efficiency and improve feasibility of the RO system.

Keywords: PV cell, Reverse Osmosis, Solar, Vetiver Roots, Moringa Oleifera Seed, Indian Gooseberry Bark, Activated Carbon

I. INTRODUCTION

Water is one of the most copious resources on Earth, covering approximately Three quarters of the planet's surface. About 97% of the Earth's water is salt water in the oceans: 3% of all fresh water is in ground water, lakes and rivers, which supply most of that required by humans and animals. Water is essential to life. The importance of supplying potable water can be overstressed. Man has been relying on rivers, lakes and underground water-reservoirs for fresh-water requirements in domestic life, agriculture and industry. However, rapid industrial-growth and the population explosion world-wide have resulted in a large escalation of the demand for fresh water. Added to this the problem of water pollution of water in rivers and lakes by industrial wastes and the large amounts of sewage discharged. On a global scale, man-made pollution of natural originator of water is becoming the single largest cause for fresh-water scarcity. Besides the only inexhaustible sources of water are the oceans. Their main difficulty, however, is the high salinity of such water industrial and agricultural activities. Available fresh-water resources from rivers and ground water are presently limited and are being increasingly depleted at an alarming rate in many places. According to the World watch Institute, more than two-thirds of the world's population may experience water scarcity by 2025, thus affecting practically every country in the world, including the developed, unless they reduce demand of water and develop additional water sources.

II. WORKING OF THE SYSTEM

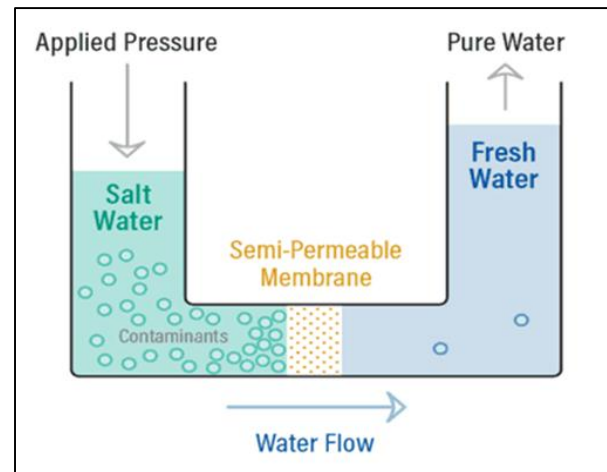


Fig. 1: Reverse Osmosis

A. Process Selection:

During the design effect, there is a need to select a process suitable for a particular application. The factors to be considered during such a selection are:

- Suitability of the process for solar-energy application.
- The effectiveness of the process with respect to energy consumption.
- The amount of fresh water required in a particular application in combination with the range of applicability of the various desalination-processes.
- The capital cost of the equipment.
- The land area required, or could be made available, for the installation of the equipment.

B. Reverse Osmosis:

Reverse Osmosis is a the process of forcing a solvent from a region of a high solute concentration through a semipermeable membrane to a region of low solute concentration by applying a pressure in excess of the osmotic pressure.

C. Principle of Reverse Osmosis:

Formally, reverse osmosis is the process of forcing a solvent with high pressure from a region of high solute concentration through a semipermeable membrane to a region of low solute concentration. The largest and most important application of RO is the separation of pure water from sea water and brackish water; seawater or brackish water is pressurized against one surface of the membrane, causing transport of salts-depleted water across the membrane and emergence of portable drinking water from the low pressure side.

D. Reverse Osmosis Process:

- Feed water flows into RO (Reversible osmosis) unit with the force of line pressure.

- Water is forced through membrane by cross flow filtration.
- Cross flow filtration is most commonly used in RO as it allows membrane to continually clean itself so that every time water will flow without previous water impurities.
- Membrane then either rejects or repels contaminants.
- Two exists stream generated; waste and product stream.
- Waste stream consists of a concentrate (reject) stream which carries contaminants (compound too large to pass through membrane).

Permeate stream consist of product water which has been forced through the membrane and is virtually free from the TDS.

III. CASE STUDY



Fig. 2: Commercial RO Plant Sangamner RO Plant is under consideration for case study.

IV. DESIGN DEVELOPMENT

A. Materials

1) Vetiver Root



2) Moringa Oleifera Seed



3) Indian Gooseberry Bark



4) Activated Carbon



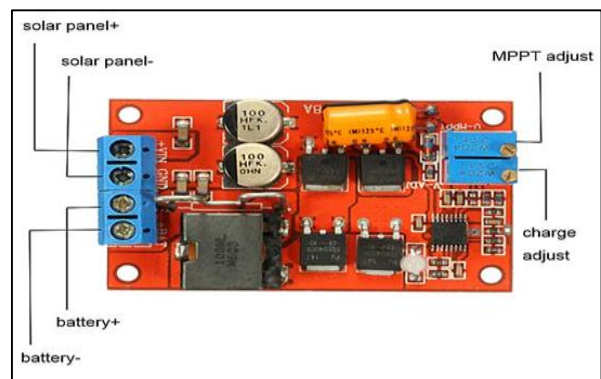
In this system we use the natural ingredients instead of the artificial membrane. This system we using the various types of natural ingredient as mention the above. The benefits of this material as follows:

- removing toxic substance
- acts as an effective coagulant for water and waste water treatment
- antibacterial activity.
- removing organic constituent and residual disinfectants

B. Solar Panel

Sr. no.	Characteristics	Specification
1	Maximum Power	30Wp+/-3%
2	Open Circuit Voltage (VOC)	21V
3	Short Circuit Current	1.8A
4	Voltage Maximum Power (IMP)	18V
5	Current At Maximum Power	1.67A
6	Maximum System Voltage	DC 600V
7	Normal Operating Cell Temperature	45.5°C
8	Temperature Coefficient	-1.036W/°C

C. Battery and Charge Controller



1) Calculation:

Ampere hours capacity

Voltage Rating of load = 24

Total Hours Required =10

Maximum Current = 1.5

Ah Capacity of battery = Maximum current × Total Hr

Ah Capacity of battery =1.5 ×10

The main function of charge controller is to prevent battery from over charging by regulating the voltage fd to the battery. In our charge controller protection is given such as short circuit protection, overload protection, over voltage protection, polarity protection.

D. Balancing pH of Processed Water

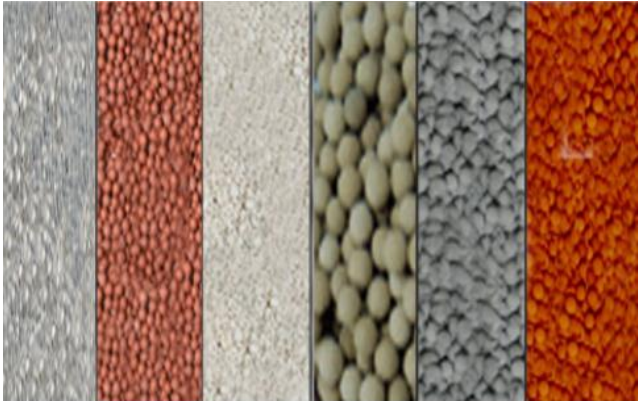
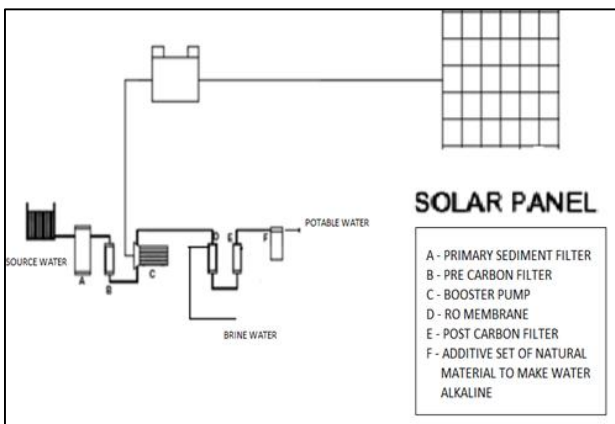


Fig. 8: Materials to make water Alkaline

Alkaline Water is recognized for its powerful healing and detoxifying effects and can assist the bodies healthy cells become more soluble which helps the minerals and vitamins for maintaining a healthy immunity system be absorbed into the tissues. Alkaline water provides the body with oxygen which gives us energy. It also gives the smoother taste to the processed water.

So, by using some natural materials like Alkaline ceramic balls, coral calcium, magnesium, ORP balls, tourmaline we have made a cartridge to make water slightly alkaline.

E. Typical Layout of System



V. ADVANTAGES

- To remove organic and inorganic contaminants from water.
- The processing system is simple.

- Low maintenance f system.
- Filtration process is Eco-friendly.
- Minimal use of chemicals.
- Installation cost is low.

VI. CONCLUSION

The paper introduce new system of water filtration, from this system we get following benefits as follows :

- To get clean and pure water with the minerals and vitamins which necessary to our body unlike the regular RO system which removes all the minerals from the water.
- Reduction of high TDS in moderate value.
- Minimal use of chemicals because we are using natural ingredients in various stages of filtration.
- Installation & maintenance cost will be very low.
- The final potable water will be slightly alkaline as we are using natural elements to make it happen.
- Increase system efficiency by reducing the waste water and improve feasibility of RO system.
- Slightly alkaline water Detoxifies the processed water which is very healthy for human body.

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