

# Comparison of Desalination by Reverse Osmosis and Solar Powered Methods

Hanna P R<sup>1</sup>, Lubna C H<sup>2</sup>

<sup>1</sup>P.G Student, Department of Civil Engineering, Malabar College of Engineering and Technology, Desamangalam, Thrissur, Kerala, India

<sup>2</sup>Assistant Professor, Department of Civil Engineering, Malabar College of Engineering and Technology, Desamangalam, Thrissur, Kerala, India

\*\*\*

**Abstract** - Water is the source of life, the basis of human survival, and the principal material base to guarantee the economy substantial development of a country. With increasing global population, the gap between the supply and demand for water is widening and is reaching such alarming levels that in some part of the world, it is posing a threat to human existence. The fresh water scarcity is a growing problem all over the world because only 1% of earth's water is fresh water available for human to drink. The US geological survey found that 96.5% of earth's water is located in seas and oceans and 1.7% of earth's water is located in the ice caps. The remaining percentage is made up of brackish water, slightly salty water found as surface water in estuaries and as groundwater in salty aquifers. The need for fresh water is at the top of the international agenda of critical problems, at least as firmly as climate change. India as a country has 16% of the world's population and 4% of its fresh water resources. In recent years, the increasing threat to water quality is due to human activities has become a matter of great concern. Problems present today are caused by contamination and by over exploitation, or by combination of both, which are faced by many Indian states.

This project deals with comparison of conventional method of desalination ie by solar powered desalination and a technological method of desalination by Reverse osmosis. With current technology; it requires great amounts of energy to desalinate ocean water on a scale large enough to meet the needs of a whole city. For this reason, most cities stick with traditional sources of freshwater, such as underground aquifers, rivers, lakes, and runoff from snowpack. Some people, like those in rural Indian villages, use an alternative to burning oil for desalination-solar power. Today, reverse osmosis (RO) membranes are the leading technology for desalination because of their strong separation capabilities and exhibiting a great potential for treatment of waters worldwide. Reverse osmosis (RO) desalination is a treatment process for production of fresh, low salinity potable water from saline water sources via membrane separation. The mineral/salt content of the water is usually measured by the water quality parameter named total dissolved solids (TDS).

**Keywords:** Desalination, Reverse Osmosis, Membrane Process, , fouling.

## 1. INTRODUCTION

Reverse osmosis (RO) membranes are the leading technology for desalination because of their strong separation capabilities and exhibiting a great potential for treatment of waters worldwide. This process was introduced near 1970s but did not attain commercial status as other desalination processes, partly because membranes suitable for the processes were not available at reasonable prices. In many situations, the energy is available at minimal cost, so membrane distillation will not be as costly as typical desalination processes which are more energy intensive. It also means that theoretically a high water recovery for sea water desalination (of the order of 80 per cent) is possible, compared with a typical 35-40 per cent for the RO technique. The ability to work with near-saturated solutions also means that the method can be used to enhance industrial salt recovery processes and sea water conversion processes.

### 1.1 OBJECTIVES

The project deals with comparison of conventional method of desalination ie by solar powered desalination and a technological method of desalination by Reverse osmosis. With current technology, it requires great amounts of energy to desalinate ocean water on a scale large enough to meet the needs of a whole city. For this reason, most cities stick with traditional sources of freshwater, such as underground aquifers, rivers, lakes, and runoff from snowpack. Some people, like those in rural Indian villages, use an alternative to burning oil for desalination-solar power.

### 1.2 SCOPE OF THE PROJECT

Today, reverse osmosis (RO) membranes are the leading technology for desalination because of their strong separation capabilities and exhibiting a great potential for treatment of waters worldwide. Reverse osmosis (RO) desalination is a treatment process for production of fresh, low salinity potable water from saline water sources via membrane separation. The mineral/salt content of the water is usually measured by the water quality parameter named total dissolved solids (TDS). Reverse Osmosis (RO) is a process that uses semipermeable spiral wound membranes to separate and remove dissolved solids, organic, pyrogens, submicron colloidal matter, color, nitrate and bacteria from water. Feed water is delivered under pressure through the

semi permeable membrane, where water permeates the minute pores of the membrane and is delivered as purified water called permeates water.

## 2. MATERIALS AND METHODS

The osmosis flow is reversed in the RO process. By applying hydraulic pressure to the high-concentration side of the solution, it forces solvents to filter through the membrane, against a pressure gradient into the lower-concentrate solution. In RO, using a mechanical pump, pressure is applied(350psi) to a solution via one side of the semi-permeable membrane to overcome inherent osmotic pressure. The process also removes soluble and particulate matter, including salt from seawater in desalination from the solution of interest.

When pressure applied on the concentrated side of the semi-permeable membrane beyond the osmotic pressure of the solution, the solvent begins to flow toward the less concentrated side. Solvent from the concentrated solution (water) passes through the membrane to the solution of lower concentration; thus, the concentration of solute in the side where the pressure is applied becomes higher. Because RO depends on a diffusive mechanism, separation efficiency varies based on solute concentration (TDS), pressure applied, and water temperature. High-pressure pumps in RO systems force water through the pores of the membranes (permeate), and the remaining water with higher concentrations of solutes is pushed out as wastewater (brine)

### 2.1 Membrane (Polyamide membrane)

Polyamide membrane is used for reverse osmosis by considering that the membrane should be inexpensive, have longer and stable life, membrane should be easily manufactured with good salt rejection i.e. slightly permeable to salt. They should have high water flux i.e. highly permeable to water and less susceptible to fouling. They should permit the flow of large amounts of water through the membrane relative to the volume they occupy. The membrane should be chemically, physically and thermally stable in saline waters. They need to be strong enough to withstand high pressures and variable feed water quality.

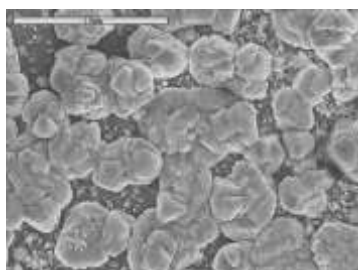


Fig 1: RO membrane



Fig2: Reverse osmosis setup

### 2.2 Solar Powered Desalination

With current technology, it requires great amounts of energy to desalinate ocean water on a scale large enough to meet the needs of a whole city. For this reason, most cities stick with traditional sources of freshwater, such as underground aquifers, rivers, lakes etc. Some people, like those in rural Indian villages, use an alternative to burning oil for desalination-solar power. Following are the procedure for solar powered desalination:

1. Collect the saltwater sample in a measuring bowl and add few drops of beetroot essence to impart red color (red infrared color, for large scale, food colorings can be used).
2. To make desalinators take 6 small bowls, where 3 for low salinity marked as D1,D2,D3. Add additional 3 tablespoon of salt to it and mark as high salinity desalinators as D1,D2,D3.
3. Place each of your six small cups inside each of the six bowls. Position the cups in the middle of the bottom of the bowls.
4. Cover the top of each bowl with a large piece of plastic wrap. Leave extra around the edges. Press down slightly with your fingers into the middle of each piece of plastic so that it sags down toward the cup as in the figure:

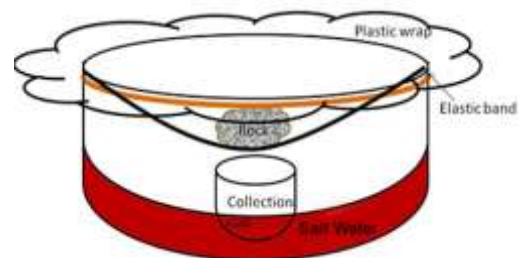


Fig3: Desalinator setup

Table 1: Desalinated Water Quality Parameters

|   | Parameters | Method of analysis | Unit | Value Solar desalination | Value RO method | Std limit(IS3025) |
|---|------------|--------------------|------|--------------------------|-----------------|-------------------|
| 1 | PH         | PH paper           | -    | 7.5                      | 7.2             | 6.5-8.5           |
| 2 | Alkalinity | Titrimetric method | Mg/l | 72                       | 81              | 200               |

|   |                   |                      |      |      |      |     |
|---|-------------------|----------------------|------|------|------|-----|
| 3 | Hardness -Calcium | EDTA Titration       | Mg/l | 43   | 38   | 75  |
| 4 | Magnesium         | EDTA Titration       | Mg/l | 10   | 20   | 30  |
| 5 | Chloride          | Argentometric method | Mg/l | 70   | 65   | 250 |
| 6 | Iron              | Phenathroline Method | Mg/l | 0.16 | 0.13 | 0.3 |

[6]T. Abraham and A. Luthra, "Socio-economic and technical assessment of photovoltaic powered membrane desalination processes for India," *Desalination*, vol. 268, no. 1-3, 2011.

[7]R. Kumar, R. D. Singh, and K. D. Sharma, "Water resources of India," *Current Science*, vol. 89, no. 5, pp. 794-811, 2005.

### 3. CONCLUSION

The efficiency of reverse osmosis method of desalination is 95% as compared to 88% of solar powered desalination. Feed water containing suspended particles, organic matter as well as inorganic salt may deposit on the membrane and fouling will occur or damage the membrane because of applied pressure and size of particles. Therefore the priority to remove these by way of pretreatment will determine the RO efficiency. Hence RO membrane performance can be checked to avoid the irreversible damages to the RO membrane. In fact success of RO system depends upon efficiency of the pre-treatment. Solar powered desalination is eco friendly and cheap as compared to reverse osmosis method and can be used for both commercial, domestic and industrial purposes. On the other hand reverse osmosis method have more efficiency due to its technical support, it is more applicable in industries as well as commercial purposes.

### REFERENCES

[1]Sunil J. Wimalawansa, "Purification of Contaminated Water with Reverse Osmosis: Effective Solution of Providing Clean Water for Human Needs in Developing Countries"

International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 12, December 2013)

[2]Garud R. M., Kore S. V., Kore V. S., Kulkarni G. S., "A Short Review on Process and Applications of Reverse Osmosis, Universal Journal of Environmental Research and Technology", Volume 1, Issue 3: 233-238

[3]Y. Li and K. Tian, "Application of vacuum membrane distillation in water treatment," *Journal of Sustainable Development*, vol. 2, no. 3, pp. 183-186, 2009.

[4]B. L. Pangarkar, P. V. Thorat, S. B. Parjane, and R. M. Abhang, "Performance evaluation of vacuum membrane distillation for desalination by using a flat sheet membrane," *Desalination and Water Treatment*, vol. 21, no. 1-3, , 2010.

[5]L. F. Greenlee, D. F. Lawler, B. D. Freeman, B. Marrot, and P. Moulin, "Reverse osmosis desalination: water sources, technology, and today's challenges," *Water Research*, vol. 43, no. 9, 2009.