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Pollution free techniques of membrane desalination

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Abstract: *The polyethersulfone reverse osmosis hollow fiber module is used to desalination of brackish water. The driving force of separation is pressure difference; the non conventional source of energy, solar energy is used to create the driving force inside the hollow fiber module. To increases the life of the membranes, the brackish water first is passed to micron cartage filter and then to reverse osmosis modules of the membranes. It was found that increases in transmembrane pressure permeate flux increased and concentrated flux decreased, after few hours, it worked reversely, due to blockage of the pores of the membrane. Membrane technology is an energy saving process, Region which is come under the saline belt and problem of an electrical energy, desalination using solar membrane technology is an ecofriendly technique of separation.*

Keywords: *Polyethersulfone, reverse osmosis, solar energy, desalination.*

I. Introduction.

An holistic approach is needs to cope with the fresh water it include Sea water desalination in coastal areas, brackish water desalination, and water purification rain water harvesting, water supply scheme. The contribution of sea water and brackish water desalination would play an important role in augmenting the fresh water needs of country

Desalination refers to the process by which pure water is recovered from saline water by the application of energy. It is energy intensive process. Most of the commercial desalination plants as on date use thermal, mechanical or electrical energy. The commercially relevant desalination process are broadly classified as, thermal and membrane process. Multistage flash, multifactor distillation and vapors compression are the proven thermal desalination processes which utilized heat energy for sea water desalination. Reverse osmosis and electro dialysis are proven membrane processes,[1] RO uses neutral membrane and mechanical energy for achieving separation of relatively pure water While ED uses ionic membrane and utilize electrical energy

Total installed seawater desalination plant capacity in the world is about 17million m^3/day, Thermal desalination process account for 55%of total production capacity compare to 45%by membrane processes, However, membrane process have about 77%of the number of installed plants While thermal processes account for 22%. This implies that large capacity plants are normally based on thermal processes where as small capacity plants are based on membrane processes. [2, 3, 4]

All kinds of land based desalination plant in the country including seawater and brackish water desalination produce more than 500,000m3/day fresh water

Sea water desalination generating a new source of fresh water rather managing the existing source of water, India presently about 200,000 m^3/day sea water desalination plant in the country. The development in desalination are directed towards reducing the overall cost of desalinate water through technological innovations.[5,6,7,8] Desalination and power plant at same location has the benefit of sharing the resources such as common seawater intake system and other infrastructure facilities

The concept of hybrid desalination is picking up for large capacity desalination plants in water scarcity coastal cities, it take in to account product water quality requirement for different uses , such as distilled water for industries and potable water for drinking use

Interest in using nuclear energy for producing desalinated water has been growing worldwide, low grade and waste heat utilization for sea water desalination appearing promising and has demonstrated in BARC by coupling a low temp evaporation plant using waste heat for nuclear desalination, ocean energy can be utilized for seawater desalination and has been demonstrated successfully , coastal cities in the country face about 100-1000MLD water short fall, mobile desalination plant can be taken from one place to another place and appear attractive for the remote villages /islands along the coast.[9]

Experimental Setup

1) It Consist of the following
2) Feed water storage tank (25 Lit.)
3) Feed Pump (Solar driven pump)
4) Micron cartridge filter

5) Damper
6) Membrane assembly
7) Permeate rotameter to measure the flow rate of permeate
8) Concentrated rotameter to measure the flow rate of concentrated
9) Conductivity meter
10) Pressure gauge
11) Needle valve
12) Ball valve

Experimental procedure:-

The brackish water sample is feed to the storage tank which having the capacity of 25 lit. then it passed to the pretreatment micron cartridge filter, after pretreatment ,it is passed to the membrane assembly, driving force of separation is pressure difference, in this plant, driving force which is required for the separation, in given by using the non-conventional energy source like solar energy, sample water is separated in to permeate and concentrated, flow rate of permeate and concentrated is measured by using flow meter, and conductivity is also measured by using conductivity meter . Pressure gauge is provided to measure the inlet and outlet pressure of micron filter. The driving pressure of separation is measured by using pressure gauge.

II. Materials And Method

Membrane Specification:-
Module specification =RO, UF, NF, MF.
Size of module –dia. 40 long each
No of R.O. Membrane Module -3 Nos.
Membrane area for R. O.-1.85 m^2
Material - Polyestersulfone
Prefiltration- Micron cartage filter polypropylene wound
Size - 2.5 dia. & 10 long.
Test cell size - 240 mm x 180 mm x 25 mm
Operating parameter of the system
R.O. = Pressure 400 Psi. Temp 40^0C
These systems consist of four Major components.

1) Pretreatment
2) Pressurization
3) Membrane Separation
4) Post Treatment.

Pretreatment:-

In this plant, the brackish water sample is passed to the cartridge filter. The cartridge filter is made up of materials poly-propylene; The Cartridge filter can filter the particle up to the size of 5 micron. It is polishing unit for removal of fine particles so as to reduce wear and tear of high pressure pumps and to protect the membrane against the fouling due to particulate matter, the minute suspended particles and other microorganism which cannot be filtered out in the pretreatment are removed by micron cartridge filter, It is find step of pretreatment.

Pressurization:-

In these studies, the driving force of separation is pressure difference, the operating parameter for R.O.plant is 400 psi, and temp is 40^0C. Turbidity is less than one and total suspended solid is less than 5 ppm.

Membrane Separation:-

Membrane made up of hollow fiber polyestersulfone module. Having area an area 1.85 m^2.The feed water sample is first passed to the pretreatment process, where cartage filter is used, afterword is passed to membrane module, where it separated in permeate and retained.

Post Treatment:-

Post treatment is the final treatment, in which PH of the product is maintained.
Applied press should be greater than the Osmotic pressure of the saline solution.
Energy required operating the process increases with increase in feed water salinity

Technical difficulties:-

- Fabrication,
- degree of semi permeability
- fouling,
- polarization,
- Scale membrane support.

RESULT AND DISCUSSION:-

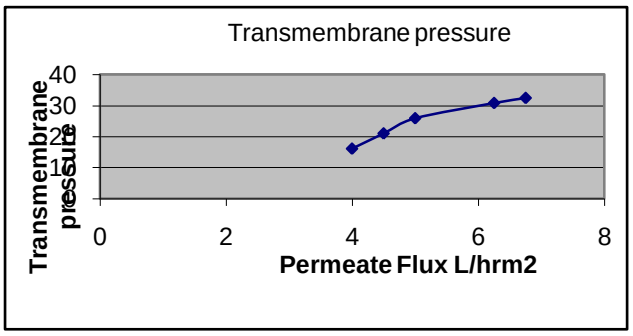

Figure1.

The figure 1.shows that increased in transmembrane pressure (kg/cm^2) , Permeate flux increased continuously, After few hours, it was found that permeate flux decreased because of the fouling and plugging of membrane, it was happened due the water contain the impurity, metal suspended solid etc. It block the pores of membrane surface, and hence the permeate concentration decreased whereas rejection percentage increased

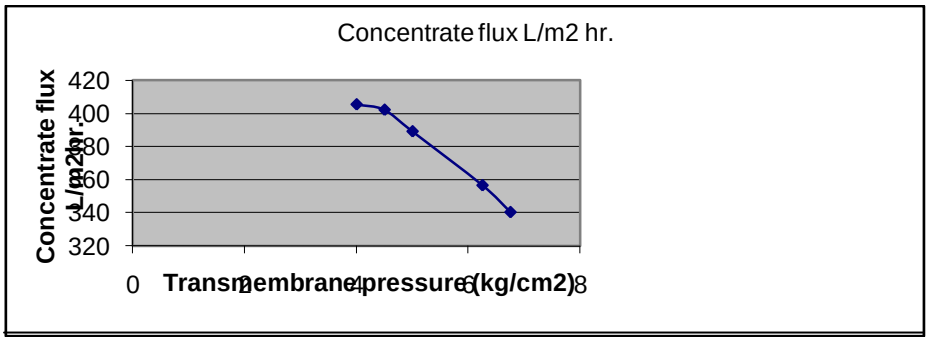

Figure2.

The Figure2.shows that the concentrate flux decreased with increased in transmembrane pressure, after few hours, it was found that the concentrate flux increased with increased in transmembrane pressure. Due to plugging and fouling of the membrane concentrated flux increased whereas permeates flux decreased.

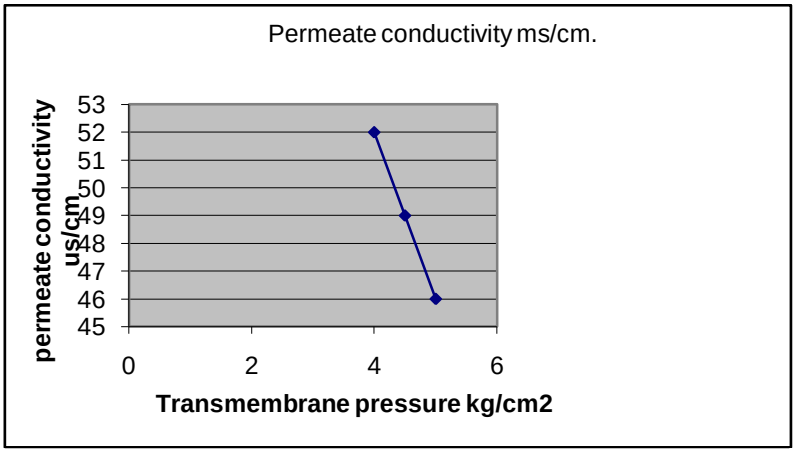

Figure 3.

Figure3. Shows that increased in Transmembranes pressure permeate conductivity decreased, it is found that permeates conductivity decreased with increased in transmembrane pressure up to 5 kg/cm^2, and after word, increased in pressure, permeate, conductivity of water increased sharply.

III. Conclusion

Membrane technology is an energy saving process, Region which is come under the saline belt and problem of an electrical energy, solar membrane desalination technique is suitable. Membrane fouling and concentration polarization reduce the flux of the membrane drastically. The pretreatment of waste water is necessary for reasonable recovery of water. Hybrid technology (solar + R.O.) is effective technology concern to control pollution. It does not create the environmental pollution. It solved the problem of drinking water and environmental pollution

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