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A Short Review on Water Quality and Its Treatment

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***Abstract--* Recent research reports have underlined reverse osmosis (RO) as the most optimized technology for water desalination related applications. However, implementing this technology to seawater desalination and other water samples such as mine water, water containing heavy metals etc. are facing challenges of membrane fouling. This includes membrane biofouling, organic and inorganic fouling which adversely affect the process performance and overall treatment cost. To overcome these issues, pretreatment units ahead of the RO system are necessary to reduce RO membrane fouling and enhance its operational efficiency. This article aimed at reviewing the literature and summarizing relevant methods, mechanisms and novel developments which improve the performance of the RO systems when coupled with either conventional or non-conventional pretreatment units. Several studies suggested that the non-conventional pretreatment units were more efficient than the conventional systems for producing better water quality and minimizing the overall treatment cost. Ultrafiltration appeared to be a cost effective and efficient method of removing suspended solids (SS) and bacteria. The advent of nano structured membranes nano filtration has the potential of becoming preferred non-conventional desalination pretreatment over a wide range of salinity, total dissolved solids (TDS), inorganics, viruses, etc. [8]**

A water filter removes impurities from water by means of a fine physical barrier, a chemical process or a biological process. Filters cleanse water to different extents for purposes like irrigation, drinking water, aquariums, ponds and swimming pools. Filters use sieving, adsorption, ion exchanges, biological metabolite transfer and other processes. Unlike a sieve or screen, a filter can remove particles much smaller than the holes through which the water passes. Our water purification system works with the concept of Reverse Osmosis. Reverse Osmosis (RO) technology is used by many industries, including pharmaceutical and semiconductor. RO is used to purify drinking water in homes, desalinate seawater, and to remove impurities from process water.

Index Terms*—Biological, Metabolite, Reverse Osmosis (RO)

I. INTRODUCTION

Coupling RO with conventional technologies

Comprehensive understanding of the raw water quality and characteristics, and type of water resource (e.g. surface water, brackish water, seawater and industrial saline water) is essential to select the appropriate pretreatment technology ahead of the RO system. For instance, surface waters have high turbidities, SDI, and NOMs as compared to water from the well source due to adsorption and filtration effect on underground water reserves. Similarly, well waters contain high silica content than surface waters. The initially large particles, which may be pumped from the well, are removed from the feed water using mesh strainers or traveling screens. Traveling screens are more useful for surface water sources, which typically have large concentrations of biological debris. The conventional pretreatment process may consist of all or some of the following treatment steps:

Large particle removal by coarse strainer
Chlorination
Clarification with floatation or flocculation
Hardness removal by lime treatment
Filtration
Alkalinity reduction by pH control
Scale inhibitor
Removal of free chlorine by sodium bisulfite or activated carbon
UV radiation

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Suspended particles removal by cartridge filtration [8]

Reverse osmosis (RO) is a water purification technology that uses a semipermeable membrane to remove larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property, which is driven by chemical potential, a thermodynamic parameter. RO is used alone or with pre- and/or post-treatment equipment to meet a specified requirement for water quality. As industrial processes have changed and environmental regulations become more stringent, reverse osmosis is now used to treat hazardous waste. One such application is the concentrating of metals in rinse water in the metal plating industry. A second application is the treatment of landfill leachate and other liquids high in Total Dissolved Solids (TDS) and Volatile Organic Compounds (VOCs).

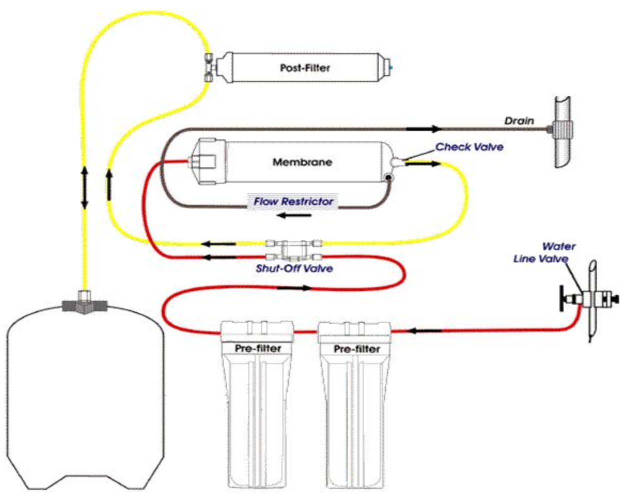


Fig a: - Architecture Diagram

When a semi-permeable membrane separates two solutions having different solute concentrations, a natural diffusion from the lower concentration to the higher concentration will take place. If one side contains fresh water and the other side contains salt water, the fresh water will diffuse to the salt water side in order to balance the concentrations on each side of themembrane. This process is called *osmosis*. When equilibrium is reached, there will be an osmotic pressure build up on the fresh water side that balances the concentration difference. In order to reverse this process, a mechanical pressure must be applied to the salt water side that is greater than the osmotic pressure. The change in direction of natural flow under this applied pressure is called *reverseosmosis*. In many commercial reverse osmosis units, operating pressures range from about 150 to 1500 pi (Geankoplis 788).

II. MANUAL CALCULATIONS

The value of osmotic pressure (π) has been experimentally determined by Van't Hoff to be:

$\pi = \phi(n/V_m)RT$

Where,

ϕ = osmotic coefficient

n = number of kg mol of solute

V_m = volume of pure solvent water (m^3)

R = ideal gas constant = $82.057x10^{-3}$

(m^3 * atm/kg mol *K)

T = temperature (K)

Osmotic pressure for salt water varies from 0 to 100 atm depending on the salt concentrations.There is two main types of membranes that are used in reverse osmosis, cellulose acetate and "Permasep". The cellulose acetate membrane is 50 to 135 μm thick with one film layer and one sponge layer. This membrane can filter 99% of the salts in solution and is most effective against the diffusion of sodium chloride (NaCl), sodium bromide (NaBr), calcium chloride ($CaCl_2$), sodium sulfate (Na_2SO_4), sucrose, and tetralkyl ammonium salts (Geankoplis 784). Permasep is the name given to synthetic polyamide membranes made into fine hollow fibers. Permasep membranes can withstand alkali conditions.

For diffusion-type membranes, the equations that represent the diffusion of solvent and solute are as follows. For diffusion of the solvent through the membrane,

$N_w = (P_w/L_w)(\Delta P - \Delta\pi) = A_w(\Delta P - \Delta\pi)$
$P_w = (D_w c_w V_w)/(RT)$
$A_w = P_w/L_m$
Where: N_w = solvent flux (kg/s*m^2)

P_w= solvent membrane permeability(kg solvent/s*m*atm)

L_m = membrane thickness (m)

A_w = solvent permeability constant (kg solvent/s*m^2*atm)

ΔP = hydrostatic pressure difference across membrane (atm)

$\Delta\pi$ = osmotic pressure difference across membrane (atm)

D_w = diffusivity of solvent in membrane (m^2/s)

C_w = mean concentration of solvent in membrane (kg solvent/m^3)

V_w = molar volume of solvent (m^3/kg mol solvent)

R = ideal gas constant = 82.057x10^{-3} (m^3*atm/kg mol*K)

T = temperature (K)

The equation representing the diffusion of the solute through the membrane is,

$N_s = (D_s K_s/L_m)\Delta c = A_w \Delta c$

Where:

N_s = solute flux (kg solute/s*m^2)

D_s = diffusivity of solute in membrane (m^2/s)

K_s = conc. of solute in membrane/conc. of solute in solution

A_s = solute permeability constant (m/s)

Δc = concentration difference across the membrane (kg solute/m^3)

The solute rejection R is the ratio of concentration difference across the membrane divided by the concentration on the feed side.When the solvent diffuses through the membrane, there is a build-up of solute that forms at the surface of the membrane. This solute build-up is called concentration polarization (β). It is defined as the ratio of the solute concentration at the membrane surface divided the concentration in the concentrate. Concentration polarization decreases the solvent flux through the membrane and increases the solute flux. This is evident in the following equations.

$\Delta\pi = \beta\pi_1 - \pi_2$

Where: π_1 = osmotic pressure of feed solution (atm)

π_2 = osmotic pressure of product solution (atm)

$$N_s = A_s(\beta c_1 - c_2)$$

Where: c_1 = concentration of feed solution (kg solute/m^3)

c_2 = concentration of product solution (kg solute/m^3)

Typical concentration polarization ratios are 1.2 to 2.0, which means that the concentration in the boundary layer is 1.2 to 2.0 times the concentration in the feed solution (Geankoplis 788).

Dissolved metal salts can be removed through reverse osmosis by forcing water through a semipermeable membrane at pressures between 400 and 800 psig. RO units can concentrate most divalent metals, such as nickel, copper, cadmium, and zinc, from rinse waters to a 10 - 20% solution. According to U.S. EPA studies, the main application of RO systems in metal plating is for the concentration of rinse water from acidic nickel-plating baths. Cellulose acetate membranes are commonly used and recovery efficiencies range between 90% and 95% (Cartwright). The concentrated solution is returned to the plating bath to make up for plating and drag-out losses of the plating solution. Additionally, the clean rinse water can be reused in the rinsing phase of the process (Higgins 270).

Due to the membrane's sensitivity to corrosive and oxidizing environments, average membrane life is between 1 and 3 years. RO systems have limitations in plating because the metals have high oxidation potentials and the acid baths often have a pH of less than 2.5 or greater than 11. Ambient temperature baths also pose a concentration problem because the RO system alone cannot concentrate the metals in rinse water to the strength of the plating bath solution. An evaporator is required to reach necessary concentrations for reuse the plating bath (Higgins 274). The benefits to using reverse osmosis are waste reduction and/or concentration the waste for disposal.

Leachate is an ongoing problem for the owners and operators of landfills. Current options for leachate management include leachate recycling, leachate evaporation, treatment followed by disposal, and discharge to municipal water systems (Tchobanoglous 440). The acceptable options are site specific and in the case of hazardous waste landfills and municipal waste landfills that accepted hazardous wastes prior to current regulations, reverse osmosis can be used to treat landfill leachate. Rochem Separation Systems, Inc. has equipment installed to treat leachate at "over 60 landfills worldwide" (EPA 52). Rochem's Disc Tube™ Module (DTM) Technology is one way that leachate can be treated, so as to concentrate the waste before removing it from a site.

Table 1: Average Concentrations during DTM evaluation at Central Landfill

Contaminant	System Feed (mg/L)	Final Permeate (mg/L)	Final Concentrate (mg/L)
1,2-Dichlorobenzene	16	.76	23
Chlorobenzene	21	2.7	36
Toluene	1.8	0.083	3.4
Barium	1.4	<0.014	4.3
Magnesium	250	<1.6	850
Total Dissolved Solids	4,900	<32	17,000
Total Organic Carbon	5,800	<100	21,000

Source: Table 4-2 in EPA's report

The United States Environmental Protection Agency evaluated Rochem's DTM at the Central Landfill in Johnston, Rhode Island. The site consists of a 121-acre disposal area where hazardous and non-hazardous wastes were accepted until April 1993. The area of concern was the "half-acre where large volumes of liquid industrial waste were disposed of in several trenches excavated into bedrock" (EPA 28). Some of the contaminants at the site were chlorobenzene at 21 mg/L and 1,2-dichlorobenzene at 16 mg/L.

The DTM equipment was evaluated during August and September 1994, during which time approximately 33,000 gallons of landfill leachate was treated. The purpose of this Superfund Innovative Technology Evaluation (SITE) was to see how effective the system was "in removing organic and inorganic contaminants from the landfill leachate and in resisting fouling and scaling of the membranes" (EPA 1). The DTM is designed to treat landfill leachate, water soluble oil-based coolants, oil/water mixtures, and solvent/water mixtures (EPA 10). DTM can treat "liquid waste that is higher in dissolved solids content and contaminant levels than liquid waste treated by conventional membrane separation processes" (EPA 9). DTM's design allows it to be used as the primary treatment step as compared with conventional membrane separation processes.

The EPA and Rochem deemed the evaluation a success, with "excellent removals of TOC, TDS, and metals" and approximately 90% removal of Volatile Organic Compounds (VOCs) (EPA 10). Landfill operators who chose to install similar systems can see the benefit of reduced volume of contaminated materials and the ability to meet discharge requirements for metals. Additionally, concentrated contaminants can be incinerated or treated by other methods.

As research continues with reverse osmosis and Rochem's DTM technology, the process will be refined and be more effective. Each application of this technology will be different and adjustments to the process will have to be made. Reverse osmosis is an effective way to treat some liquid hazardous waste.

III. MODULE DESCRIPTION

A. Raw Water Pump

1) Purpose: To feed the Dual Media Filter at pressure more than 2.0 bar, which is min. operating pressure for filter.

a) Specifications

- *i)* MOC : CI
- *ii)* Type : Horizontal Centrifugal
- *iii)* Flow Rate : 1000 liters per hour
- *iv)* Head : 32 m
- *v)* Power Required: 0.37 KW
- *vi)* Electrical : 220 V, Single phase , 50 hz
- *vii)* Cycle : 2900 rpm
- *viii)* Make :Kirloskar
- *ix)* Quantity : 1 No.

B. Dual Media Filter

1) Purpose: To remove the total suspended solids, dirt, iron and reduce silt density index which can foul the membranes

a) Specifications

Vessel:

- *i)* Make: Pentair, USA
- *ii)* Material of Construction: FRP
- *iii)* Diameter: 250 mm
- *iv)* Height: 1350 mm
- *v)* Testing Pressure: 10 kg/cm2
- *vi)* Opening: Top only
- *vii)* Quantity: 1 No.

Valve:

- a) Make: Midas/Initiative
- b) Material of Construction :Noryl
- c) Type: Multiport Single lever value
- d) Size: 0.5 inches
- e) Maximum Flow Rate: 3000 LPH
- f) Working Pressure: 2-4 Bar

g) Working: Down-Flow

Media:
Mixed bed sand media consisting of the following
i) Gravel ii) Pebbles iii) Quartz Sand iv) Anthracite
Average Porosity 50 micron particulate size Bed depth : 900 mm
Pipelines & Accessories:
Pipe of PVC 10 Bar tested pressure

C. Activated Carbon Filter

1) Purpose: To remove the total color, smell, odor, from the water.

Specifications Vessel:
a) Make: Pentair, USA
b) Material of Construction: FRP
c) Diameter: 250 mm
d) Height: 1350 mm
e) Testing Pressure: 10 kg/cm2
f) Opening: Top & Bottom
g) Quantity: 1 No.

Valve:
a) Make: Midas/Initiative
b) Material of Construction :Noryl
c) Type: Multiport Single lever value
d) Size: 0.5 inches
e) Maximum Flow Rate : 3000 LPH
f) Working Pressure : 2-4 Bar
g) Working : Down-Flow

Media:
Mixed bed sand media consisting of the following
i) Gravel ii) Pebbles iii) Carbon Average Porosity 50 micron particulate size
Bed depth: 900 mm
Pipelines & Accessories:
Pipe of PVC 10 Bar tested pressure Testing cock & pressure gauges at inlet-outlet of system

D. Dosing System

1) Purpose: To dose Antiscalant chemical to protect the scaling formation on RO membranes.

Specifications
a) MOC : PP
b) Type: Electronic Metering Type diaphragm pump
c) MOC of Diaphragm: Teflon coated.
d) Capacity: 0-5 LPH
e) Pressure: 5 Bar
f) Qty.: 1 No.

g) Make :Seko/ EtatronDS,Italy
h) Qty.: 1 No.
i) Storage Tank: PP chemical grade.
j) Capacity: 100Liters
k) Make: Frontier/Sintex
l) Qty.: 1 No.

E. Micron Filter

1) *Purpose:* To remove the fine particles up to 05 microns and reduce silt density index levels to acceptable level.

Specifications: Cartridge Filter & Housing
Housing:
- *a)* Make: Pentair /ECO India
- *b)* MOC of Housing: PP
- *c)* Length : 20”
- *d)* Diameter: 4.0”
- *e)* Quantity: 1 no.

Cartridge:
- *a)* Make: Filtermation/ H2O
- *b)* Cartridge MOC : Polypropylene
- *c)* Length: 20”
- *d)* Diameter : 2.5”
- *e)* Quantity: 1 no.
- *f)* Micron rating: 05, 10 micron

F. High Pressure Pump

1) *Purpose:* To feed the Reverse Osmosis Membrane at pressure more than the osmotic pressure taking into consideration flux rate, flow and recovery.

Specifications
a) MOC : Stainless Steel-304
b) Type : Vertical Multistage
c) Flow Rate: 1000 liters per hour
d) Head: 100 mwc
e) Power Required: 1.1 KW
f) Electrical: 440 V, three phase, 50 hz
g) Cycle: 2900 rpm
h) Make :Grundfos
i) Qty.: 1 No.

G. RO Membrane
1) *Purpose:* To remove the major part of TDS upto 98% by Reverse Osmosis Membranes arranged and designed to give adequate flow and recovery.

Specifications

a) Type: Spiral Wounded
b) Diameter of Membrane: 1.0 inch
c) Length of Membranes: 1 Mt.
d) No. of Membranes : 1
e) Recovery per Membrane: 10-15%
f) Salt Rejection per Membrane: 98-99%
g) Make of Membranes: Dow/Hydranautics, USA

H. RO Pressure Tube

1) Purpose: To pack Reverse Osmosis Membranes and operate at high pressure up to 300 psi

Specifications

a) MOC: FRP Composite
b) Diameter of Pressure Vessel: 4.2 inch
c) Length of Pressure Vessel: 1.3 m
d) No. Pressure Vessels: 1
e) No. of Membrane per Vessel: 1
f) Make: Pentair, USA
g) Position: Horizontal, Series
h) Arrays: 1 No.

I. R.O. Automation

A. Purpose

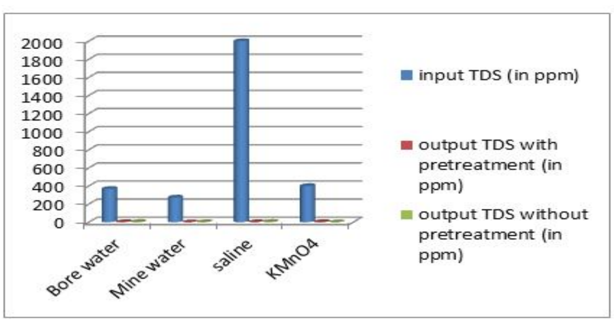
To prevent all the pumps from dry running and it will automatically shuts down the RO plant if the raw water tank is empty Or the product water tank gets filled through automatic centralized control panel for fully automatic operation of the plant.

a) Water level controller: 2nos.
b) Automatic Control panel: 1no.
c) Electrical wirings inputs: 1lott

IV. PROPERTY ANALYSIS

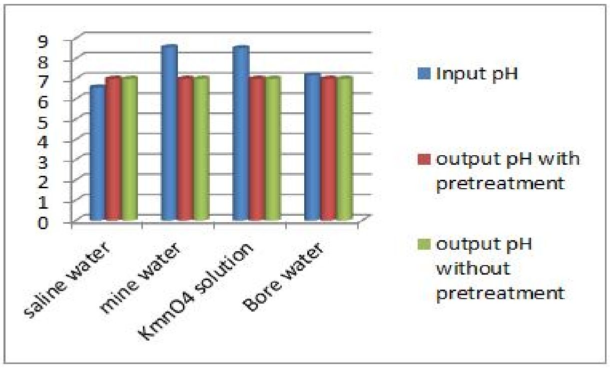
TDS analysis

Name of sample	Input TDS in PPM	Output TDS with pre-treatment (ppm)	Output TDS without pre-treatment(ppm)
Bore Water	368	2	4
Mine Water	273	0	1
Saline water	2000	2	4
KMnO4 solution	400	0	0



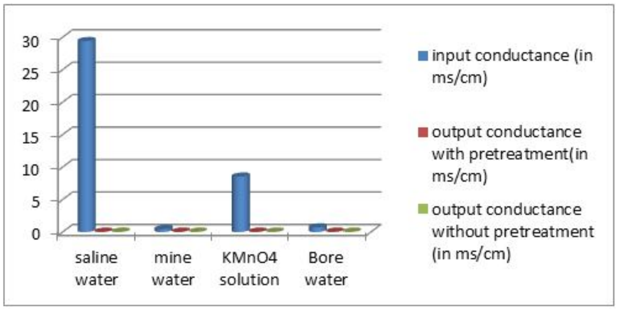
pH analysis (alkanality testing)

Name of sample	Input pH	Output pH with pre-treatment	Output pH without pre-treatment
Saline water	6.57	7	7
Mine water	8.56	7	7
KMnO4 solution	8.52	7	7
Bore water	7.18	7	7



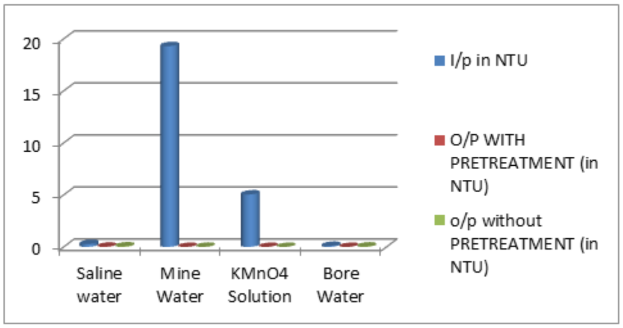
Conductance analysis

Name of sample	Input conductance in ms/cm	Output conductance with pre-treatment (ms/cm)	Output conductance without pre-treatment (ms/cm)
Saline water	29.4	0.0643	0.06565
Mine water	0.458	0.06431	0.06435
KMnO4 solution	8.546	0.064	0.06412
Bore water	0.718	0.06431	0.06541



Turbidity analysis

Name of sample	Turbidity of Input in NTU	Turbidity of output with pre-treatment (NTU)	Turbidity of output without pre-treatment (NTU)
Saline water	0.28	0.024	0.049
Mine water	19.3	0	0.01
KMnO4 solution	5.044	0	0
Bore water	0.103	0	0.04



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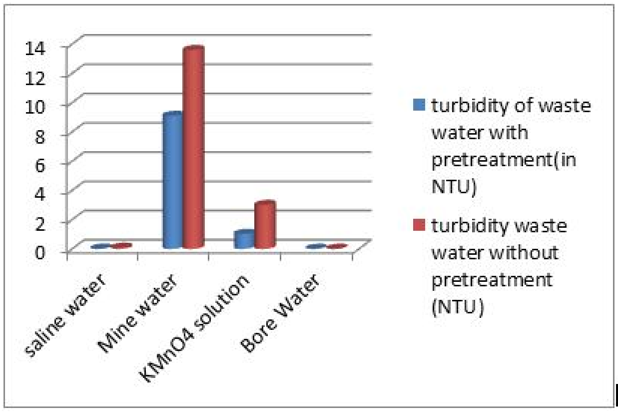
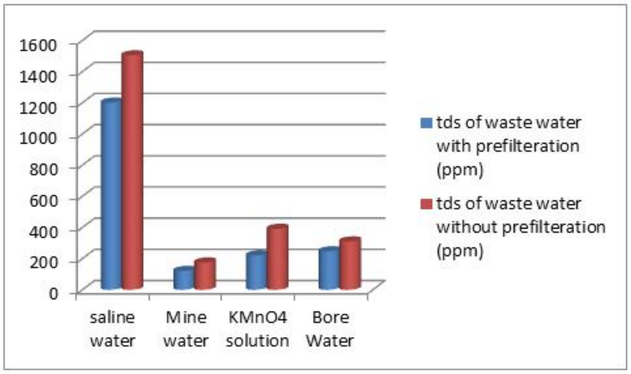
Waste water from purifier turbidity analysis

Name of sample	Turbidity of waste water with pre-treatment	Turbidity of waste water without pre-treatment
Saline water	0.024	0.0843
Mine water	9.1	13.6
KMn04 solution	1.03	3.01
Bore water	0.01	0.013



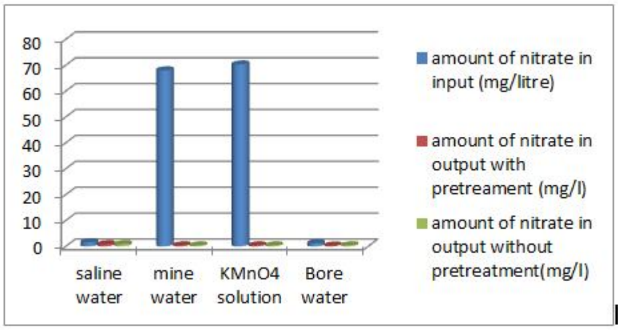
Waste water TDS analysis

Name of sample	TDS of waste water with pre-treatment (ppm)	TDS of waste water without pre-treatment (ppm)
Saline water	0.024	0.0843
Mine water	9.1	13.6
KMnO4 solution	1.03	3.01
Bore water	0.01	0.013



Amount of nitrate present (by using UV-spectrophotometer)

Name of sample	Amount of nitrate Input (mg/litre)	Amount of nitrate in output with pre-treatment (mg/litre)	Amount of nitrate in output without pre-treatment(mg/litre)
Saline water	1.6	0.8	0.84
Mine water	68	0.4	0.4
KMnO4 solution	70.3	0.4	0.4
Bore water	1.2	0.31	0.40



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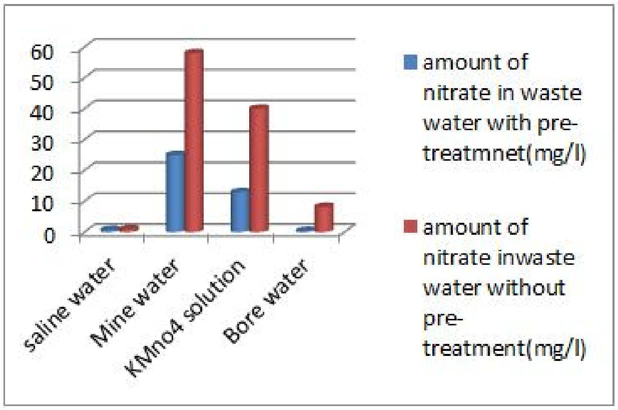
Waste water nitrate analysis

Name of sample	Nitrate present in waste water with pre-treatment (mg/l)	Nitrate present in waste water without pre-treatment (mg/l)
Saline water	0.7	1
Mine water	25	58
KMno4 solution	13	40
Bore water	0.4	8.2



PROJECT SNAP SHOTS

V. ECONOMICAL ASPECTS OF RO WITH PRETREATMENT TECHNOLOGIES

Extensive attempts were made to evaluate the costs of construction and maintenance of RO desalination plants. These methods ranged from the use of empirical estimation according to the experience and opinion of the experts, to sophisticated predictions through process simulations based on material balances. Moreover, the economics of desalinating water using RO has been constantly improving, due to the enhancements of the RO membrane technology. In spite of the fact that the prices of seawater and brackish water membrane elements are slightly different, the desalting cost of seawater RO is significantly higher than the cost of brackish water RO. However, the production of drinking water from seawater is considered an affordable alternative when there is no reliable fresh water sources are available. The RO factor that has the main impact on both investment and operating cost is the recovery rate of permeate. The RO feed flow is inversely related to the recovery rate of the design. Consequently, the recovery rate directly impacts the size as well as the cost of all the equipment and power consumption. Yet, in RO systems, the recovery rate cannot exceed certain limit, due to the fact that higher recovery rates will lead to higher feed salinity that will result in higher osmotic pressure and consequently increase the permeate salinity . In California, many water agencies have embarked on exploring seawater desalination because of the diminishing capacities of fresh surface and ground water. Most of the water utilities in Southern California currently purchase imported water from the Bay Delta and Colorado River at a rate of US $2.30 to $2.45/1,000 gallons ($750 to $800/AF), and the cost of these water supplies is very likely to increase by 15% or more through 2015 due to additional expenditures needed to comply with more stringent drinking water quality regulatory requirements promulgated by the US EPA (Fig. 1).

Studies were carried out to evaluate the total cost of UF as pretreatment to RO technology. Some of them found that an UF–RO system is economically unfeasible while others weren't in line.

The operating cost of RO can be increased due to the frequent replacement rate of its membranes. However, pretreatment by low-pressure membrane filtration was proven to improve the cost of the RO in the long-term as it increases the lifespan of the RO membrane by 20–30%.

Voutchkov showed that the use of UF and MF membrane pretreatment for RO systems significantly lowered the SDI values of the feed significantly, hence less RO membranes biofouling potential. Both the RO and the low pressure membranes need occasional chemical cleaning. Pearce examined the effect of UF/MF pretreatment on the chemical cleaning cost of a RO plant. It was concluded that, by the use of UF/MF pretreatment, the basic cleaning frequency would be reduced to two or one cleaning per year. Nevertheless, conventional pretreatment systems might be very attractive in terms of low energy cost than non-conventional pretreatment systems. Gleuckstern and Priel compared the treatment cost of the 90,000 m3/d RO sea water desalination plant via using: 1) conventional and 2) UF as pretreatment technologies. Table 1 demonstrates the comparative cost with respect to capital, operational and maintenance, energy, chemical, and the total variable operational costs. The conventional pretreatment systems have lower total cost, labor cost, and unit cost. However, the performance of RO in producing a good quality of effluent with conventional pretreatment is still limited. To summarize, Table 2 demonstrates the capital and effluent costs of the pretreatment systems based on salinity ranges.[8]

Table 2

Comparison of water cost of UF and conventional pretreatment for the 90,000 m^3/d RO desalination plants [41].

Filtration method	Conventional $/$m^3$	UF $/$m^3$
Capital cost	0.22	0.23
Fixed O&M cost	0.07	0.09
Energy cost	0.16	0.16
Chemical cost	0.05	0.03
Total variable operational cost	0.22	0.20
Total cost	0.51	0.52

Table 3:

Comparison of capital cost, produced water cost, energy consumption, and the salinity range of the pretreatment systems.

Pretreatment	Salinity range (ppm)	Capital cost	Energy consumption	Produced water cost
MF and UF	1500-35,000	The higher fixed cost, 1.92 Cent/m^3, is associated with the lower energy and chemical costs (~0.02 Cent/m^3 and ~2.12 Cent/m^3).	The O&M unit costs of MF are lower than UF, probably because of lower membrane replacement costs and lower energy consumption. The approximate OSM unit costs for MF and UF processes in plants with a capacity of 1 MGD are about $0.20/1000 gal and $0.43/1000 gal, respectively.	Around $40/$m^2$, with an overall area requirement of 24,000 m^2, and a 7 year membrane life
Conventional systems	1500-35,000	22.13 (Cent/m^3)	16.06 (Cent/m^3)	

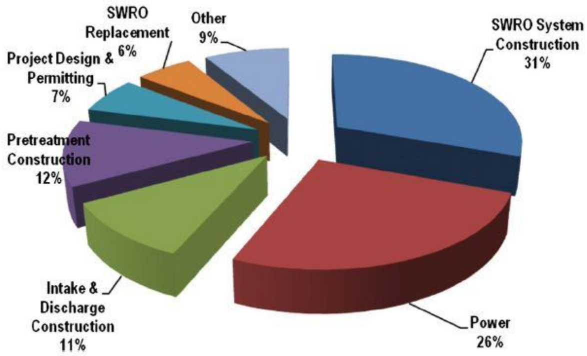


Fig. 1. SWRO plant construction cost breakdown [85].

VI. CONCLUSION

Pretreatment plays the critical role of removing source water constituents, like sediment andmicrobes, which could hinder the downstream reverse osmosis (RO) desalination process. While some source waters require negligible pretreatment, others like surface waters, require rigorous treatment to protect the RO process operation.
The RO industry grew rapidly between 1995 and 2010. Growth pushed the industry to find cost-effective and robust large-scale pretreatment solutions. Over the last two decades, RO manufacturers have also developed membranes with greater fouling resistance and advocated system designs that reduce fouling potential. As a result, the state of the art in pretreatment has progressed significantly since the mid 1990s.
Many of the improvements in pretreatment were enabled by a better understanding of fouling processes. Because fouling is complex and dynamic, with biofouling contributing to its complexity, significant research and development have been necessary to identify improvements.
This paper provides a basis to understand the various fouling mechanisms found in RO systems and to describe the current state-of-the-art of the pretreatment technologies for fouling control. The paper addresses pretreatment of the myriadwater sources inwhich RO technology is applied, with greater emphasis on seawater RO SWRO pretreatment as the largest single pretreatment market segment. [9]
Thus we developed the project which is intended to introduce An exceptional level of purity for the purified water.Reverse Osmosis is used in order to obtain the filtration RO is used with pre- and/or post-treatment equipment to meet a specified requirement for water quality. The resultant water quality is of best of its kind and the whole statistics is mentioned inproperty analysis section of our paper.

VII. ACKNOWLEDGMENTS

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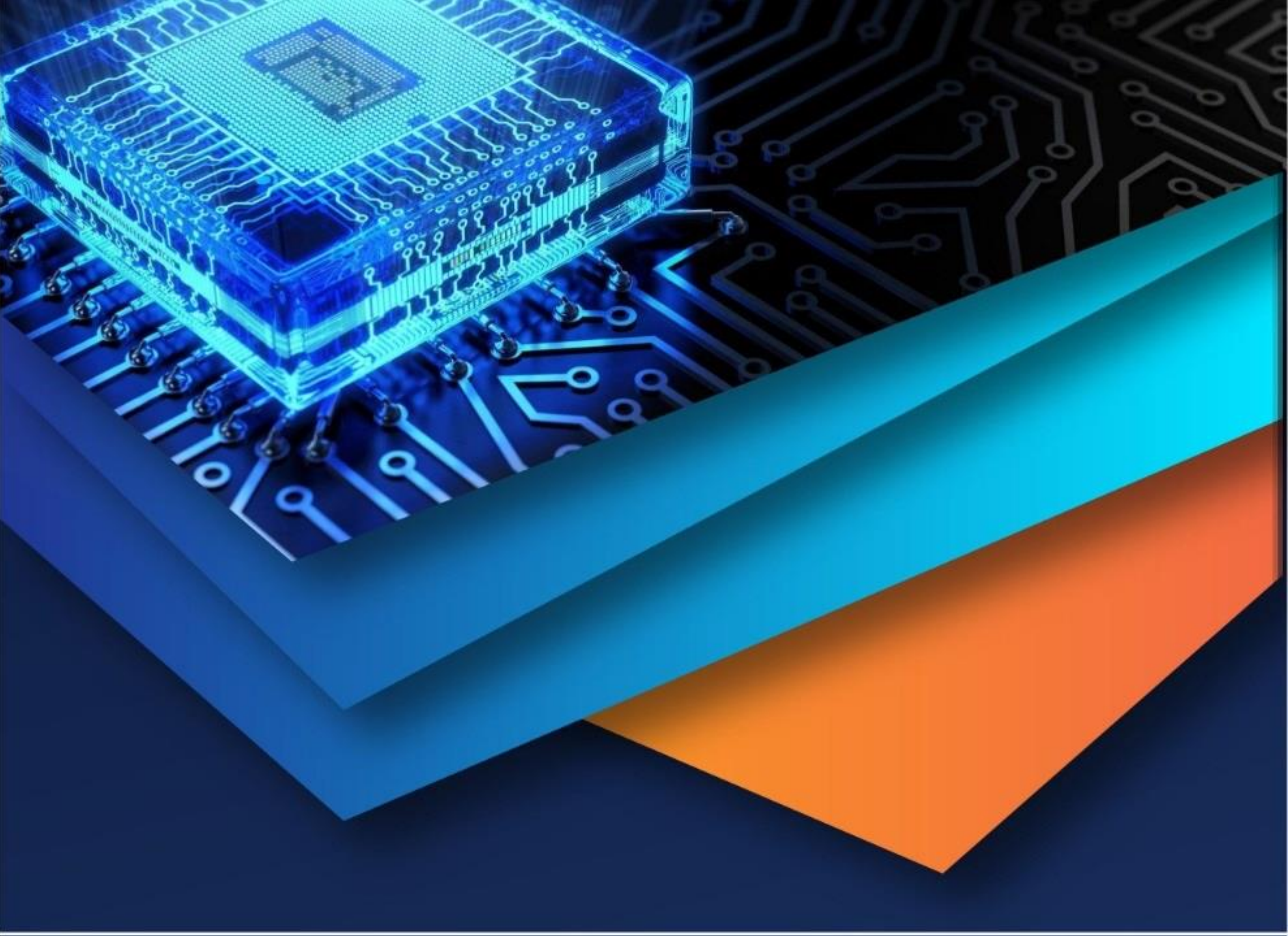

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