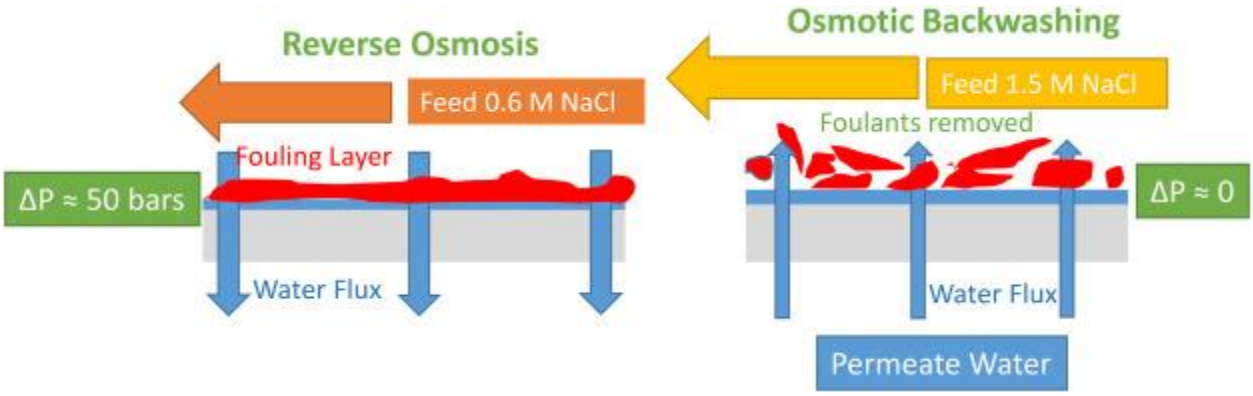
RO – Fouling

RO - Fouling:

When contaminants get accumulated on the membrane surface & plugging occurs the Fouling. If we go for municipal feed water, then we can get usually many contaminants. These contaminants pose the ability to perform a quick plugging or fouling in RO membrane.

Membrane fouling caused by deposition & precipitation of molecules or particulates on the membrane surface or membrane pores.



Generally, fouling starts in the front end of RO & results with a higher pressure drop. Same time, the permeate flow gets down. As a result, incurs the higher operating cost as well as chance to clean the RO membrane or to change the RO membrane.

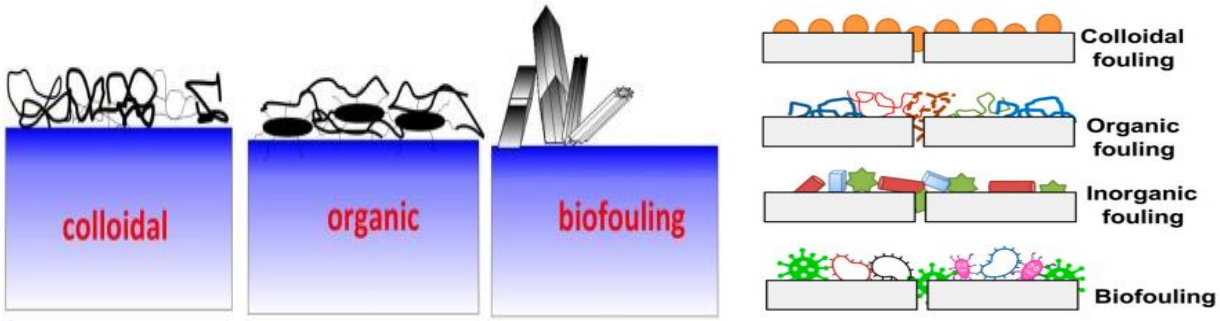


Figure: Fouling

Though you have an effective pretreatment, sometimes the RO system can gets fouling in its pore. If you have a proper pretreatment in your system, there is a minimal chance of RO fouling.

RO Fouling can be caused by the following.

- Colloidal or Particulate Matter [with dirt, slit, clay etc.]
- Organic Matter
- Biofilms/Micro-organisms [bacteria can produce biofilms which can cover the membrane surface]
- Breakthrough of Filter Media Upstream [softener bed leak can lead to a RO fouling]

A] Colloidal or Particulate Matter [with dirt, slit, clay etc.]

Colloidal Fouling – Result:

- Higher pressure drops
- Higher salt passage
- Less salt rejection
- Low permeate flow
- Lower permeate water quality

Colloidal or Particulate Fouling – Cause:

- Suspended Particles
- Colloidal Silica
- Carbon Powder
- Metal Oxide [Fe…]

Colloidal or Particulate Fouling – Solution Estimated:

- Pretreatment Issue
- Cartridge Filter Bypassed
- ACF Leakage
- Pipe Corrosion

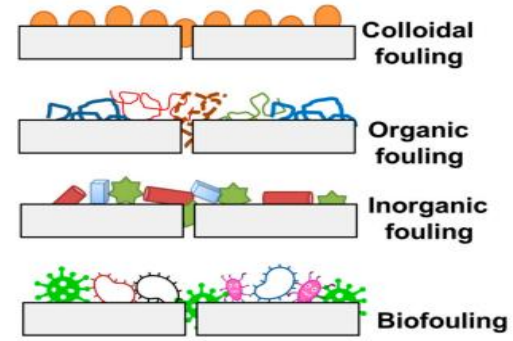


Figure: Fouling

B] Organic Matter

Organic Matter Fouling – Result:

- Membrane block
- Oil particle clogged

Organic Fouling – Cause:

- Oil [Pump Sealant, New Pipe]
- Overdose of Anti-Scalant
- Overdose of Cationic Flocculants
- High COD, BOD in feed

Organic Fouling – Solution Estimated:

- Check the Sealant, Check Pipe
- Optimum dose of Anti-Scalant
- Optimum dose of Cationic Flocculants
- Control of COD, BOD in Feed

C] Biofilms/Micro-organisms:

Generally, includes the forming of biofilms in permeate surfaces of cross-flow membranes, polyester support fabrics, permeate collection materials & feed channel spacer materials.

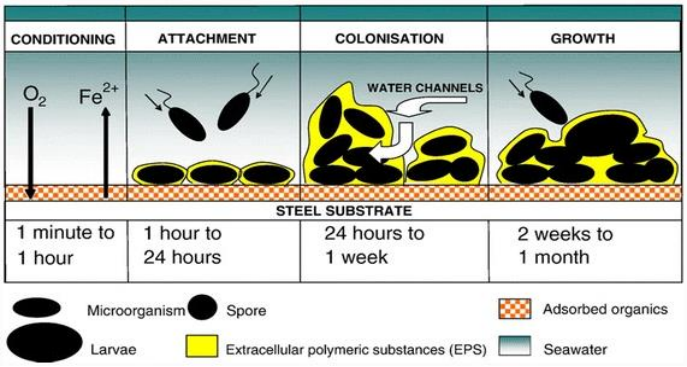


Figure: RO Membrane Biofouling

Bio-Fouling – Result:

- Membrane cleaning need
- Membrane change need
- Output hampered

Bio-Fouling – Cause:

- Bio Slime
- Algal Flora
- Bacteria

Bio-Fouling – Removal:

- Disinfection [Physical: Sand Filtration, UV Treatment, Ultrasonic Sound etc.]
- Disinfection [Chemical: Chlorination, Ozonation]
- pH adjustment

D] Breakthrough of Filter Media Upstream [softener bed leak can lead to a RO fouling]

Breakthrough of Filter Media Upstream – Result:

- Membrane cleaning need
- Membrane change need
- Output hampered

Breakthrough of Filter Media Upstream – Cause:

- If don't have any cartridge filter before RO system
- Leaking in cartridge filter
- Leaking in softener

Breakthrough of Filter Media Upstream – Solution Estimated:

- Installing cartridge filter before RO system
- No leak in cartridge filter
- No leak in softener

RO Problem Indicators & Corrective Measures:

Permeate Flow	Salt Passage	Differential Pressure	Direct Cause	Indirect Cause	Corrective Measure
↓	↑	↑	Scaling	Poor Scale Control	Cleaning, Scale Control
↓	↑	↑	Colloidal Fouling	Insufficient Pretreatment	Cleaning, Improve Pretreatment
↓	→	↑	Biological Fouling	Insufficient Pretreatment	Cleaning, Biocide, Improve Pretreatment
↓	→	↑	Organic Fouling	Polymer Overfeed Oil	Cleaning, Improve Pretreatment

RO – When to Clean the System:

RO cleaning system can be emerged when the below mentioned situation occurs.

- Pressure Drop Increase 10% - 15%
- Permeate Flow Decrease 10% - 15%
- Permeate Quality Decrease 10% - 15%
- Before Starting after a Long Time Shut Down

Some other issues can be illustrated as…

- Scaling Fouling
- Chemical Fouling
- Mechanical Fouling

Scaling:

When dissolved in-organic compounds get more concentrated [reach the maximum solubility limit], then RO scaling takes place. In this situation the in-organic compounds exceed their limit of solubility. Hence, in-organic compounds precipitate on the membrane surface with scaling formation. [eg. CaCO3]

Figure: RO Membrane Scaling

Scale Fouling – Result:

- Higher pressure drops
- Higher salt passage
- Less salt rejection
- Low permeate flow
- Lower permeate water quality

Scaling Fouling – Cause:

- CaCO3
- CaSO4
- Ca(PO4)2
- SiO2

Scale Fouling – Removal:

- Water Softening
- Use of Antiscalant
- Acid Injection
- Disinfection [Physical: Sand Filtration, UV Treatment, Ultrasonic Sound etc.]
- Disinfection [Chemical: Chlorination, Ozonation]
- pH adjustment

Chemical Fouling:

For water treatment Chlorine or Chloramines are used in stream. Present RO membranes are Thin Film Composite. Hence, the Chlorine or Chloramine has a major chance to make “holes” in RO membrane.

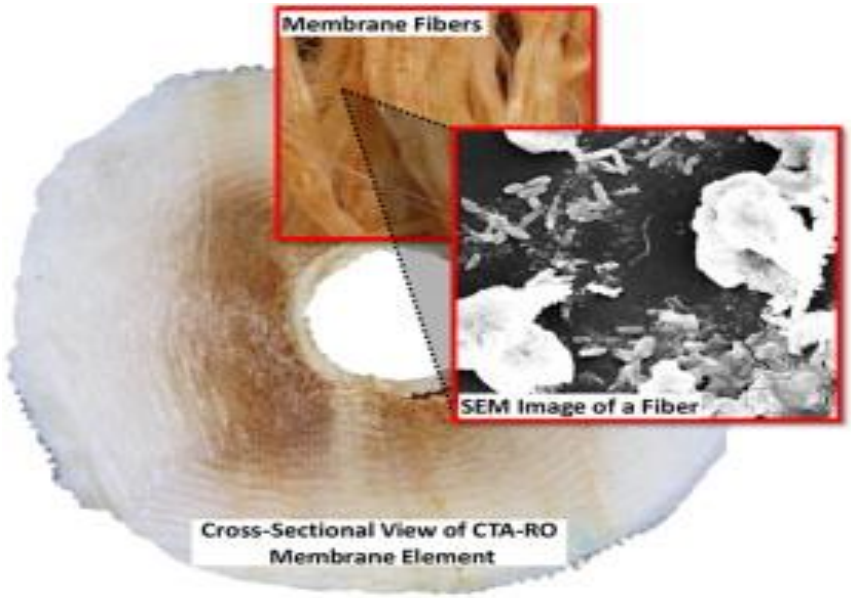


Figure: Chlorine or Chloramine damage RO membrane

Chemical Fouling - Result:

- Higher permeate flow
- Higher salt passage
- Holes induces microbial growth

Chemical Fouling – Cause:

- Chlorine
- Chloramine

Chemical Fouling Removal:

- Use of ACF before RO

Mechanical Fouling:

While operating RO system, there are some installation task as well as after commissioning task. It has incorporated with

- RO system Pre-Plumbing
- RO system control

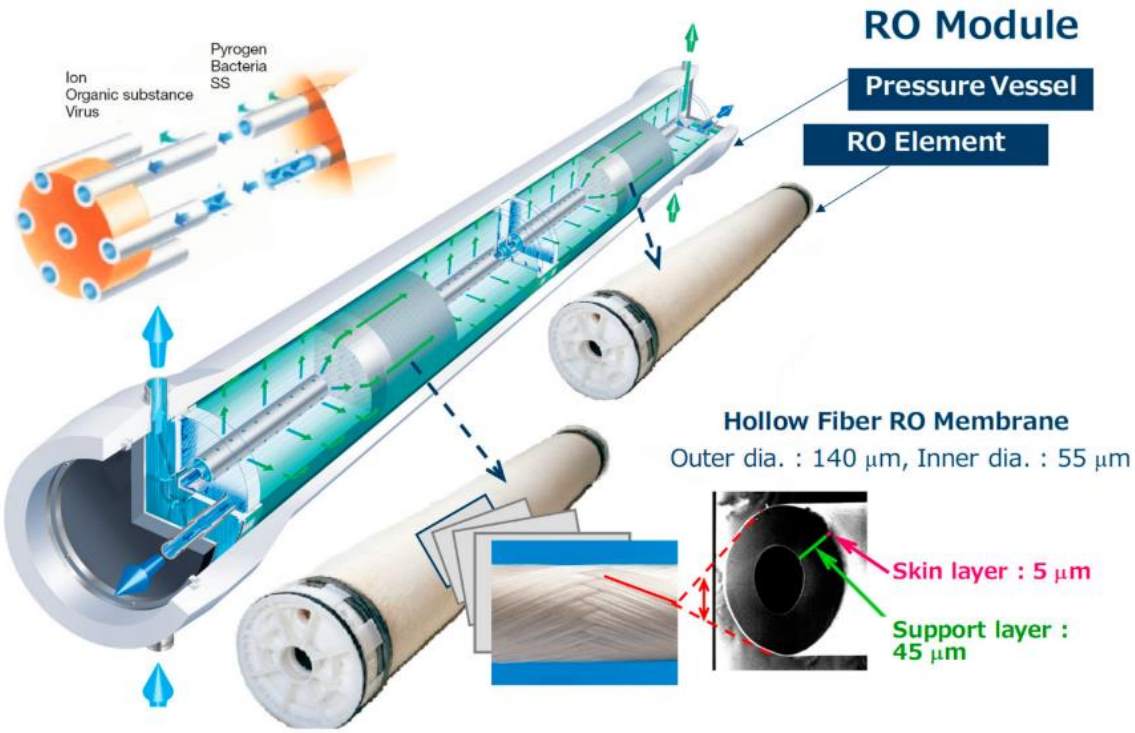


Figure: RO Membrane Piping

If there is any mechanical damage while installation, there is a major chance of RO fouling which is termed as mechanical fouling.
If the backpressure of RO system is too much, there is a major chance of RO fouling which is termed as mechanical fouling.

Result of Mechanical Fouling:

- Various types of problem recurring
- Output hampered
- Loosing system control

Mechanical Fouling Removal:

- Accurate plumbing
- Accurate system control