

Troubleshooting for RO membranes

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Troubleshooting for RO membranes

- 1-Membrane Oxidation •*
- 2-High Operating Pressure •*
- 3-Membrane Fouling •*
- 4-Differential Pressure Increase •*
- 5-Scaling •*

1-Membrane Oxidation case #1

1- If composite polyamide RO membrane elements are exposed to the oxidizing chemicals such as free chlorine, chloramine, bromine, ozone, or other oxidizing chemicals, irreparable damage is happened to the membrane, normally, evidenced by decrease of salt rejection.

2 - Lead end elements are typically more affected than the others in case of oxidizing chemical presents in RO feed water.

3- If several specific conditions are assembled, chlorine generating problem might be occurred.

- - Dissolved Oxygen,
- - NaHSO₃(SBS),
- - Heavy Metal Ion (Cu, Co, Mn, etc. Low concentration, ppb order, is enough)
- - High Salinity Chloride Ion

1-Membrane Oxidation case #2

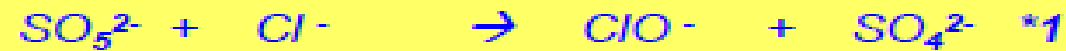
Chlorine Generation Mechanism under existing of Heavy Metal

Even if RO feed water does not contain Chlorine, Chlorine will be generated.

- Following substances are required to generate chlorine.

1. Dissolved Oxygen,
2. NaHSO₃ (SBS)
3. Chloride Ion
4. Heavy Metal Ion(Cu, Co, Mn. etc.)

- Following chemical reactions in the process of generating chlorine (e.x. with Copper).



(ClO⁻:Chlorine, Cl₂)

Reference

*1 : C. H. Barron and H. A. O'Hern, Chemical Eng. Sci. 21(1966) 397-404

2-High Operating Pressure (Low Permeate Flow)

High Operating Pressure (Low Permeate Flow)

High operating pressure(= low permeate flow) can be caused by the following:

- Membrane fouling
- Differential pressure increase
(Plugging of the feed channel)
- Scaling

3-Membrane Fouling

Membrane Fouling

- The deposition of suspended particles on the membrane surface.
 - Foulant on the membrane surface increases the resistance to the flow of water through the membrane.
 - Fouling causes lower productivity at constant net pressure or higher net pressure at constant productivity.
 - Sometimes higher salt passage will be caused by membrane fouling.

▶ 3-Membrane Fouling

Membrane fouling is caused by

- Improper pretreatment system
- pretreatment condition upset
- Chemical dosing system upset
- Improper material selection (piping, valve, pump, etc.)
- Improper flushing after shutdown
- Scaling by excess recovery ratio
- Biological contamination in feed water
- Feed water chemistry change

▶3-Membrane Fouling

Cause of Trouble : Fouling (Suspended Solid, Coagulant)
(SS leakage from pretreatment)




Fouling Amount : 62.4g
(Dry weight)




Ash Ratio : 75.9%
(SiO₂:32%, Al:9.7%, Fe:4.8%)

▶ 3-Membrane Fouling

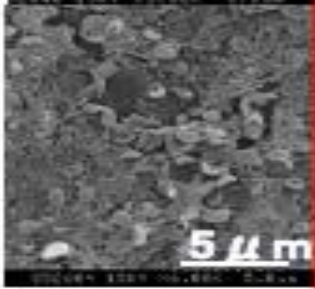

Cause of Trouble : Fouling (Biological Fouling)



New Membrane



After Fouling
(Bacteria and Fe)



Fouling Amount : 130g
(Dry weight)

Ash Ratio : 32.2%
(SiO₂:11%, Al:5.1%, Na:2.1%)

4-Differential Pressure Increase

Differential Pressure Increase = Plugging of the Feed Channel

- ◆ Increase of normalized *Differential Pressure* indicates fouling of feed / brine channel.
- ◆ Typical causes of DP increase.
 - Upstream :
 - Suspended solids, colloid, bacteria, silt, clay, iron corrosion and pretreatment coagulant in the feedwater
 - Downstream : scaling
 - Any stage | mainly lead position : Biological fouling

Clean condition



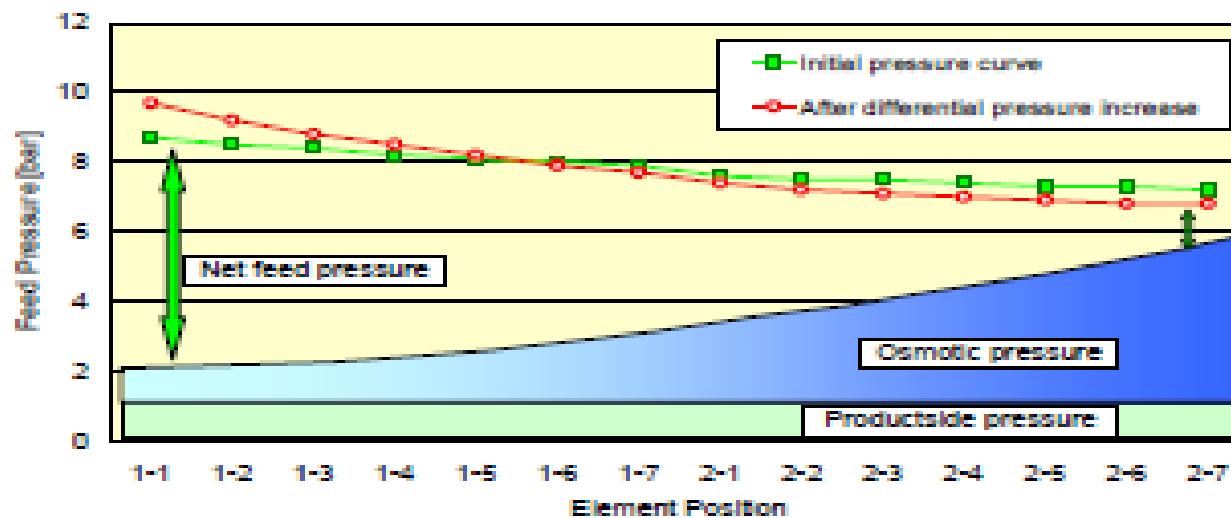
Biological fouling



► 4-Differential Pressure Increase

Problem of High Differential Pressure (1)

- ◆ Fouling will be accelerated
- ◆ RO element mechanical trouble by thrust force
- ◆ Getting difficult to remove by cleaning



DP increase by fouling

Permeate flow decreasing

Operating pressure increase

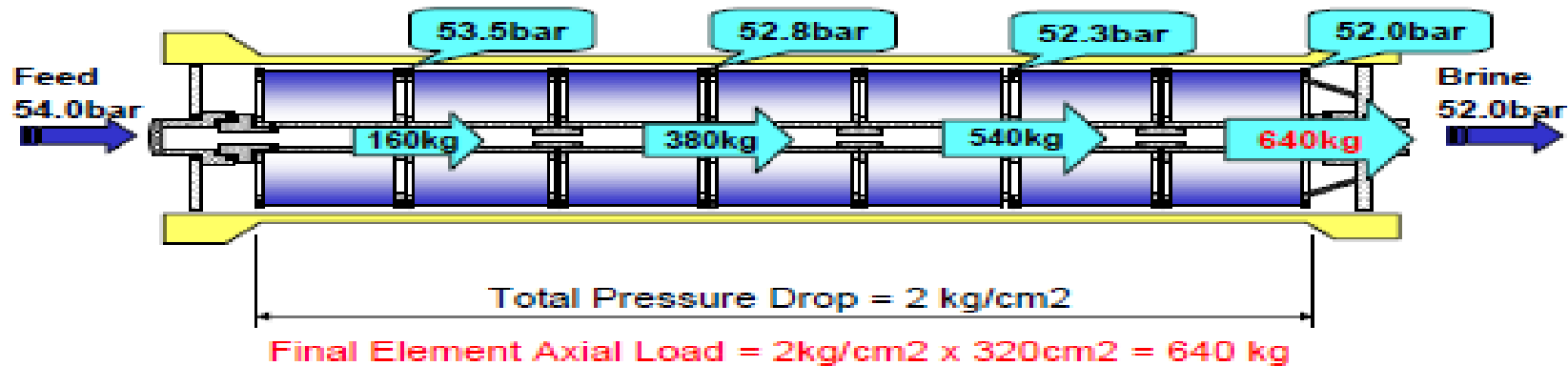
Front end element's flux increase

Fouling will be accelerated

► 4-Differential Pressure Increase 2

Problem of High Differential Pressure (2)

- Fouling will be accelerated
- RO elements mechanical trouble by thrust force
- Getting difficult to remove by cleaning



5-Scaling

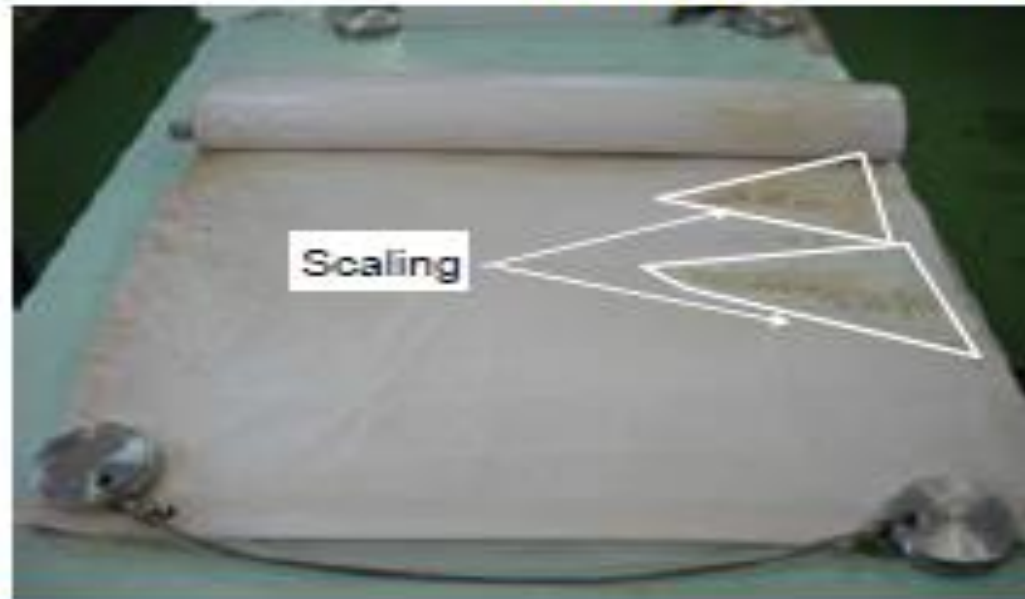
- The deposition of sparingly soluble salts on to the membrane surface and/or the feed channel material.
- – Scaling occurs primarily in the downstream elements because of the higher concentrations existing in this portion of the RO system.
- – Common scalants include calcium sulfate, silica and calcium carbonate.
- – Normalized Product Flow Rate will be decreased.
- – Normalized Salt rejection might be decreased by membrane mechanical ablations caused by scaling.
- – Differential pressure will be increased

► 5-Scaling

Cause of Trouble : Scaling

Scaling caused by :

- Too much high recovery
- Higher pH operation
- Lower antiscalant dosing
- Water chemistry change



The end

THANKS FOR YOU

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