

Metal Fouling Control for RO-Membrane with Sokalan[®] RO3500

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Metal Fouling Control for RO-Membrane with Sokalan[®] RO3500

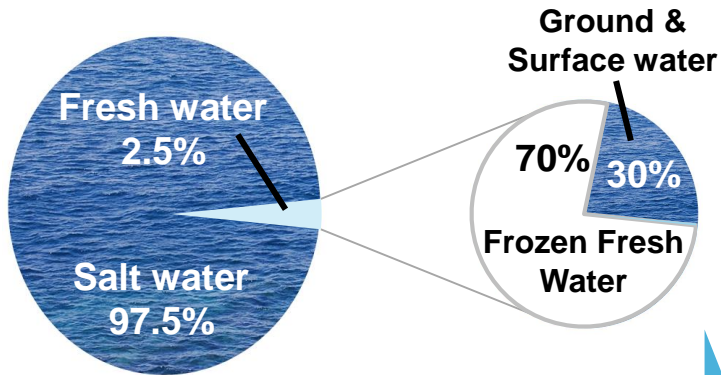
Outline

- Water facts
- Importance of pretreatment
- Results of static tests
- Results of dynamic test/total recirculation
- Results of dynamic test/permeate withdrawal
- Summary

Water Resource

How Much Water Do We Have?

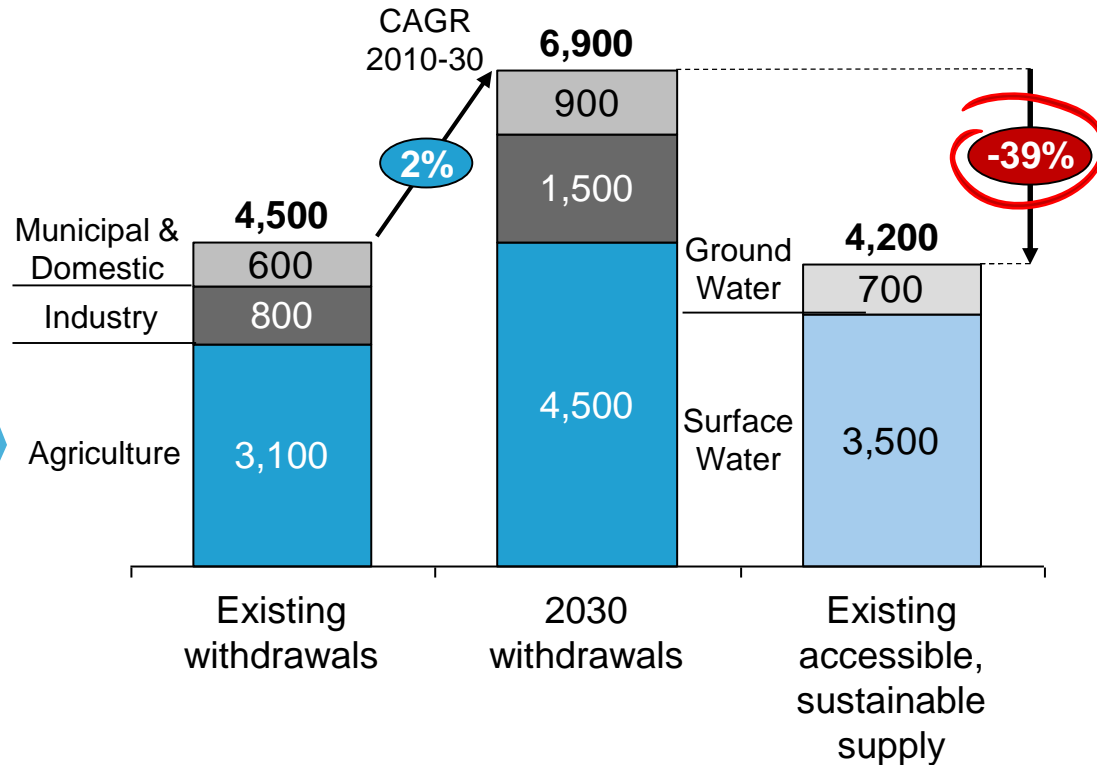
Global Water Resource



Only **0.76%** of earth water is accessible ground water and surface water

Water Supply & Demand Balance 2030

Km³, based on 154 basins/regions



Water Desalination

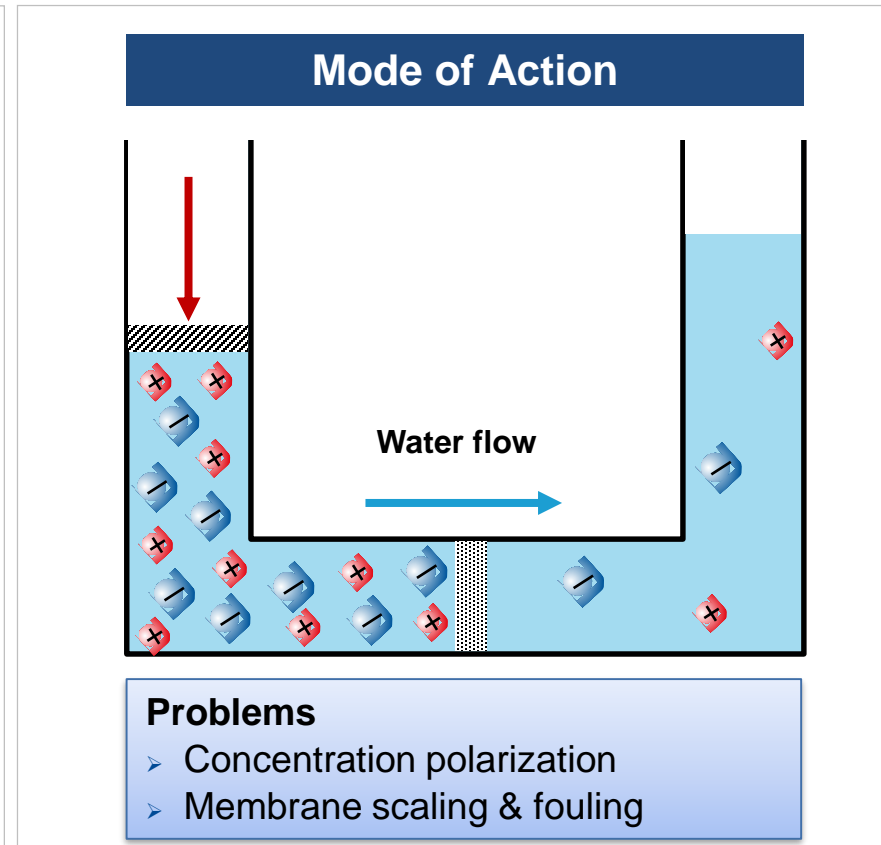
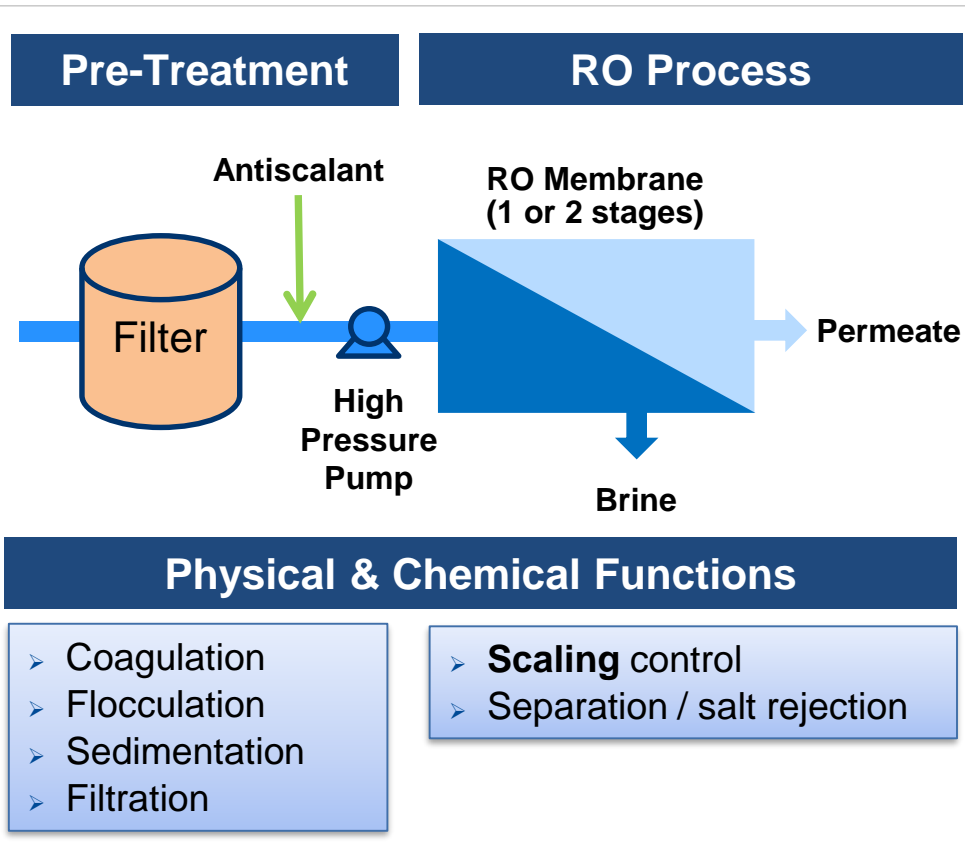
Some Facts

- **2.3 billion people live in “water stressed” regions**
- **300 million people in 150 countries use desalinated water**
- **Desalinated water production: 75 million m³/day of which 47 million m³/day (~63%) produced via RO**
- **Feed water sources: 59% seawater; 22% brackish water, 9% river water, 6% waste water, 4% pure water**
- **Socio-economic megatrends (population growth, urbanization, industrialization and resource contamination) will continuously drive the increase in global water consumption**

Sources: Shiklomanov & UNESCO, 1999 & DesalData 2015

RO Desalination

Importance of Pretreatment

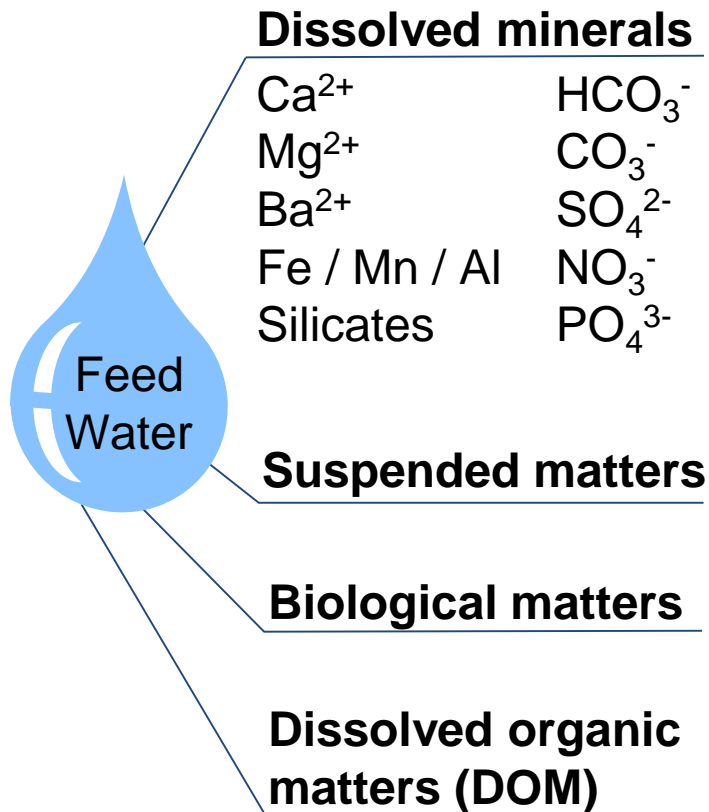


➔ Pretreatment protects RO membranes and improves productivity

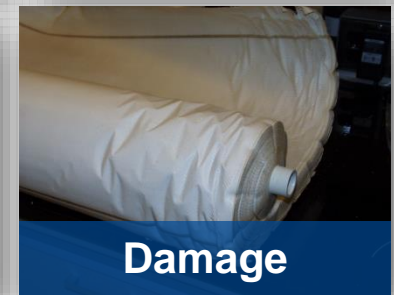
RO Desalination

Why Does It Need Multifunctional Antiscalant?

Typical Feed Water Composition



Main scale & fouling problems



- CaCO_3 , CaSO_4 , BaSO_4 , MgOH , $\text{Ca}_3(\text{PO}_4)_2$ & silica scaling
- Fe/ Mn, colloidal & bio- fouling

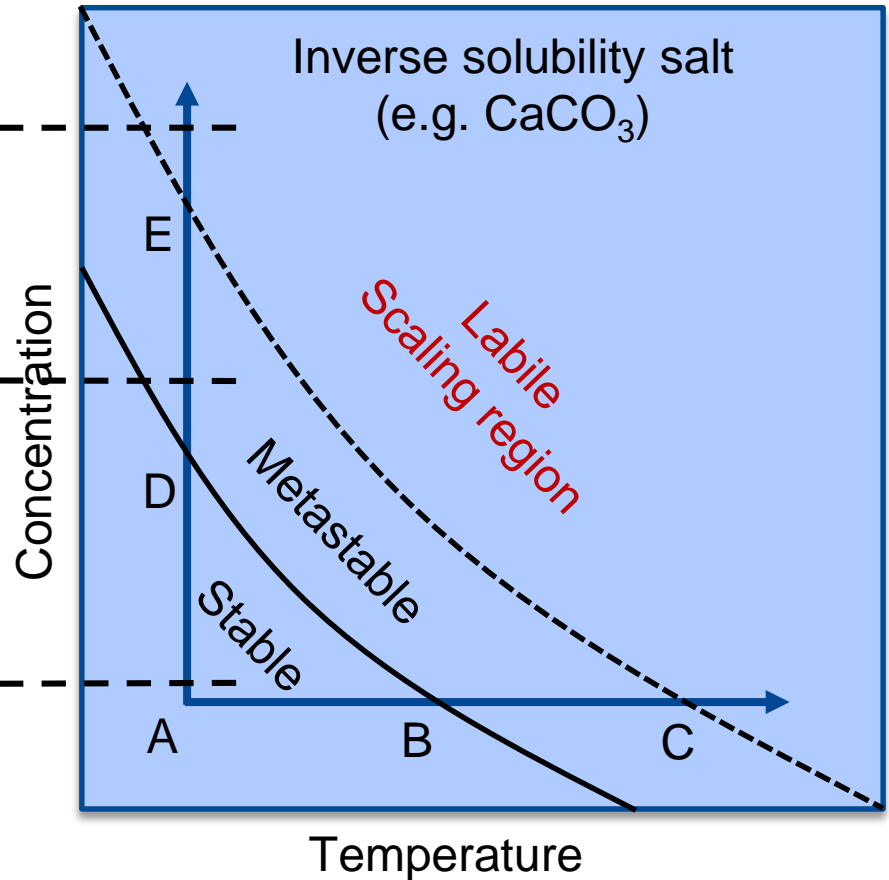
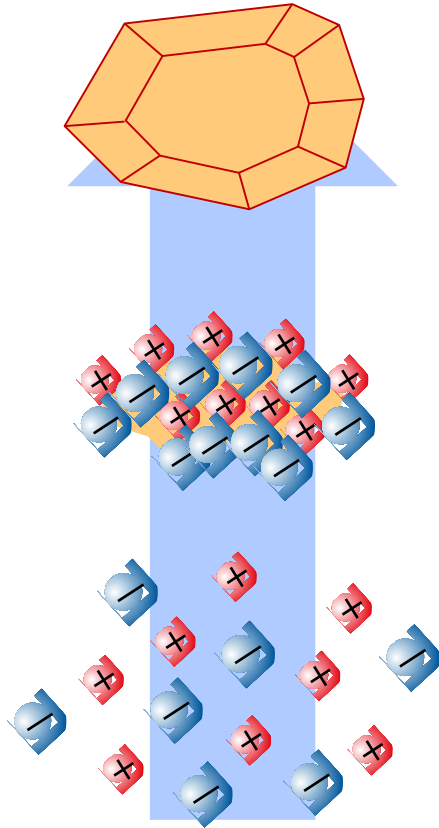
RO Desalination

How Does Scale Form?

Nucleation
& crystal
growth

Super-
saturation

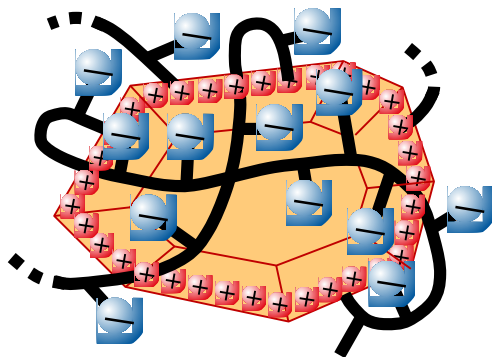
Under-
saturation



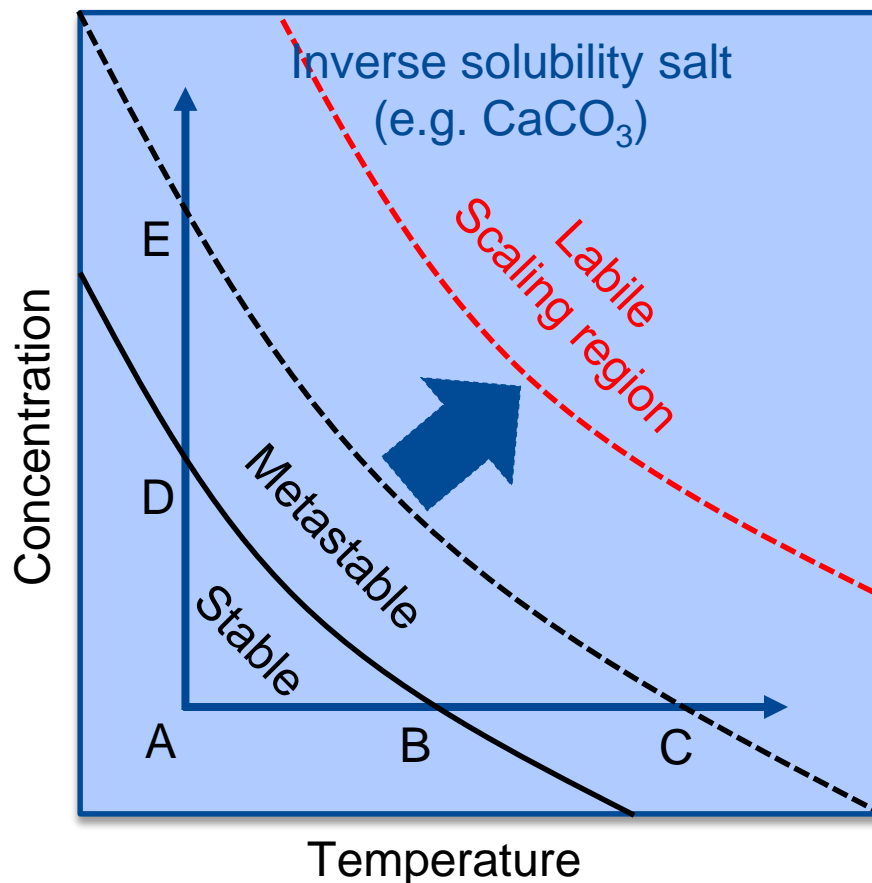
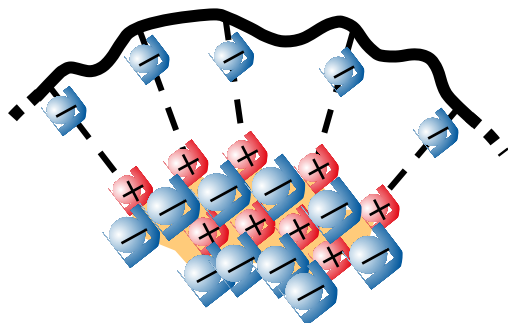
Multifunctional Antiscalant for RO

How Does It Work?

Crystal modification & dispersion



Threshold inhibition



➔ Crystallization inhibition and particles dispersion

Experimental Results

Static and Dynamic Test Methods

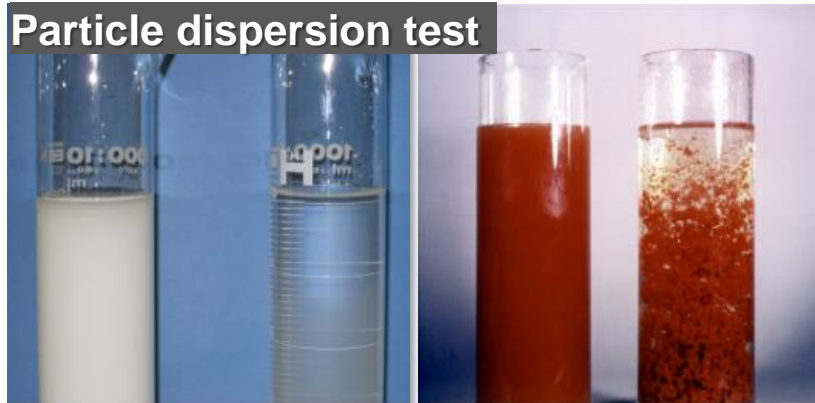
Laboratory Jar / beaker Test:

- Simulation of Crystallizations and Particles Deposition

Crystal inhibition test



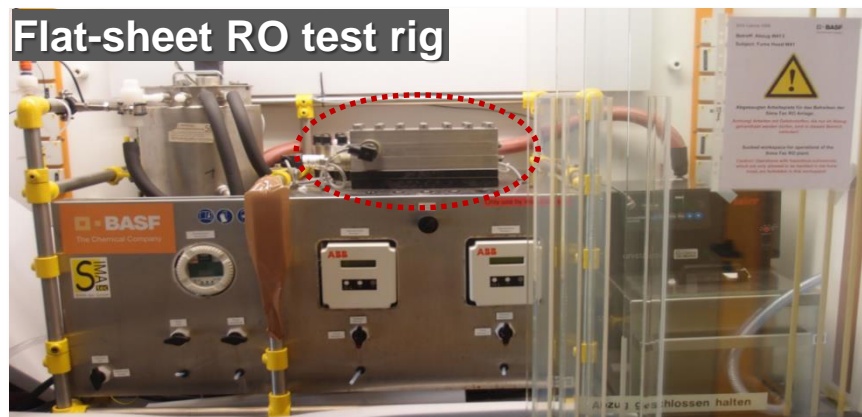
Particle dispersion test



Laboratory Flat – Sheet RO Test:

- Simulation of Process RO systems

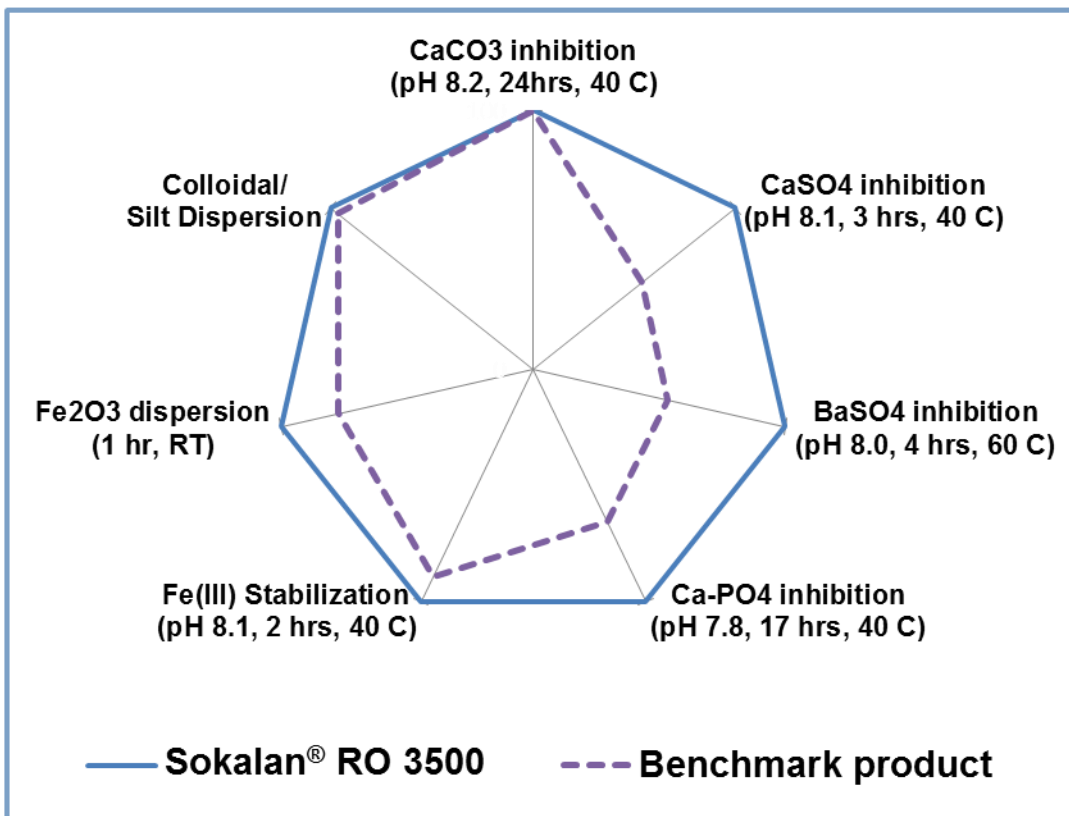
Flat-sheet RO test rig



Sokalan® RO 3500 from BASF

Static Test Results

Laboratory Jar / Beaker Test Results



- Very low phosphorus content (< 50 µg P/L vs. 1500 µg P/L for ATMP @ 5 ppm dose & 75% Rec.)
- A multifunctional antiscalant to handle multiple scale potentials
- Outperforms benchmark product in CaSO₄, BaSO₄ & Ca-PO₄ inhibitions, and iron control.
- Performs at the same level as Polymaleate/Phosphonate blend in CaCO₃ inhibition

Dynamic RO Flat-Sheet Test

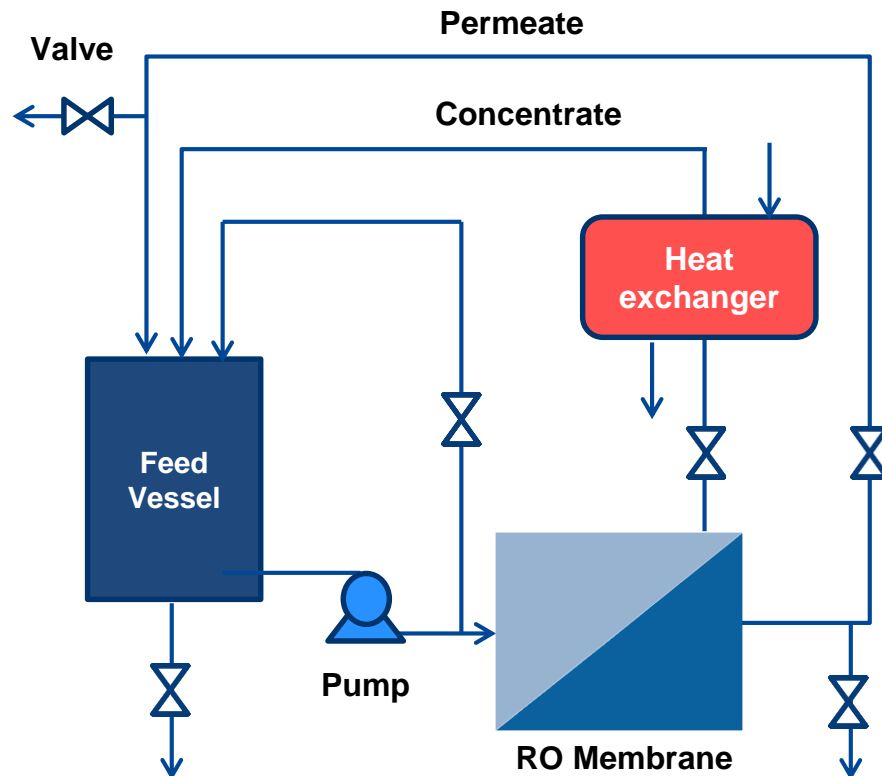
Two Different Modes of Operation

■ Permeate withdrawal mode:

Study the maximum water recovery achievable with an antiscalant

■ Total recirculation mode:

Study water system stabilization at constant recovery by an antiscalant

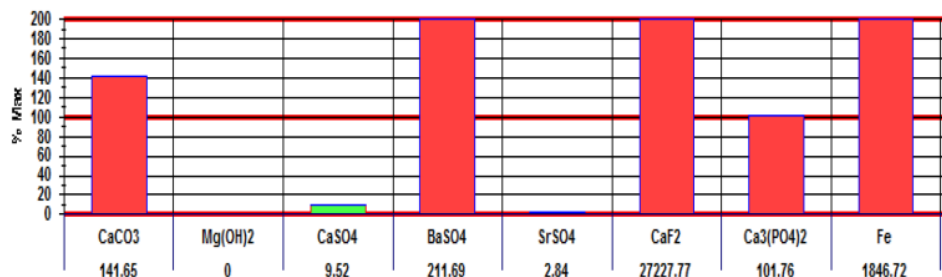


Tertiary Effluent Feed Water Composition

Scaling / Fouling Analysis

	Feed Water Composition	Brine @ 75% recovery
Species	ppm / unit	ppm / unit
Al	0.1	0.4
Ba	0.01	0.04
Ca	23.8	95.2
Cu	0.007	0.028
Fe	0.1	0.4
K	11.15	44.6
Mg	7.75	31
Na	95.25	381
NH4	3.34	13.36
Ni	0.013	0.052
Cl	114.15	456.6
F	10.0	40
HCO3	65.6	262.4
PO4	8.0	32
SiO2	10.5	42
SO4	73.05	292.2
TDS	422.82	1691.28
pH	7.0	7.6
Recovery	0	75%

Scaling/Fouling Prediction BASF RO Xpert Software



Cleaning solution analysis Dominant Scaling/Fouling Type

1st stage / 2nd stage

Fe fouling

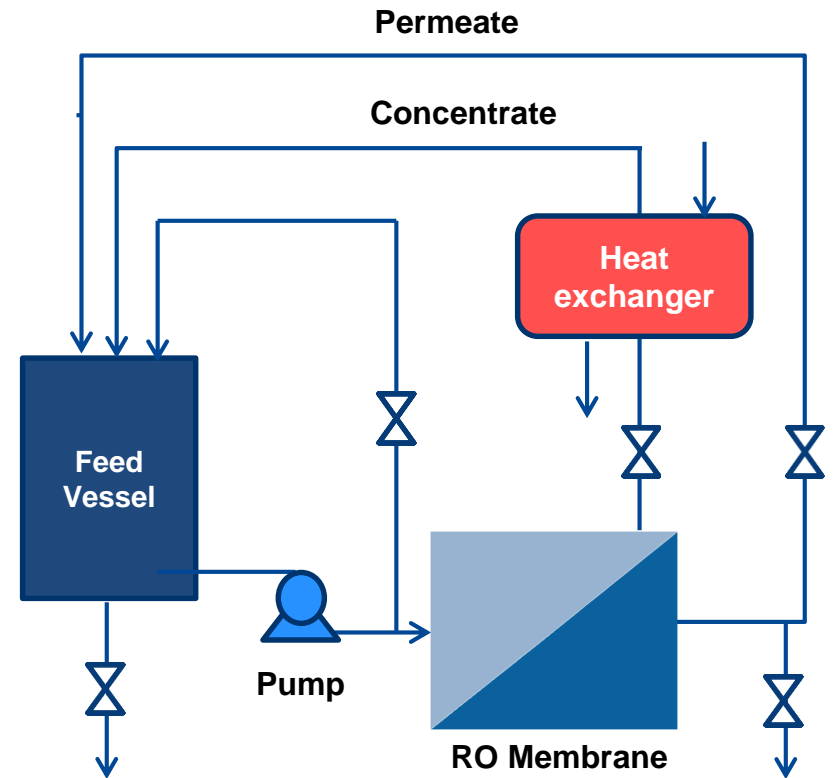
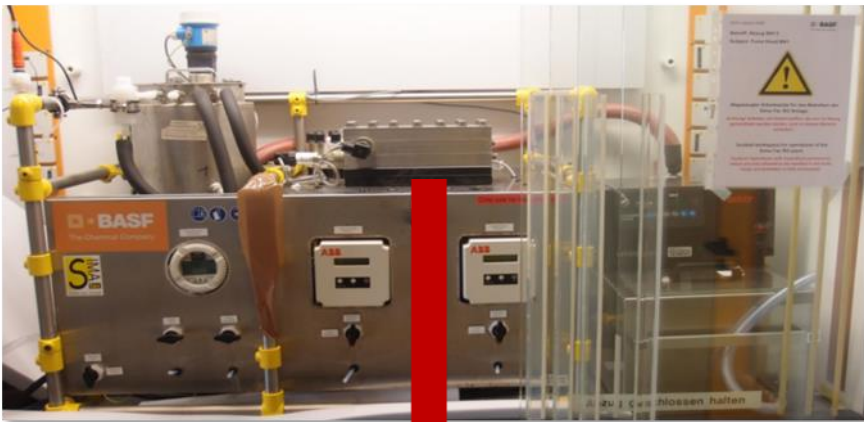
Al fouling

CaCO₃ & BaSO₄

CaCO₃ & BaSO₄

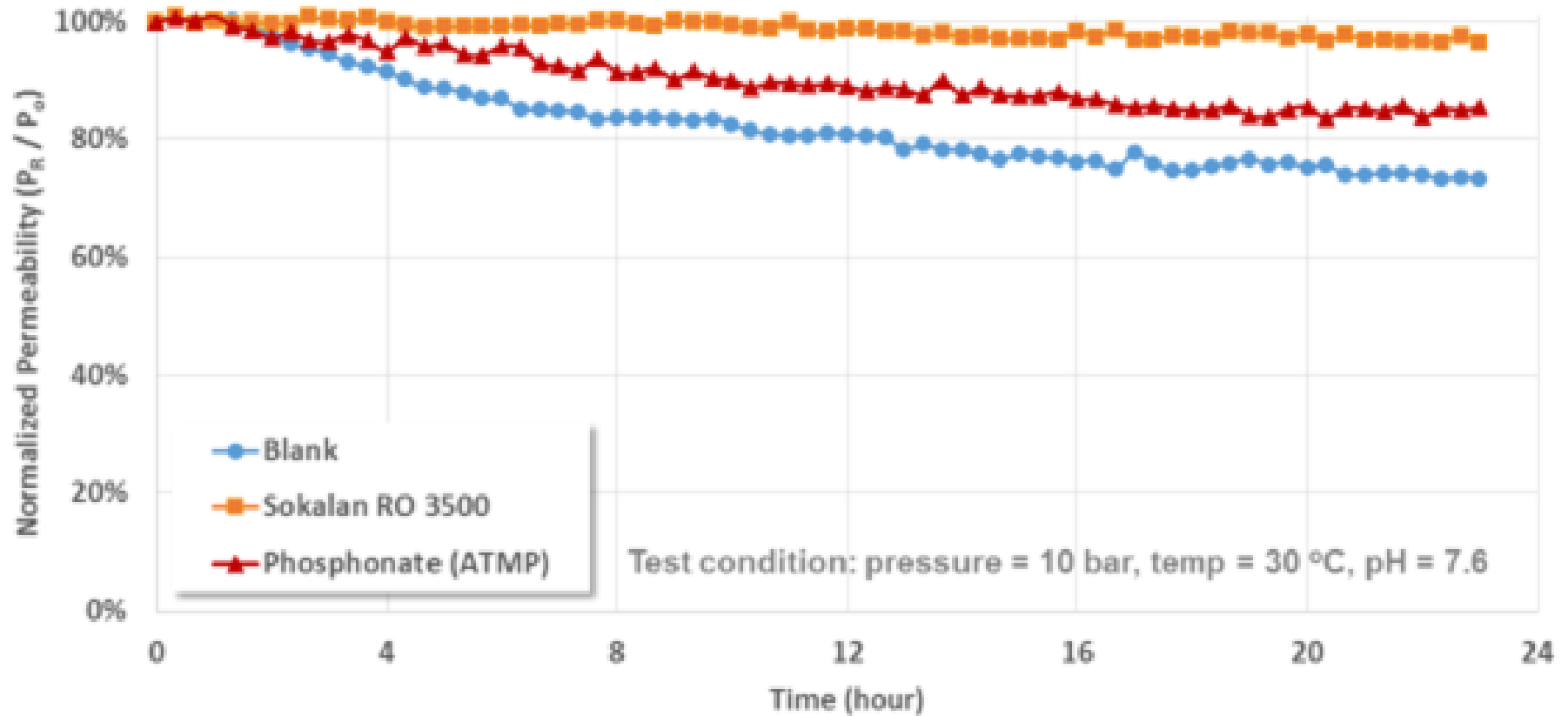
Dynamic RO Flat-Sheet Test

Total Recirculation Mode



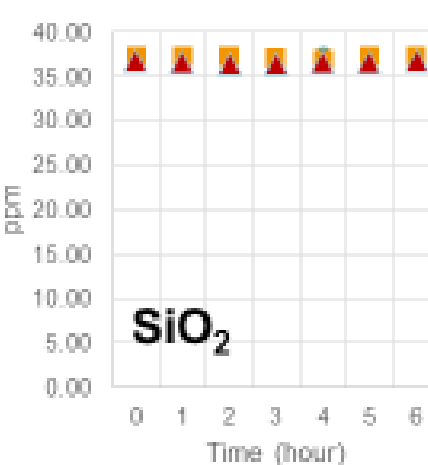
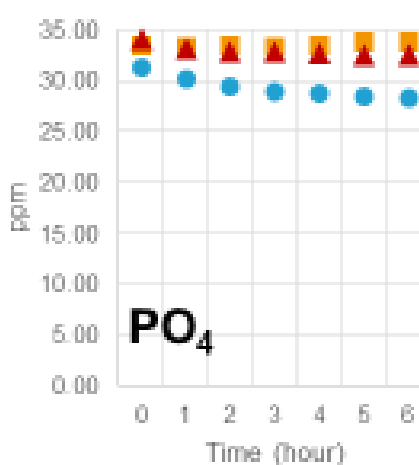
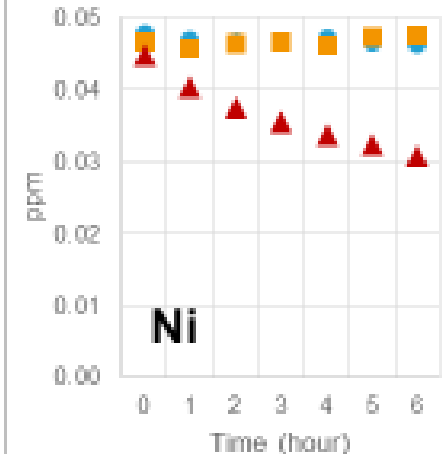
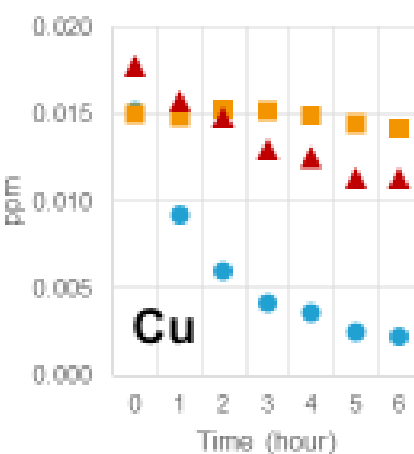
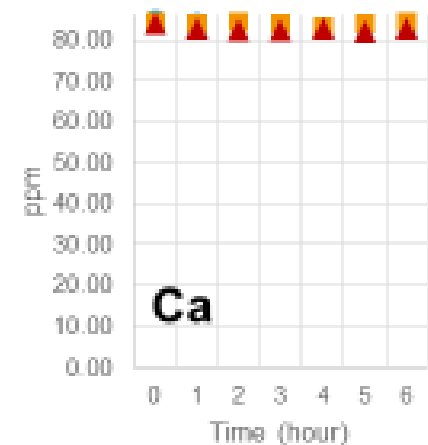
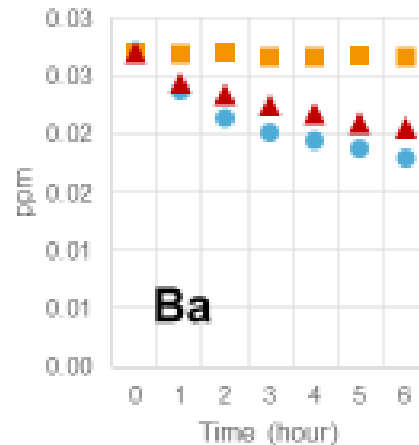
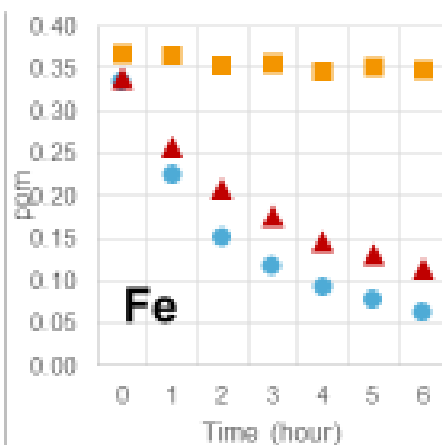
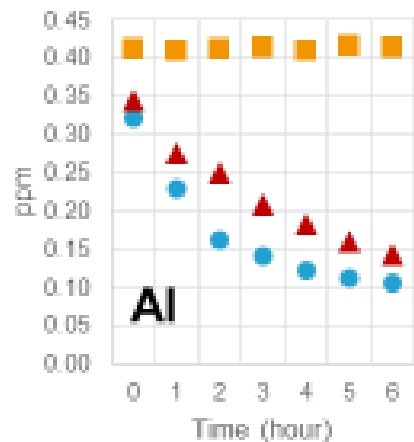
Laboratory RO Flat-Sheet Test Results

Recirculation Mode at 75% Recovery



Laboratory RO Flat-Sheet Test Results

Total Recirculation Mode



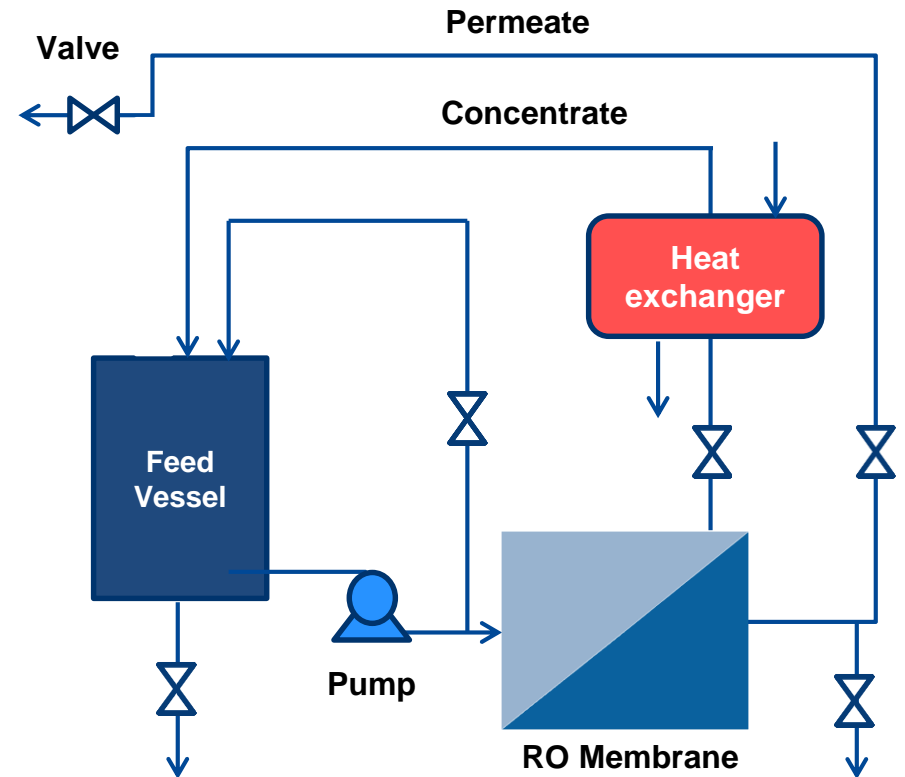
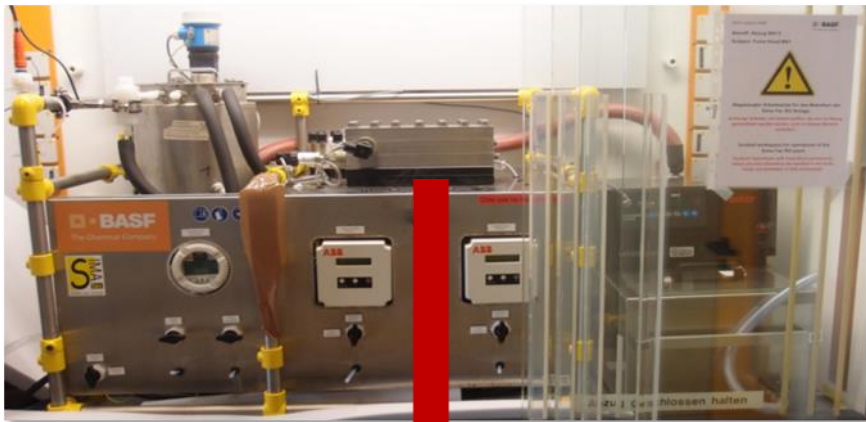
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■ Sokalan® RO 3500

▲ Phosphonate (ATMP)

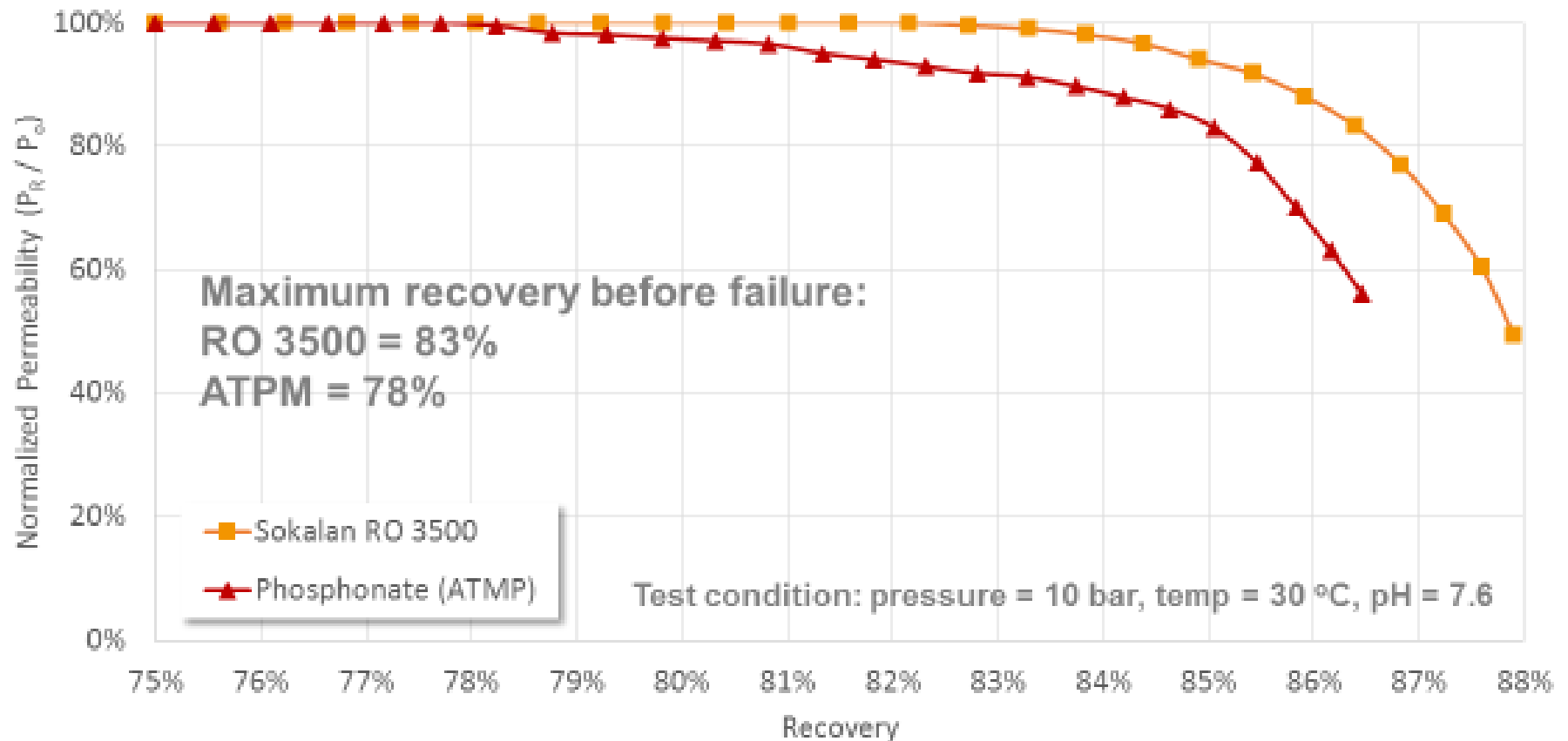
Dynamic RO Flat-Sheet Test

Permeate Withdrawal Mode



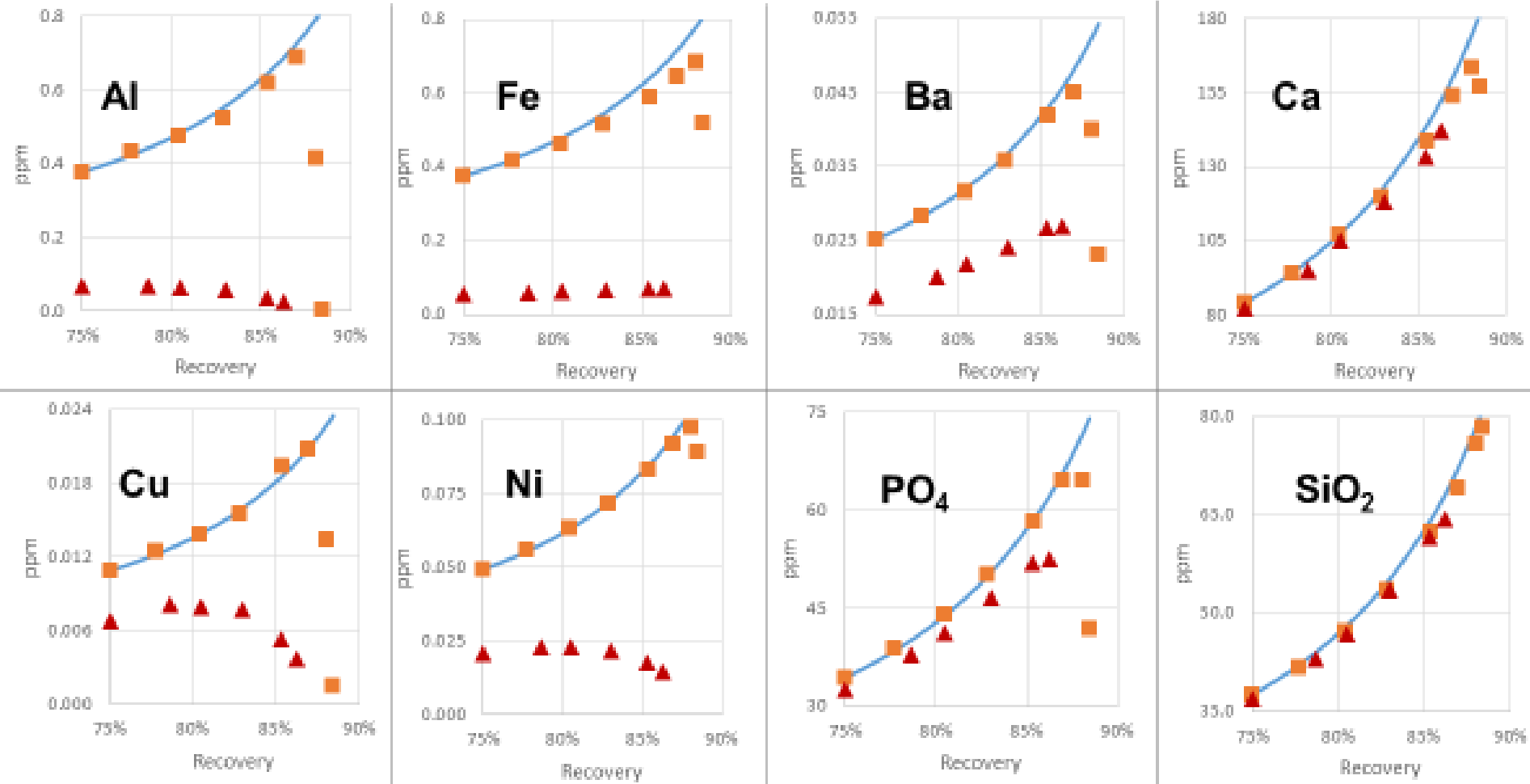
Laboratory RO Flat-Sheet Test Results

Permeate Withdrawal Mode



Laboratory RO Flat-Sheet Test Results

Permeate Withdrawal Mode



— Theoretical value line

■ Sokalan® RO 3500

▲ Phosphonate (ATMP)

BASF
We create chemistry

Summary

- Sokalan® RO3500 is effective against multiple scaling / fouling potentials such as CaCO_3 , CaSO_4 , BaSO_4 , CaF_2 , Ca-PO_4 , Al, Fe, Cu, etc.
- Comparative test results show that the Sokalan® RO3500 effectively inhibits multiple scales / foulants as compared to phosphonate based antiscalant like ATMP.
- Sokalan® RO3500 RO allows plants to operate at higher recovery compared with phosphonates while protecting the membrane against scaling / fouling.

Thank you for your attention!

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