

Causes of Membrane Fouling and Cleaning Protocols to Promote Membrane



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Food Protein R&D Center

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2476 TAMU

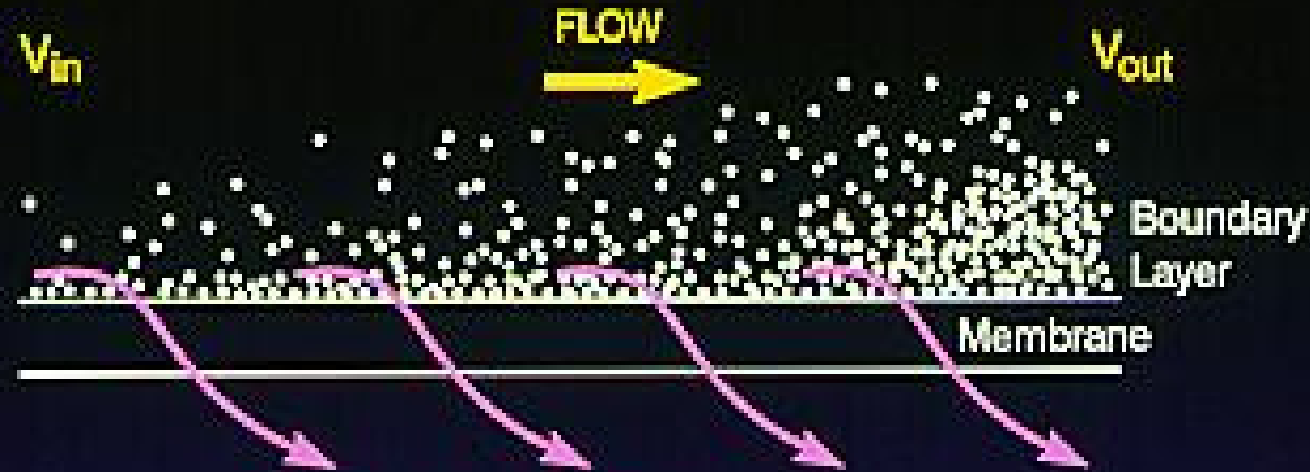
College Station, TX 77843



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URS

SALT CONCENTRATION IN THE BOUNDARY LAYER



Velocity : $V_{in} > V_{out}$
Salt Conc. : $TDS_{in} < TDS_{out}$

Poor Permeate Quality

FOULING

Low Water Production

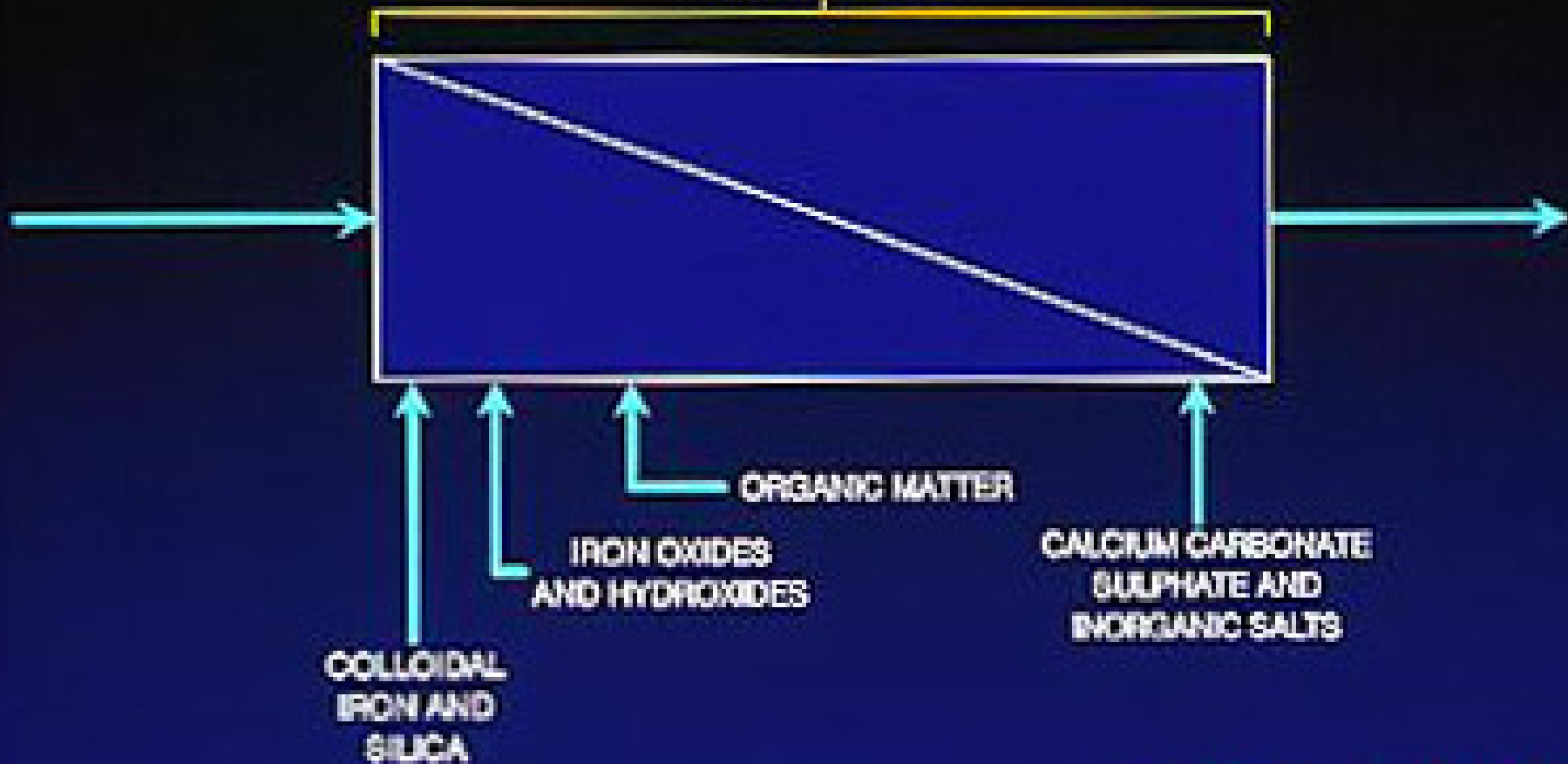
Membrane Damage

Frequent Cleaning



PRINCIPLE FOULING LOCATIONS

BIOFOULING

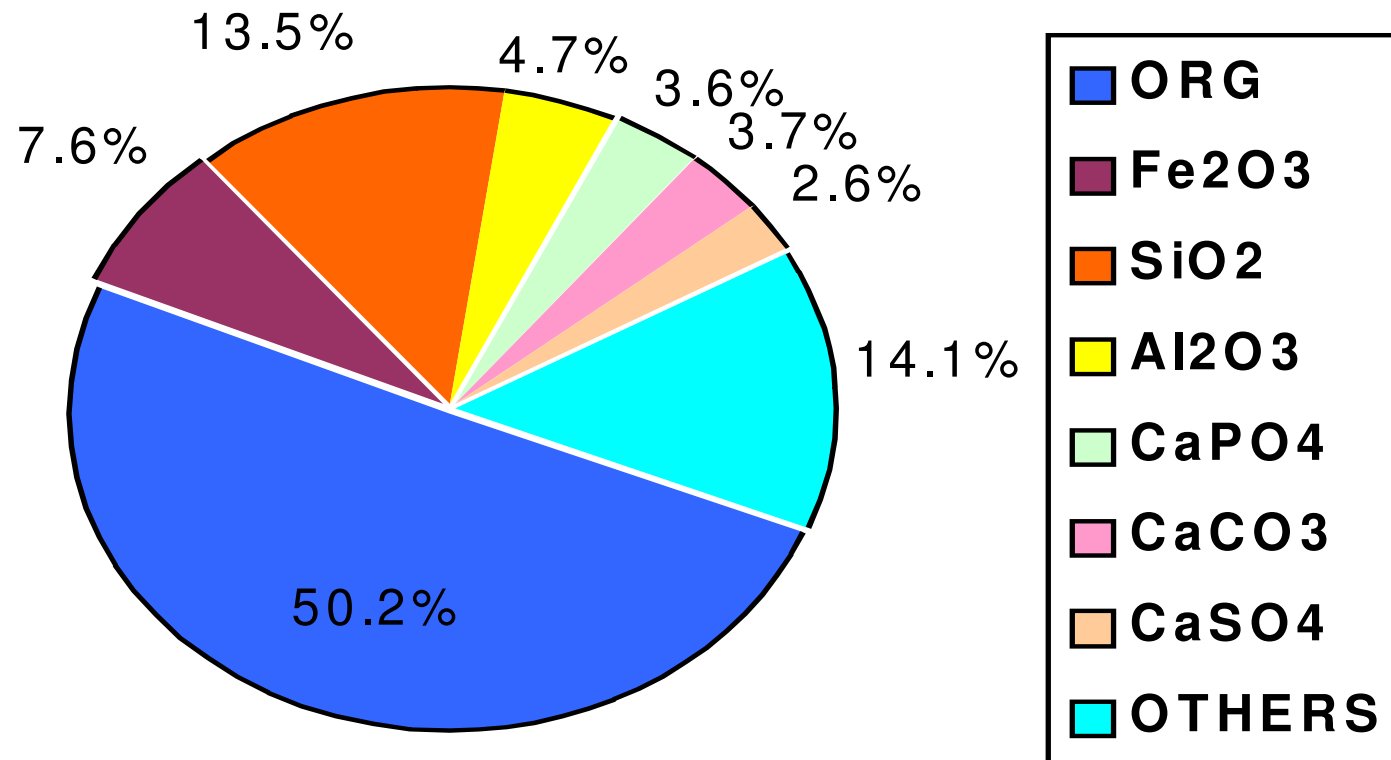


Fouling Indicators

Permeate Flow	Salt Passage	Diff. Pressure	Direct Cause	Indirect Cause	Corrective Measure
↓	↑	↑	Scaling	Poor Scale Control	Cleaning; Scale Control
↓	↑	↑	Colloidal Fouling	Insufficient Pretreatment	Cleaning; Improve Pretreatment
↓	→	↑↑	Biological Fouling	Feed water; Insufficient Pretreatment	Cleaning; Biocide; Improve Pretreatment
↓	→	→	Organic Fouling	Polymer Overfeed; Humics; Oil	Cleaning; Improve Pretreatment

Common Fouling Risks

AVERAGE FOULANT DISTRIBUTION
WORLDWIDE



When do I clean?

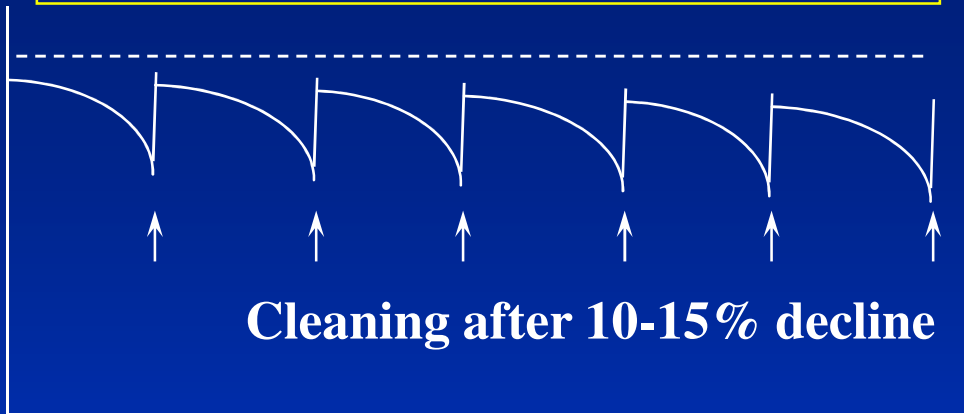
- When any ONE of the following changes:
 - ✓ **Differential Pressure** by 15%
 - ✓ **Salt Passage** by 15%
- Exceeding these limits may be irreparable
- Start planning your strategy at the 1st indication of a minimum change!

Maintenance Cleaning

- RO's need to be Cleaned!
- Typically:
 - √ SDI 3 -5 Cleaning 4 /year
 - √ SDI 1- 3 Cleaning 2 /year
 - √ SDI < 1 Cleaning 1 /year

Proper Cleaning Maintenance

Normalized
Permeate
Flowrate

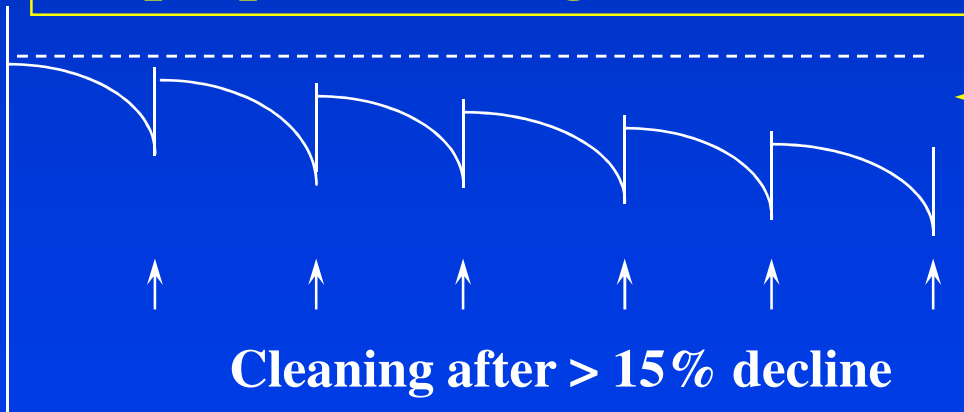


Cleaning after a
10-15% decline
maximizes RO
performance

Time

Improper Cleaning Maintenance

Normalized
Permeate
Flowrate



Waiting too
long
to clean reduces
RO
performance

Time



Ref: Permacare Membranes

Chemical Cleaning Products

- **Non-oxidising Biocide**
- **Chelating Agent**
- **Non-oxidising Biocides**
- **Cl₂ Release Sanitizer**



Chemical Cleaning Products

- **Mild Alkaline Surfactant**
- **Weak Acid**
- **Strong Mineral Acid**
- **Alkaline Surfactant**



Factors Influencing Cleaning

- **Plant Design - Ensure CIP tank & pump is correct size**
- **Plant Operation**
- **Membrane - Max pH/Temp limits**
- **Chemicals Selected**

Factors Influencing Cleaning

- Temperature
- pH
- Flow vs. Soaking
- Time
- Velocity

Cleaning Tips

- **Pressure drop < 60 PSI**
- **Flow 35- 40 GPM per pressure vessel (8")**
- **Cleaning Solution Volume: Use 8 - 10 Gallons Per 8" element. Each pressure vessel = 50 gallons volume**
- **Use Alkaline cleaners first if organic fouling is suspected - acid can tighten organic foulant onto the membrane**



Cleaning Tips

- **Max Solution Temperature advised by Membrane Manufacturer**
- **Soak Membranes - reduces cleaning solution channeling**
- **Clean “stage by stage”**
- **Replace Turbid Cleaning Solutions**
- **Keep good records**



Keep Good Records

CLEANING DATA COLLECTION SHEET

RO System : Chemical _____

DATE: _____

Stage:

Tank Gallons: Volume or LBS. _____

OPERATOR: _____

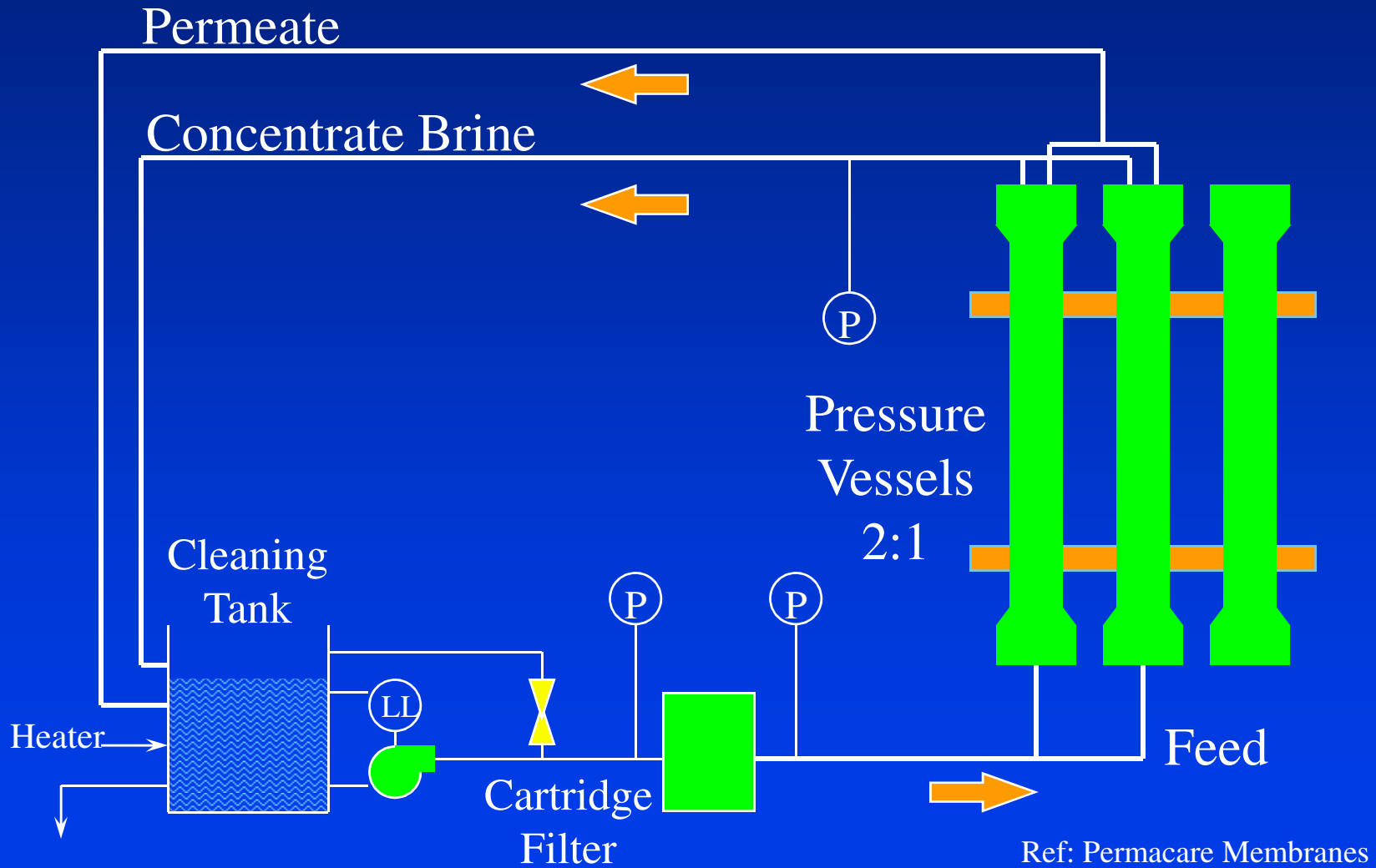
Minutes	0	15	30	45	1 hour	15	30	45	2 hours	15	30	45
pH												
Flow												
Temperature												
Comments												



Minutes	3 hours	15	30	45	4 hours	15	30	45	5 hours	15	30	45
pH												
Flow												
Temperature												
Comments												

Ref: Permacare Membranes

Cleaning Skid



Membrane Preservation

- Preserve if out of service >24 hrs
- Sodium Bisulfite - 1%
- RESAT-DE 55 or / 56 - 0.05%
- Formaldehyde - NO - carcinogenic
- Glutraldehyde - NO - membrane damage



Membrane Flushing

- **Permeate flush if system shuts down**
- **Acts as a “mini clean” and removes concentrate**
- **Reduces fouling and scaling**



Membrane Autopsy

- **Destructive procedure consisting of observations and analytical tests on used membrane**
- **Determines cause of failure or poor performance**
- **Results used to develop site specific custom cleaning program**

Questions

