

Presentation

On

RO – 04 - Fouling

Prepared By

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RO – 04 - Fouling

Water Impurities

Water has some Impurities on to it

Ionic Type Impurity

Non-Ionic Type Impurity

Gas Type Impurity

Particulate Type Impurity

**Impurities
Present in Water**



Water Impurity – Ionic Type

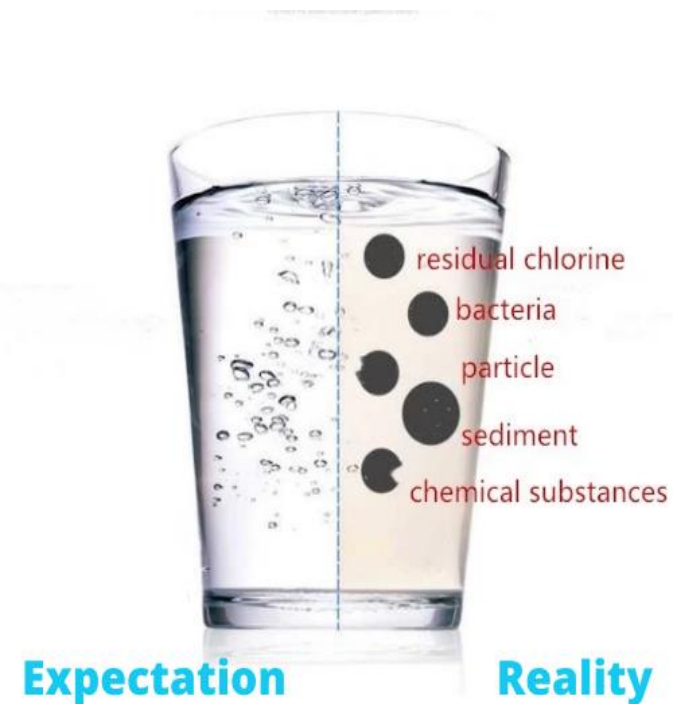
Water Impurity – Ionic Type

Cations Type

Ca ion
Mg ion
Na ion
K ion
Fe ion
Mn ion
Al ion
NH₄ ion

Anions Type

Cl ion
NO₃ ion
SO₄ ion
HCO₃ ion
CO₃ ion
SiO₃ ion
PO₄ ion



Water Impurity – Non-Ionic Type

Water Impurity – Non-Ionic Type

Colloid Type Material

Suspended Solids

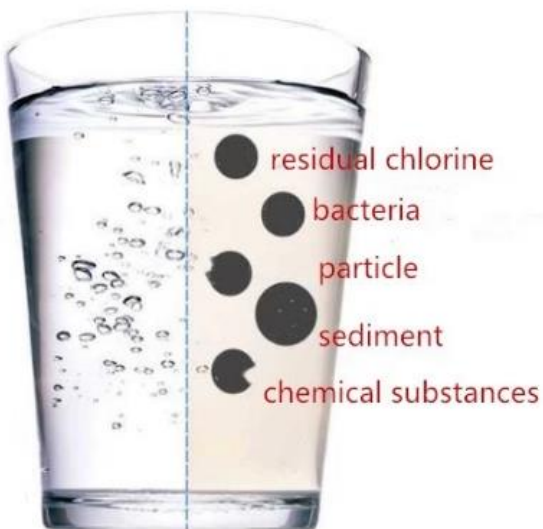
Microbiological Type

Bacterial Type

Viral Type

Algal Type

Pyrogenic Type



Expectation

Reality

Water Impurity – Gas Type

Water Impurity – Gas Type

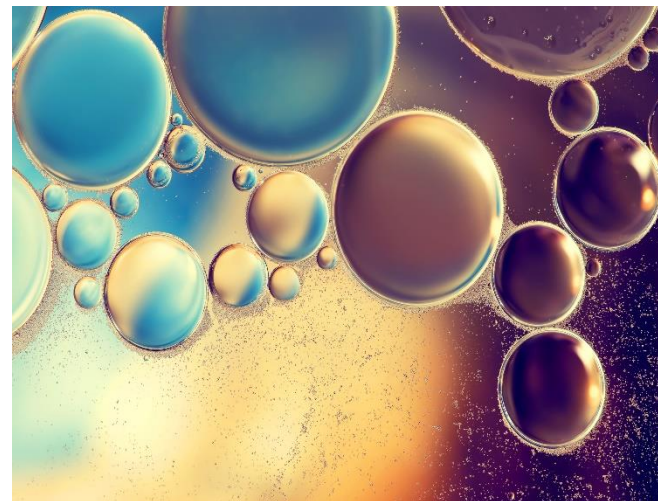
Carbon Di-Oxide [CO₂]

Oxygen[O₂]

Chlorine [Cl]

Nitrogen [N₂]

Hydrogen Sulfide [H₂S]



Water Impurities & Removal System

Water Impurities & Removal System

Ionic Impurity

RO, Nano Filtration

Non-Ionic Impurity

RO, Nano Filtration

Particulate Impurity

RO, Nano Filtration

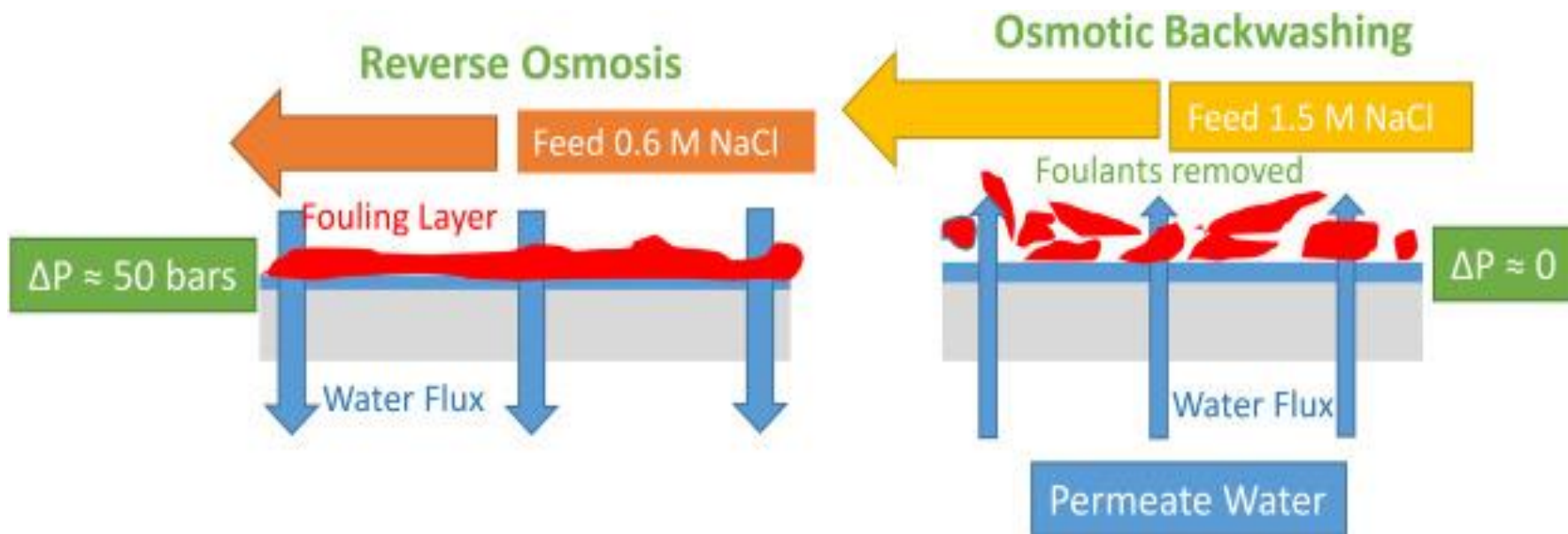
Gas Type Impurity

De-Gasifier

RO Fouling

Contaminants get accumulated on **Membrane Surface**

Contaminants **Pose the Ability to Perform Quick Plugging**

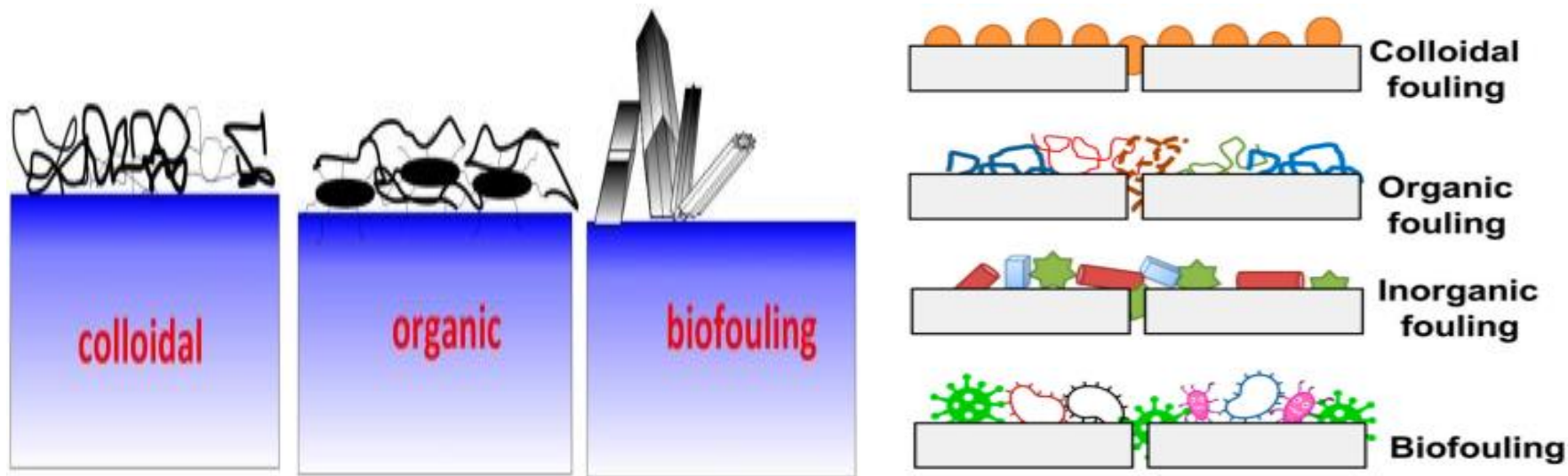


Fouling starts in the **Front End** & Results **High Pressure Drop**

RO Fouling

During Fouling, the Permeate Flow Gets Down

Fouling Incurs the **Higher Operating Cost & Membrane Change**



Proper Pretreatment = Minimal Chance of RO Fouling

RO Fouling - Cause

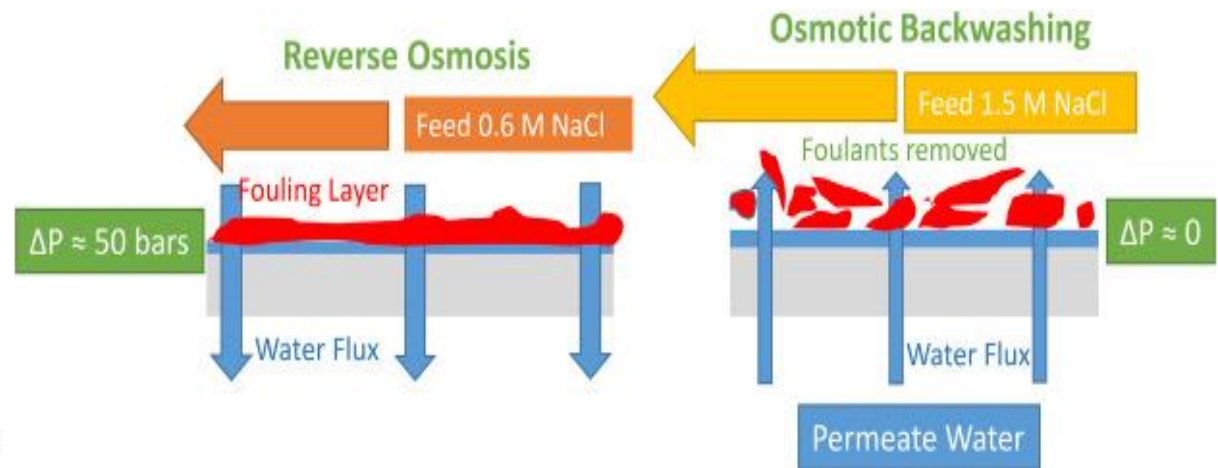
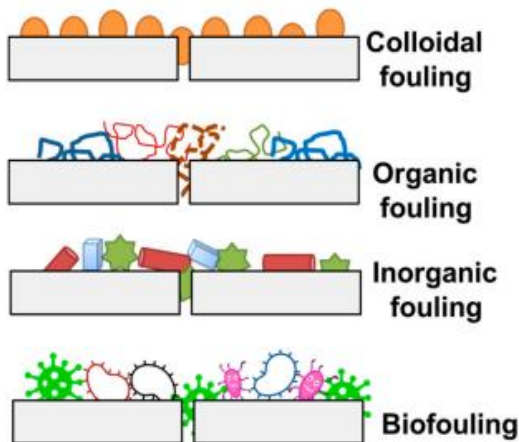
RO Fouling Can be Caused By

Colloidal or Particulate Matter [with Dirt, Silt, clay etc.]

Organic Matter

Biofilms/Micro-organisms [Bacteria with biofilms]

Breakthrough of Filter Media Upstream [Softener Leaking]



Fouling starts in the Front End & Results High Pressure Drop

RO – Membrane Problem Result

RO – Membrane Problem Result

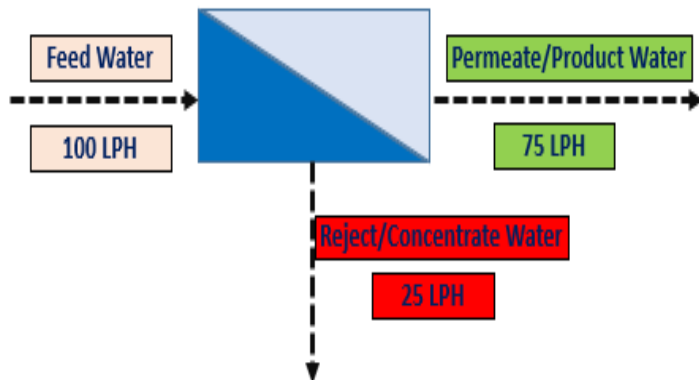
Water Quality will be **Very Poor**

Water Production will be **Very Low**

Tends to perform **Frequent Cleaning**

Tends to perform **Membrane Replacement**

Operating Cost will be hampered & will be **High**



RO – Common Problem

RO – Common Problem found in System

Different Fouling

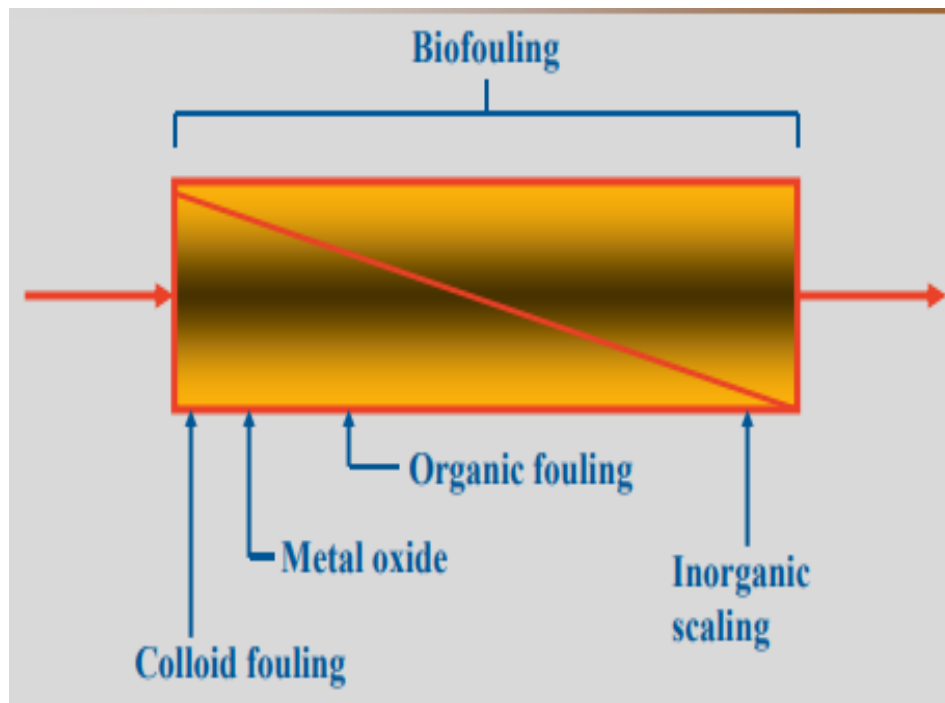
Colloidal Fouling

Organic Fouling

Microbial Fouling

Scale Forming

Mechanical



RO – Problem VS Solution

Colloidal Fouling & Solution Estimated

Colloidal Fouling - Cause

Suspended Particle

Colloid Silica

Carbon Powder

Metal Oxide [Fe...]

Solution Estimated

Pretreatment Issue

Cartridge Filter Bypassed

ACF Leakage

Pipe Corrosion

Colloidal Fouling - Result

Higher Pressure Drops

Higher Salt Passage

Less Salt Rejection

Low Permeate Flow

Low Permeate Quality

RO

RO – Problem VS Solution

Particle Fouling & Solution Estimated

Particle Fouling - Cause

Suspended Particle

Colloid Silica

Carbon Powder

Metal Oxide [Fe...]

Solution Estimated

Pretreatment Issue

Cartridge Filter Bypassed

ACF Leakage

Pipe Corrosion

Particle Fouling - Result

Higher Pressure Drops

Higher Salt Passage

Less Salt Rejection

Low Permeate Flow

Low Permeate Quality

RO

RO – Problem VS Solution

Organic Fouling & Solution Estimated

Organic Fouling - Cause

Oil [Pump Sealant, New Pipe]

Overdose of Anti-Scalant

Overdose of Cationic Flocc.

High COD, BOD in Feed

Solution Estimated

Check the Sealant, check Pipe

Optimum dose of Anti-Scalant

Optimum dose of Cationic Flocc.

Control COD, BOD in Feed

Organic Fouling - Result

Membrane Block

Oil Particle Clogged

RO – Problem VS Solution

Biofilms/Microbial Fouling & Solution Estimated

Biofilms Fouling - Cause

Bio Slime

Algal Flora

Bacteria

Solution Estimated

Disinfection [Sand Filter, UV]

Disinfection [Cl, O3]

pH Adjustment

Biofilms Fouling - Result

Membrane cleaning need

Membrane change need

Output hampered

RO – Problem VS Solution

Breakthrough of Filter Media Upstream Fouling & Solution Estimated

Breakthrough - Cause

No Cartridge Filter before RO

Leaking in Cartridge Filter

Leaking in Softener

Solution Estimated

Installing Cartridge before RO

No leak in Cartridge Filter

No leaking in Softener








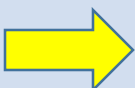


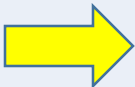
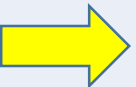
Breakthrough Fouling - Result

Membrane cleaning need

Membrane change need

Output hampered

RO – Problem Indicators & Corrective Measures

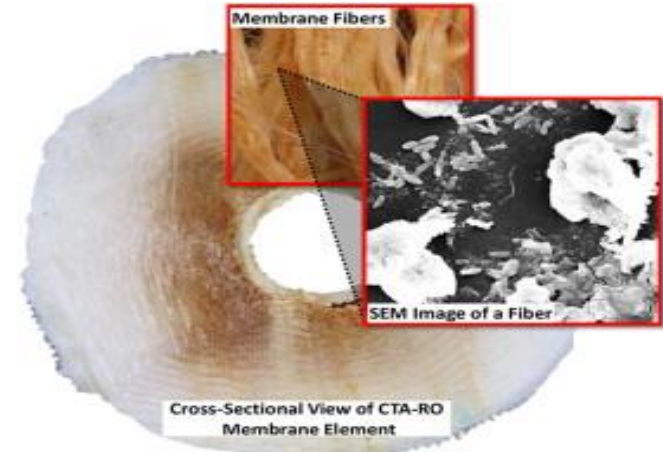
Permeate Flow	Salt Passage	Differential Pressure	Direct Cause	Indirect Cause	Corrective Measure
			Scaling	Poor Scale Control	Cleaning, Scale Control
			Colloidal Fouling	Insufficient PreT	Cleaning, Improve PreT
			Biological Fouling	Insufficient PreT	Cleaning, Biocide, improve PreT
			Organic Fouling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

RO – Some Other Issue's

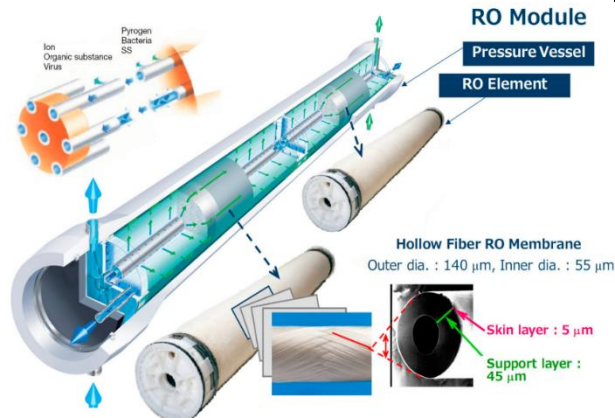
Some other Problems can be Illustrated as...



Scaling



Chemical Fouling



Mechanical Fouling

RO – Problem VS Solution

Scaling Fouling & Solution Estimated

Scaling Fouling - Cause

CaCO₃

CaSO₄

Ca₃(PO₄)₂

SiO₂

Solution Estimated

Water Softening

Use of Antiscalant

Acid Injection

Disinfection, pH Adjustment

Scaling Fouling - Result



Higher Pressure Drops

Higher Salt Passage

Less Salt Rejection

Low Permeate Flow

Low Permeate Quality

RO

RO – Problem VS Solution

Chemical Fouling & Solution Estimated

Chemical Fouling - Cause

Chlorine

Chloramine

Solution Estimated

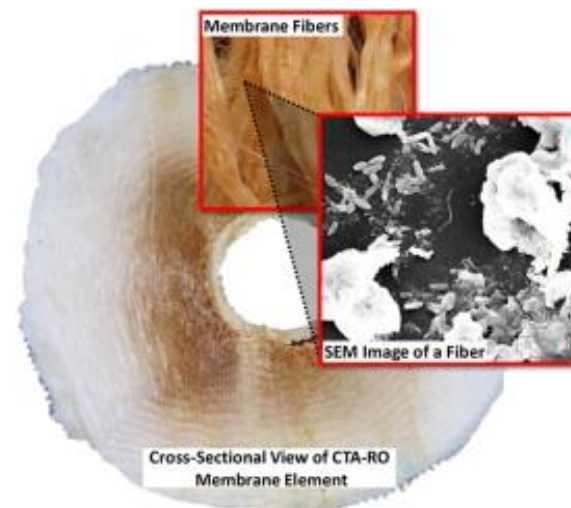
Use of ACF before RO

Scaling Fouling - Result

Higher Permeate Flow

Higher Salt Passage

Holes induces Microbial Growth



RO – Problem VS Solution

Mechanical Fouling & Solution Estimated

Mechanical Fouling - Cause

Damage while installation

Piping incorrect

System control problem

Solution Estimated

Accurate Plumbing

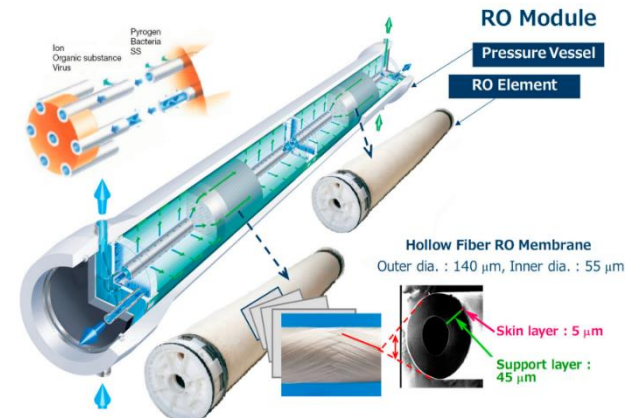
Accurate system control

Mechanical Fouling - Result

Various types of problem recurring

Output hampered

Loosing system control



RO – When to Clean the System

RO Membrane Need to Clean if below Criteria Appears

Pressure Drop increase's 10% – 15%

OR

Permeate Flow Decrease's 10% - 15%

OR

Permeate Quality Decrease 10% - 15%

OR

Before Starting, after a Long Time Shut Down

RO - Monitoring

RO Monitoring is very much Important Thing

Entire RO is a Costly Item

RO Fouling tends to be the Change of Membrane

Pretreatment: 90% of Operational Problems are found here

System: 90% of Operational Problems are found here



RO – Monitoring [Pretreatment]

RO Pretreatment Monitoring

Silt Density Index [SDI]

pH

Chlorination

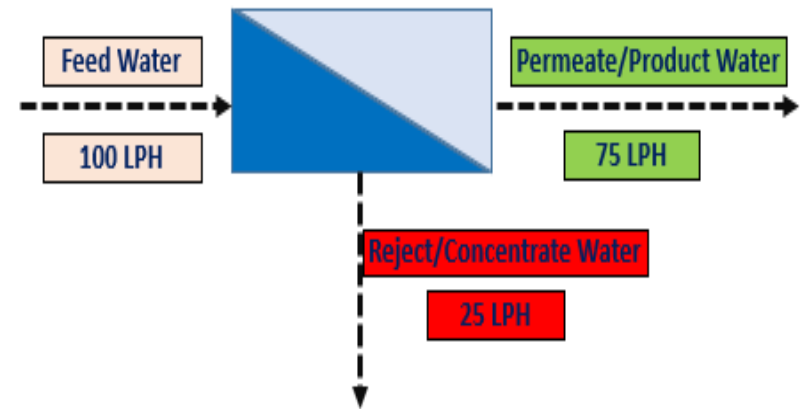
Turbidity

Temperature

Pressure

Conductivity

Microbiological Foulants [Bacteria, Silica, Hardness]



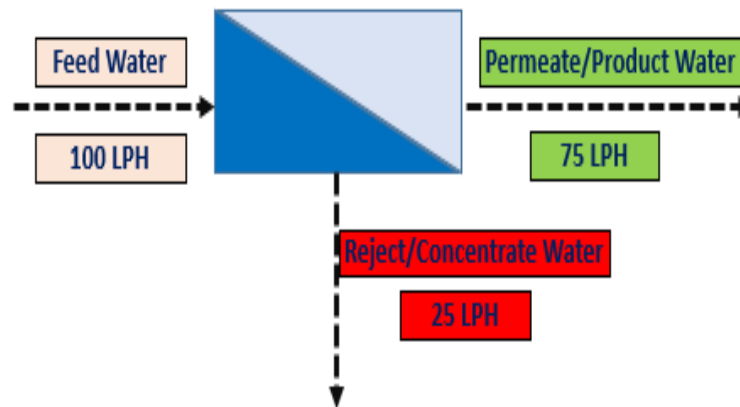
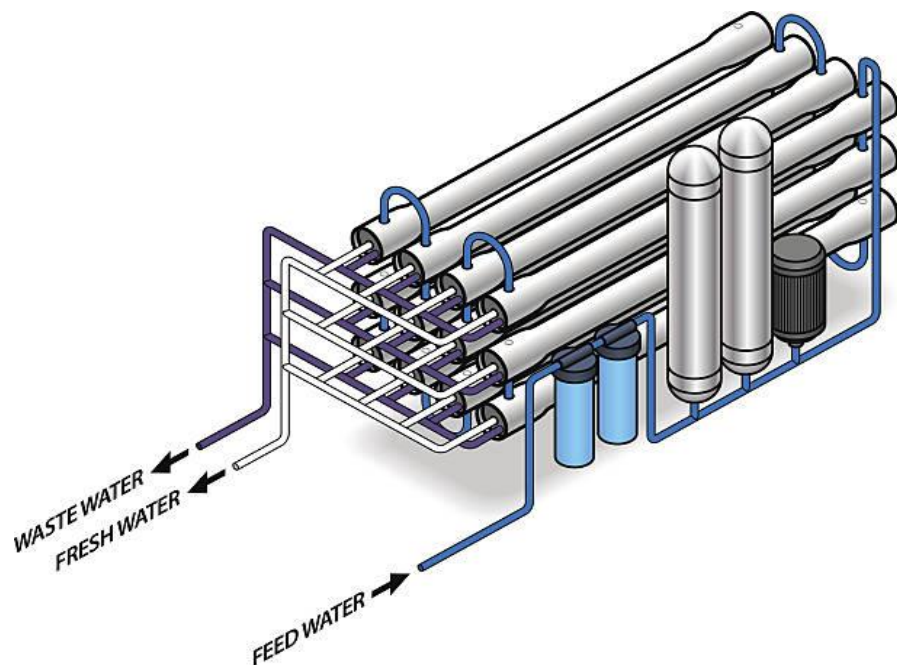
RO – Monitoring [System]

RO System Monitoring

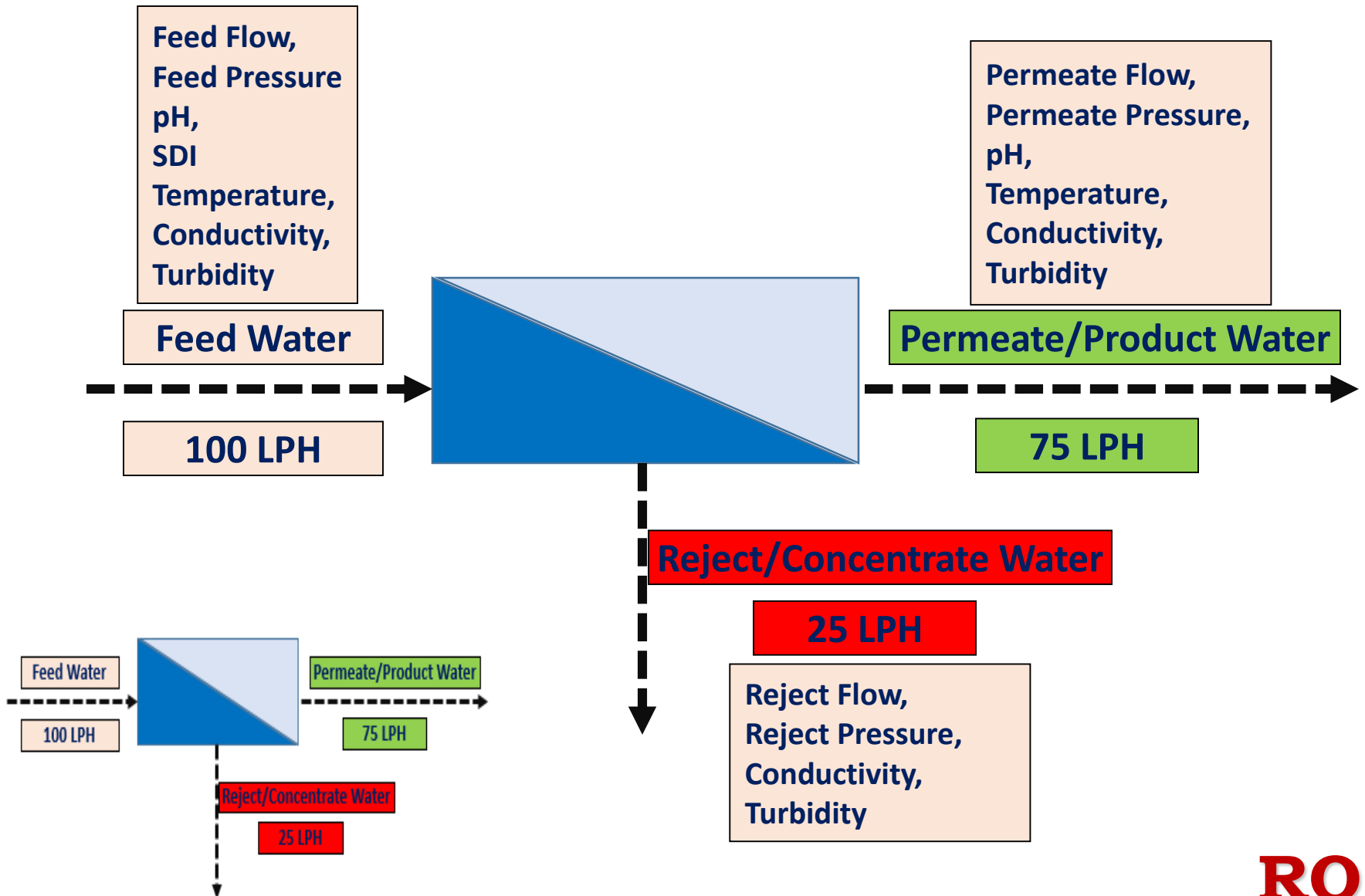
Present Salt Rejection

Differential Pressure

Percent Recovery



RO – Important Parameter Location



RO – Daily Operation & Performance Data

RO – Daily Operation & Performance Data

Feed Water pH	Permeate Water pH, Temp.
Feed Water Temperature	Permeate Water Conductivity, Turbidity
Feed Water Conductivity	Permeate Water Flow, Pressure
Feed Water Turbidity	Reject Water Flow, Pressure
Feed Water SDI	Reject Water Conductivity, Turbidity
Feed Water Flow	Percent Salt Rejection [Calculated]
Feed Water Pressure	Differential Pressure [Calculated]
Daily Graphical Trend	Percent Recovery [Calculated]

Any Question...!?



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