



DSR Training 2023

WATER TREATMENT

Presented by
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18th July, 2023

Summary

1. Introduction to Water Treatment
2. Filtration
3. Packaged Surface Water Treatment Plants (WP/WG/WR/ KWAT)
4. Reverse Osmosis
5. ION Exchange systems
6. Disinfection
7. Domestic/Light commercial purifiers
8. Blowers
9. Dayliff Chemicals and HACH products

Basic Water Treatment Acronyms

- WT – Water Treatment UV- Ultraviolet
- TDS – Total Dissolved Salts MMF – Multimedia Filter
- TSS – Total Suspended Solids IX - Ion Exchange
- RO – Reverse Osmosis ORP –Oxygen/Reduction Potential
- UF – Ultrafiltration EC – Electrical Conductivity
- BWT – Boiler Water Treatment Demin (DM) – Demineralization
- CWT – Cooling Water Treatment
- SDI – Silt Density Index
- AC – Activated Carbon
- Indion RS-F – Fluoride Removal resin
- WWTP – Wastewater Treatment plant (STP/ETP/**Biodigester**)
- TMP – Transmembrane Pressure

WHY WATER TREATMENT

Opportunities: Global water challenges

Availability

- Growing population and industry
- Climate change and draught

Quality

- Deteriorating water quality
- Increased industrial pollution

Environmental

- Strict regulations on discharge/withdrawal
- Water reuse incentives and mandates

Energy

- Energy demand to increase ~30% by 2030
- Demand for water to increase ~40%

Growing water scarcity and impairment

System Design Considerations

- Source of water- Borehole, Well, River, Lake etc
- Water analysis- Comprehensive
- Daily water requirement – cubic meter/day or litres/day
- Daily hours of operation or flow rate in m³/hr. or litres/hr.
- Intended use of the water- Domestic, Bottling, Industrial etc
- Site location- Accessability, Power and Security
- Budget

Comprehensive Water Analysis Report

Physiochemical and Microbiological tests - D&S Internal Laboratory



Water Pumps
Borehole Service
Swimming Pools
Water Treatment
Generators
Solar Equipment
Irrigation

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LABORATORY WATER ANALYSIS REPORT

Client : Juma Oruko		Reference No : 04/22/RO/0517		Date Received : 13/04/2022	
Site Location : Kisumu		Source : Borehole		Analysis Date : 13/04/2022	
Type of Test : Reverse Osmosis Water Analysis		Sampling Date : 12/04/2022		Report Date : 14/04/2022	
KEY:	PASS	FAIL	NS - No Standard	ND - Not Detected	TN - Too Numerous
PARAMETERS	METHOD OF ANALYSIS	UNITS	VALUES	WHO GUIDELINES	REMARKS
PHYSICAL ANALYSIS					
pH	USEPA Electrode: 8156	pH Units	7.40	6.5 - 8.50	
TDS	Instrument analyzed insitu	Mg/l	10110	<1000	
Total Suspended Solids(TSS)	Photometric: 8006	Mg/l	5	NIL	
Salinity	Instrument analyzed insitu	ppt	7.62	NS	
Electrical Conductivity(EC)	Instrument analyzed insitu	µS/cm	16080	<1500	
Turbidity	EPA: 180.1	NTU	2	<5	
CHEMICAL ANALYSIS					
Iron, Fe	FerroVer: 8008	Mg/l Fe	0.05	<0.30	
Manganese, Mn	Periodate Oxidation: 8034	Mg/l Mn	0.10	<0.10	
Copper, Cu	Bicinchocinate: 8506	Mg/l Cu	3.44	<2.0	
Fluorides	Fluoride ISA	Mg/l F	5.69	<1.5	
Ammonical Nitrogen	Salicylate Method 8155	NH3-N	0.00	NS	
Ammonium	Salicylate Method 8156	NH4+	0.00	<1.5	
Ammonia	Salicylate Method 8157	NH3	0.00	<2.0	
Nitrate N	Cadmium Reduction: 8039	Mg/l NO3N	2.9	<11.3	
Nitrate	Calculated	NO3-	13	<50	
Nitrates	Ferrous Sulfate	Mg/l NO2	0	<3	
Nitrite N	Ferrous Sulfate	Mg/l NO2-N	0.0	<1.0	
Potassium	Tetraphenylborate	Mg/l K	62	<50	
Phosphates	Phosver3	Mg/l PO4^3-	0.17	<0.61	
Silicon	Spectroscopy	Mg/l	27	< 50	
Silica	Silicomolybdate: 8185	Mg/l SiO2	58	<107	
Calcium	DS/TH/CHEM04	Mg/l Ca2+	360	<150	
Magnesium	DS/TH/CHEM04	Mg/l Mg2+	110	<100	
Calcium Hardness	Titration method 8204	Mg/l Ca2+ (CaCO3)	900	NS	
Magnesium Hardness	Titration method 8204	Mg/l Mg2+ (CaCO3)	450	NS	
Total Hardness	Titration method 8205	Mg/l CaCO3	1350	<300	
Aluminium, Al	Aluminon method	Mg/l Al	0.00	<0.10	
Sulphate, SO4	SulfateVer4: 8051	Mg/l SO4	69	<400	
Chlorides	Silver Nitrate Method:8207	Mg/l Cl	4360	<250	
Total Alkalinity	Titration	Mg/l CaCO3	660	NS	
Phenolphthalein Alkalinity	Titration	Mg/l CaCO3	ND	NS	
Bicarbonates	Titration	Mg/l HCO3-	660	<255	
Carbonates	Titration	Mg/l CO3^2-	0	<121	
Barium	Turbidimetric: 8014	Mg/l Ba2+	2	<0.7	
Sodium, Na	Direct Method: 8359	Mg/l Na	3345	<200	
BACTERIOLOGICAL ANALYSIS					
Total Coliforms	ISO 9308-1: 2014	CFU/100ml	TN	Not Detectable	
E. Coli	ISO 9308-1: 2014	CFU/100ml	TN	Not Detectable	
Total Viable Count at 37°C	ISO 6222:1999	CFU/ml	TN	50	
COMMENTS					
Based on the water analysis, the levels of TDS, TSS, EC, Manganese, Copper, Fluorides, Potassium, Calcium ions, Magnesium, Total Hardness, Chlorides, Bicarbonates, Barium, Sodium, Total Coliforms, E. Coli and Total Viable Count at 37°C did not meet WHO limits, therefore, water treatment is recommended.					

■ Testing determines

- Contaminants to be removed
- Suitable Pre-treatment/Treatment method(s)
- Design considerations for WT systems

■ Parameters includes

- Physical - turbidity, colour, pH, TSS.
- Chemical – dissolved minerals/salts/solids, hardness, salinity
- Bacteriological – E.coli, coliforms, TBC, etc. (disease causing pathogens)



Water Sources and Common Contaminants

- Borehole water - high mineral content
- Surface sources - bacteria, colour, sediments
- Shallow well water - bacteria, minerals
- Rainwater - sediments, bacteria
- Sea Water - high salinity levels (sodium and chloride)

Over View of Water Treatment Unit Operations

Suspended solids/ Organic matter/Colour

1. Filtration

- Media Filters – Sand/ Glass/ Anthracite
- Bag/ Cartridge filtration
- Ultrafiltration

3. Chemical Dosages

- Acid/Aalkali
- Flocculant
- Antiscalant
- Oxidation - chemical

pH Correction/ Iron/Manganese

- Well water
- River/lake water
- Borehole water
- Sea water

Dissolved minerals

(Hardness/Iron/Manganese/
Fluoride/Others)

2a. Special Resins

- Softening
- DMI65 filtration (Fe/Mn)
- Indion RS-F (Fluoride)

2b. Reverse Osmosis & Nanofiltration

2c. Demineralization & Deionization

2d. Oxidation – physical

4. Disinfection

- UV treatment
- Chlorine
- Ozone

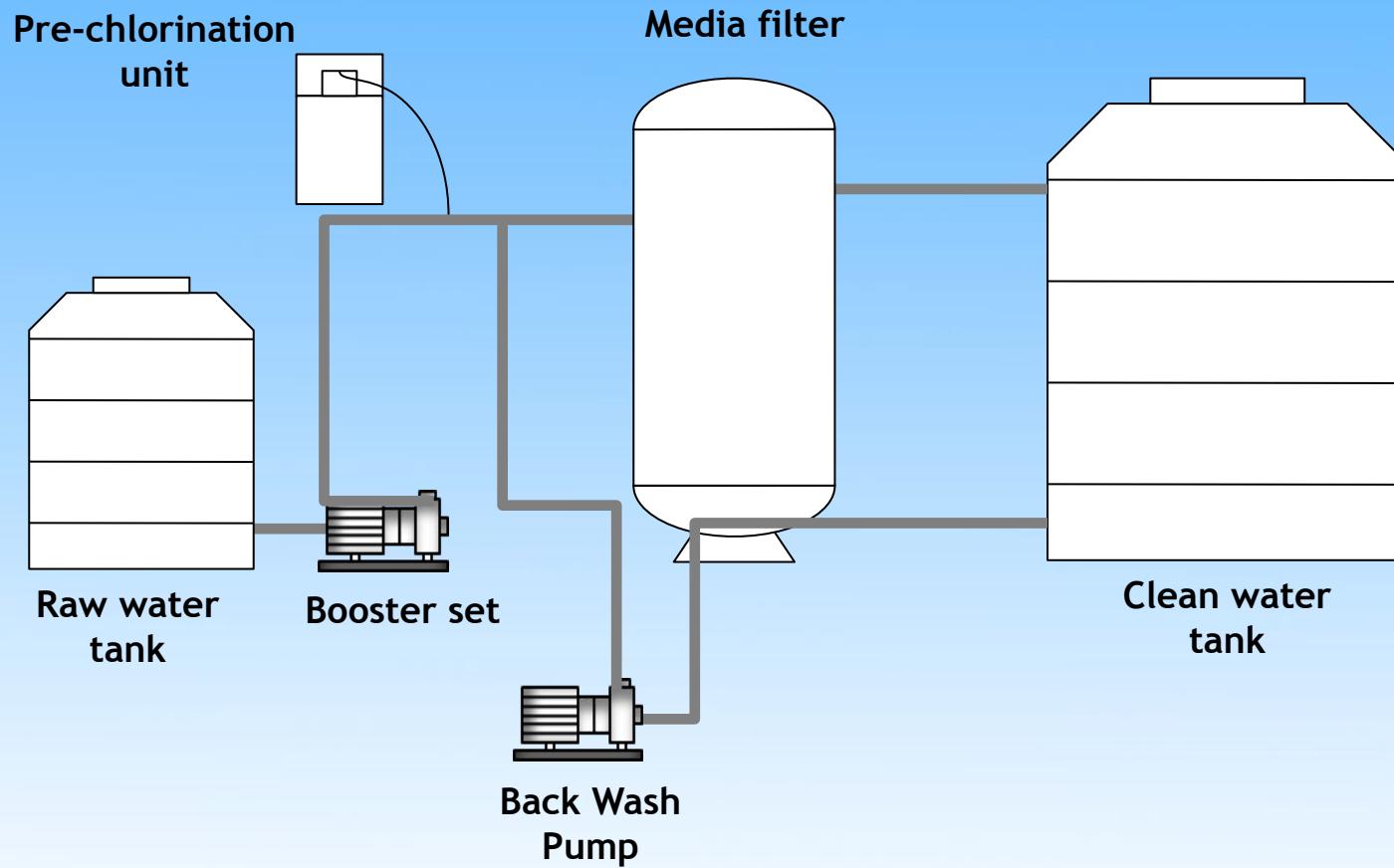
Microbial Contamination

PARTICLE FILTRATION

Particle Filtration

- Filtration is a process that removes suspended matter from a fluid
- Low pressure separation system by passing fluid through different mesh sizes or media filter or a microporous membrane.
- Depending on application, pore size reduction is about 20(μm)

Media Filtration systems



Dayliff CX & CXD

- Glass-reinforced plastic (GRP)
- Standard & Deep Bed (<3Bar)
- Non-corroding Construction
- Auto-air bleeding
- Multiport valves
- Special media



Pentair PXD Filters

- Manual/Automatic operation
- Deep Bed configuration (Specialized media).
- Fiber-reinforced plastic (GRP)
- Higher pressure (10Bar)
- High efficiency internal flow arrangement for even filtration and effective backwash.



Dayliff FC filters

- Mild Steel vessels
- Standard & Deep Bed
- S/S on special order
- Higher pressure (5.5Bar)
- Special media
- Manual control valve



Water Treatment Media

- **Sand/Glass/Anthracite** – Particle filtration (backwash)
- **Jacobi Activated Carbon** – De-chlorination/organics & odour removal by adsorption (backwash and regeneration)
- **DMI65** – Iron and manganese removal (Sodium hypochlorite activation and regeneration)
- **Indion RS-F** – Fluoride removal (PAC regeneration)

Ion Exchange

- Softening resin- Exchange of $\text{Ca}^{2+}/\text{Mg}^{2+}$ with Na^+
- Di-Mineralizing resins- Ambelite anion and cation resins

Hydra Self Cleaning filter

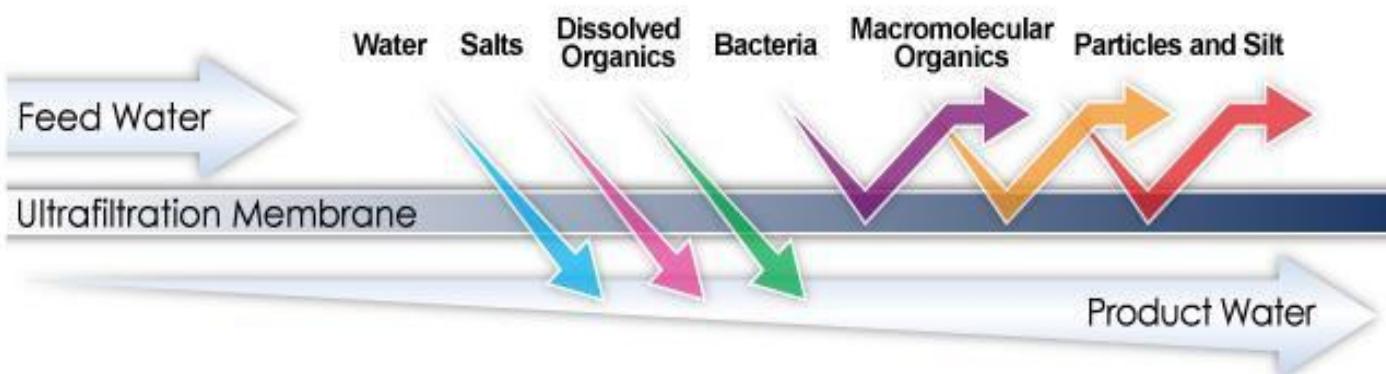
- Strainer filter with mesh size of 50 and 90 micron
- Backwash provision via a drain valve to wash off accumulated sediments.
- Used as stand alone or as a pre-filter to media filters, Ultrafiltration, softeners etc.
- Largest size does up to 10,000litres/hour however for higher flow rates, units can be arranged in parallel



Ultrafiltration

- Membrane process based on size exclusion i.e. physical sieving – up to **0.03micron**
- Rejects solid particles, colloids, suspended solids, oxidized Iron/Manganese and micro-organisms/pathogens
- **Does not reject dissolved organics matter and minerals (salts)**
- Alternative to traditional sedimentation process with high tolerance for turbidity (300NTU) and harsh chemicals
- Ideal for surface water sources

Ultrafiltration

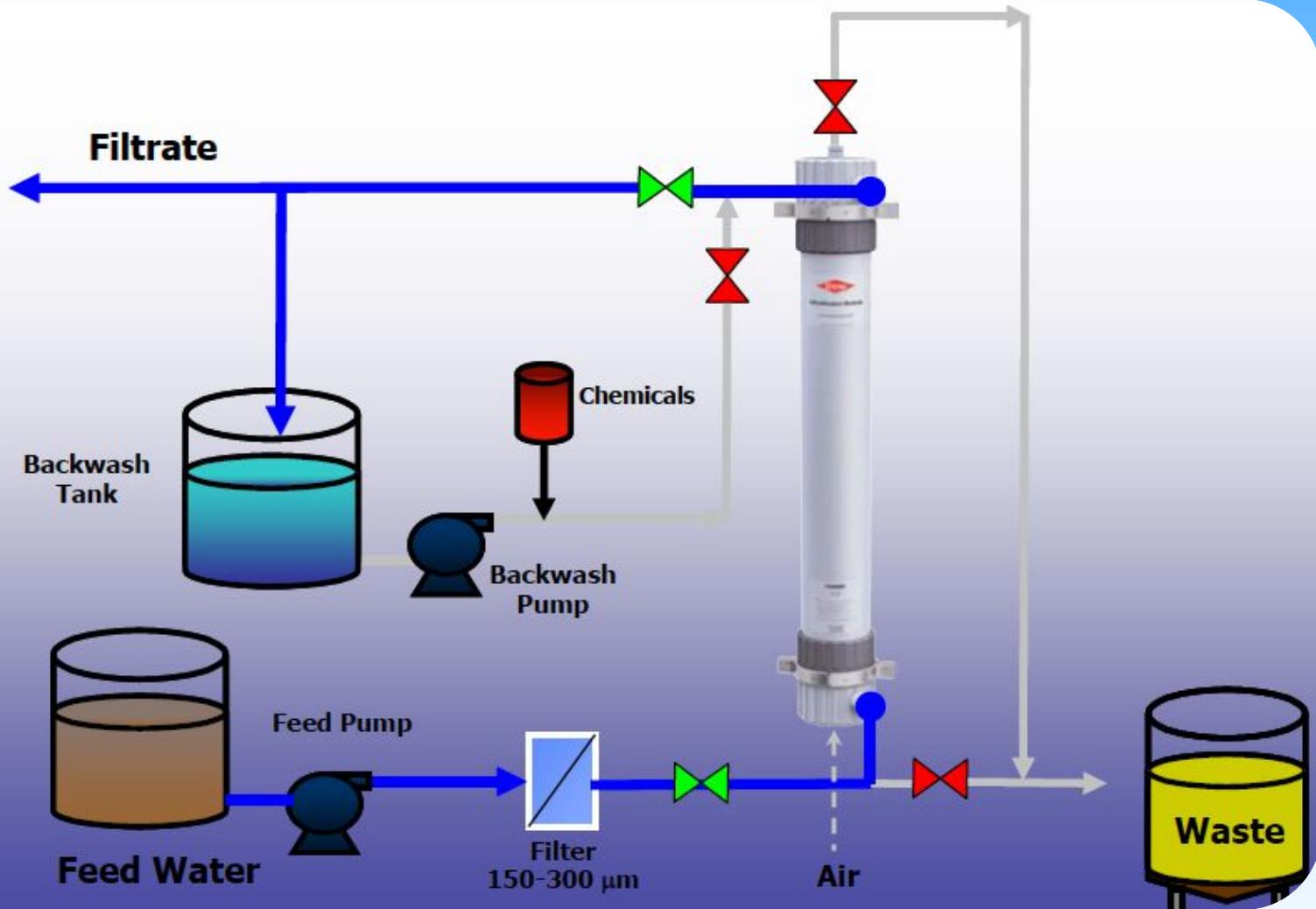


Standard Dayliff UF Assembly



- D&S Standard Capacities: 2 – 30m³/hr
- Larger and bespoke capacities available on order
- Fully Automated cycles of Filtration-Air-Scour-Bac kwash-Rinse cycles
- High tolerance to harsh chemicals

Dayliff UF Schematic



Wave Simulation Sample Report



WATER APPLICATION VALUE ENGINE
DOW WATER & PROCESS SOLUTIONS

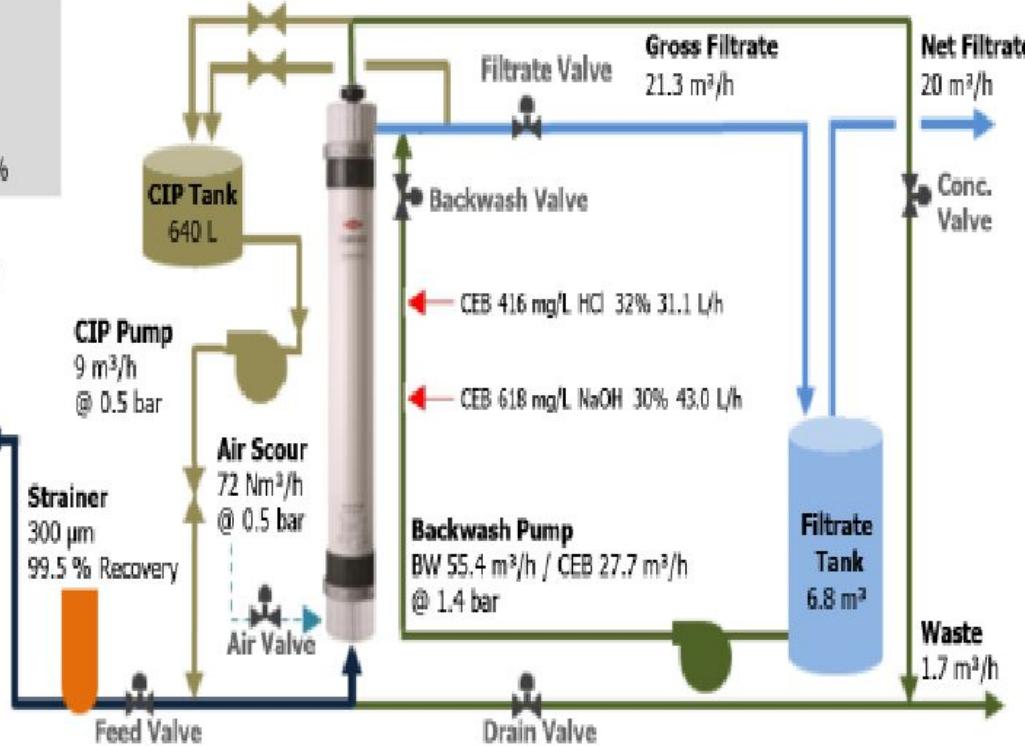


UF Detailed Report

Module: IntegraPac IPD-77
Total UF Trains: 1
UF Modules: 1 x 6 = 6
Operating Flux: 51 LMH
UF System Recovery: 92.1%

Feed Water
Average Feed Flow: 21.8 m³/h
Type: Surface Water
TSS: 20.0 mg/L
TOC: 0.0 mg/L
Turbidity: 24.7 NTU

Feed Pump
Max 26.7 m³/h
@ 3.2 bar



DOW IntegraPac™ Concept



- Lower footprint (single stage process)
- Higher and more consistent filtrate quality, independently of the feed water quality
- Rejects pathogens resistant to chlorination
- Lower chemical use (coagulant, pH adjustment,...)
- Easier maintenance (highly automated operation)
- Easier expandability
- Supports shipment by container
- Minimized Fittings & Materials

Githunguri Dairy (Fresha) 30m³/hr - Processing

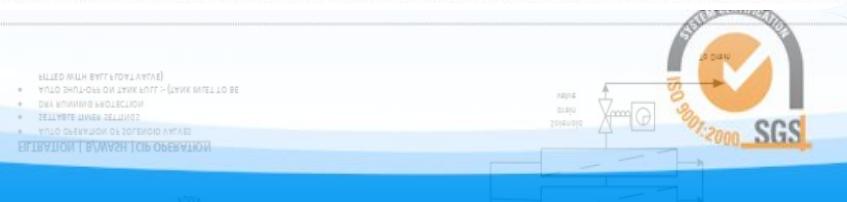
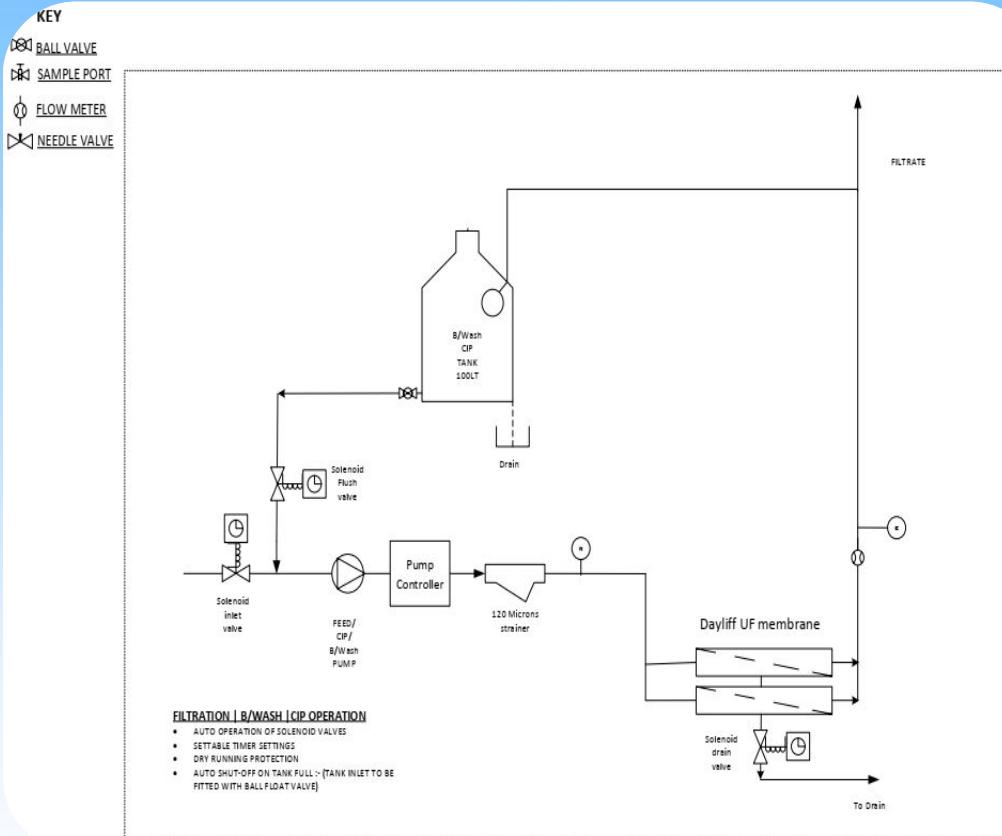


Dayliff Economy UF

- Compact unit with single Dayliff feed/backwash/Cleaning pump saving energy, Low CAPEX and OPEX
- **Raw Water Quality:** Turbidity -15 NTU, Oil/Grease - 0mg/l, Particle wipe off >0.2µm



- UF membrane supplied independent of the vessel/housing - versatile.
- Capacities: 350 - 1500 L/hr



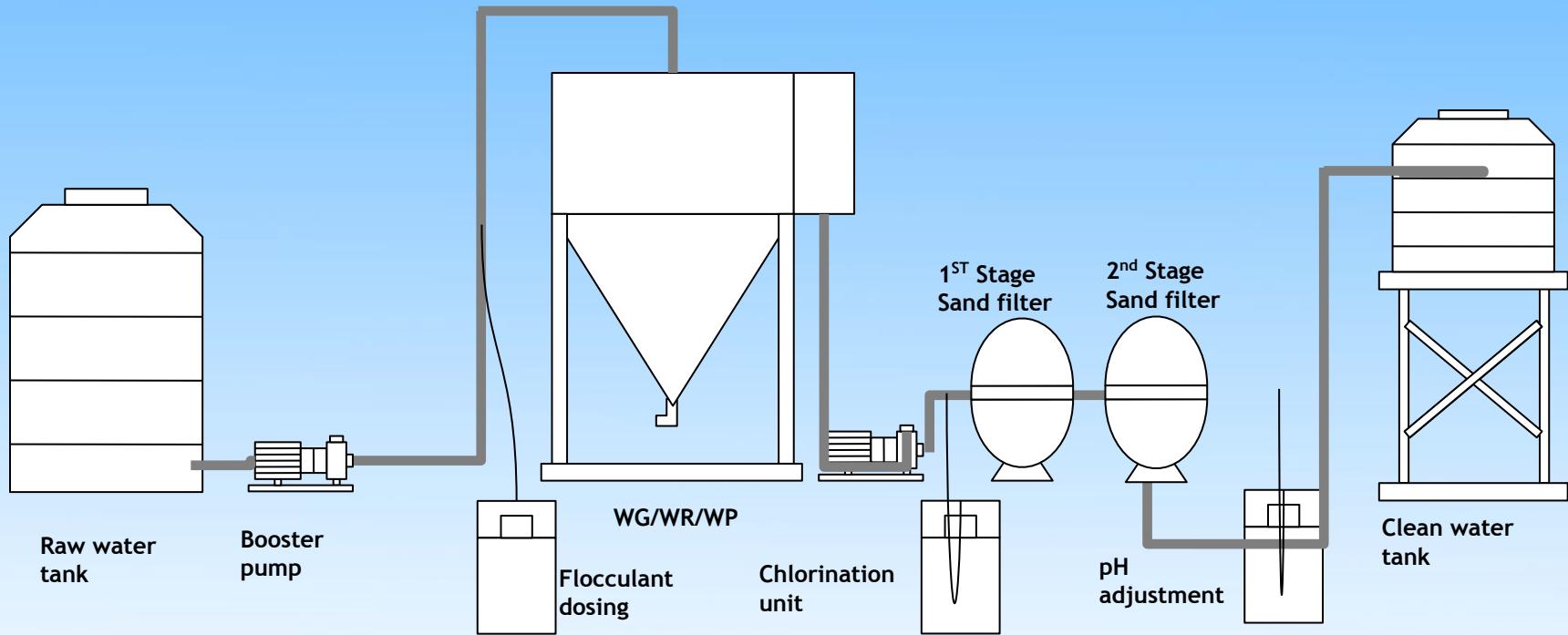
SURFACE WATER TREATMENT (WP/WG/WR/KWAT)

Surface Water

Characteristics

- ▶ Low TDS 50-200mg/l
- ▶ High Turbidity levels
- ▶ High levels of TSS (Total Suspended Solids)
- ▶ Microbial contamination
- ▶ Organic load

Process flow



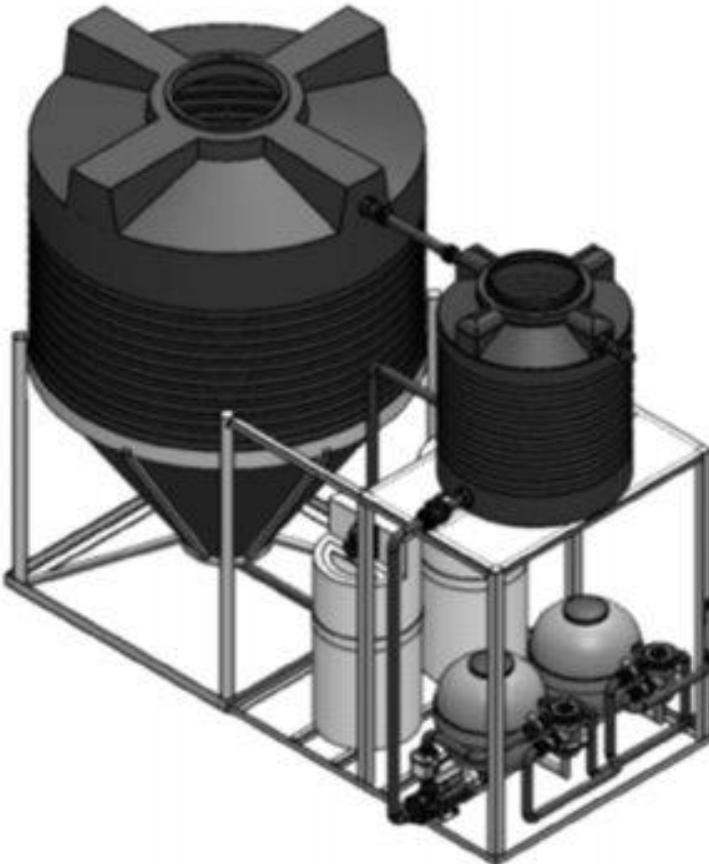
Dayliff WP Plant 10,000l/hr



WG Plant 500l/hr



WR Plant



Features

- PVC tanks based “WP”
- Corrosion resistance hence good for pre-chlorination applications such as Fe & Mn Removal
- Easy to transport

=>Available in 1.5m³/hr, 2.5m³/hr and 5m³/hr

KWAT Clarifier and Storage Tanks



KWAT Clarifier and Storage Tanks

50,000L/hr system delivered in 3 days in Wote, Makueni



Day 1



KWAT Clarifier and Storage Tanks



Day 2



KWAT Clarifier and Storage Tanks



Final
Day 3





Raw water - raw water tank.



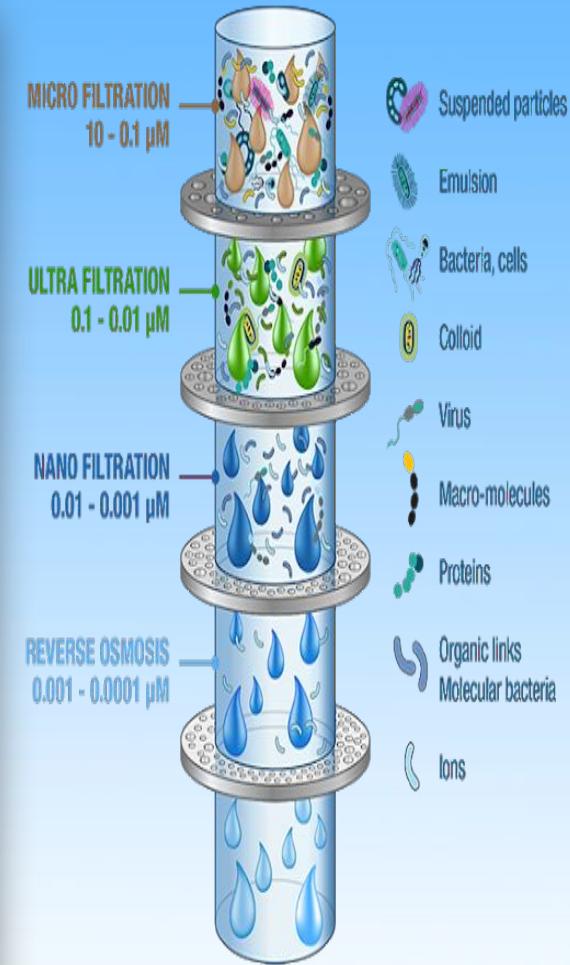
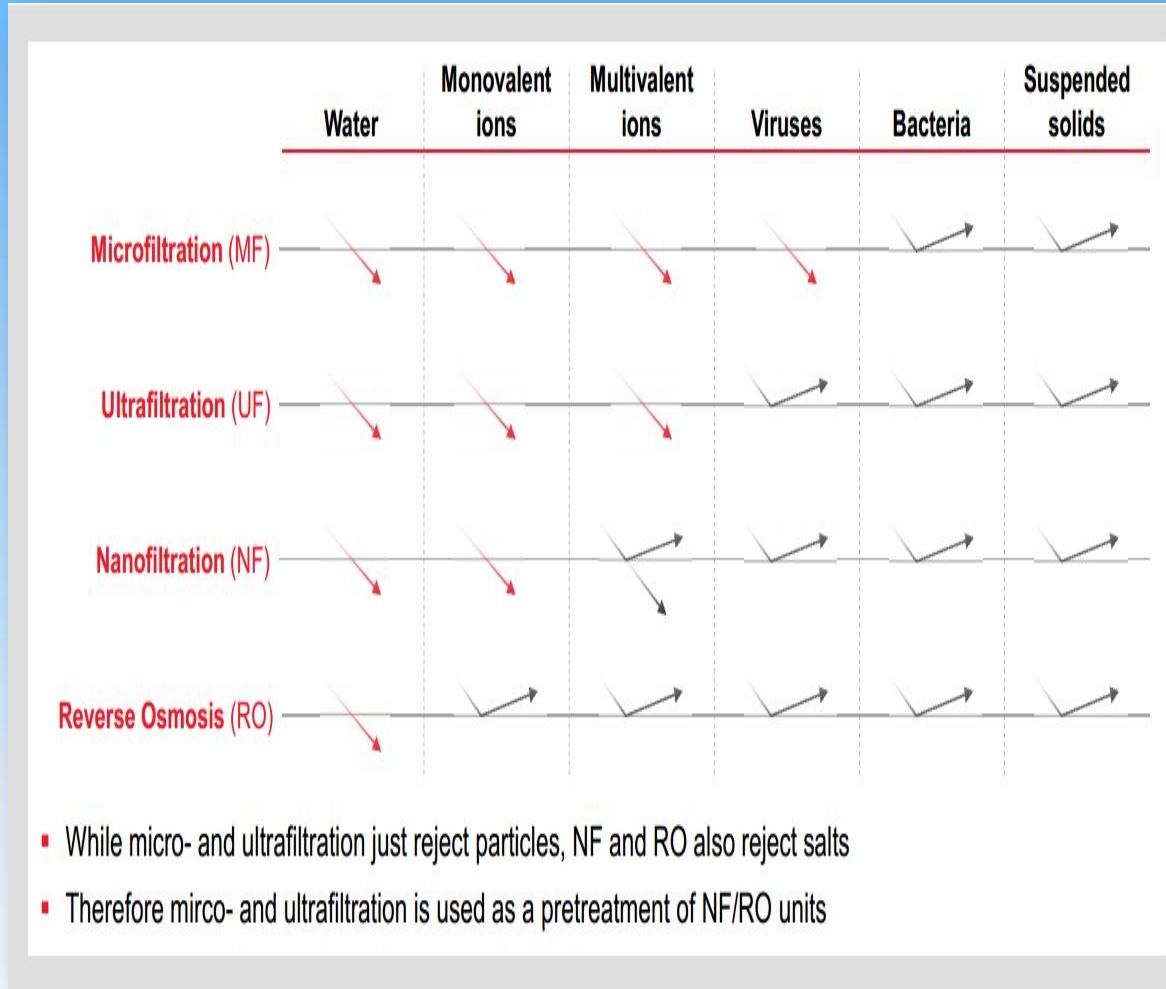
Clean water - clean water tank.

REVERSE OSMOSIS (RO) PLANTS

System Design Considerations

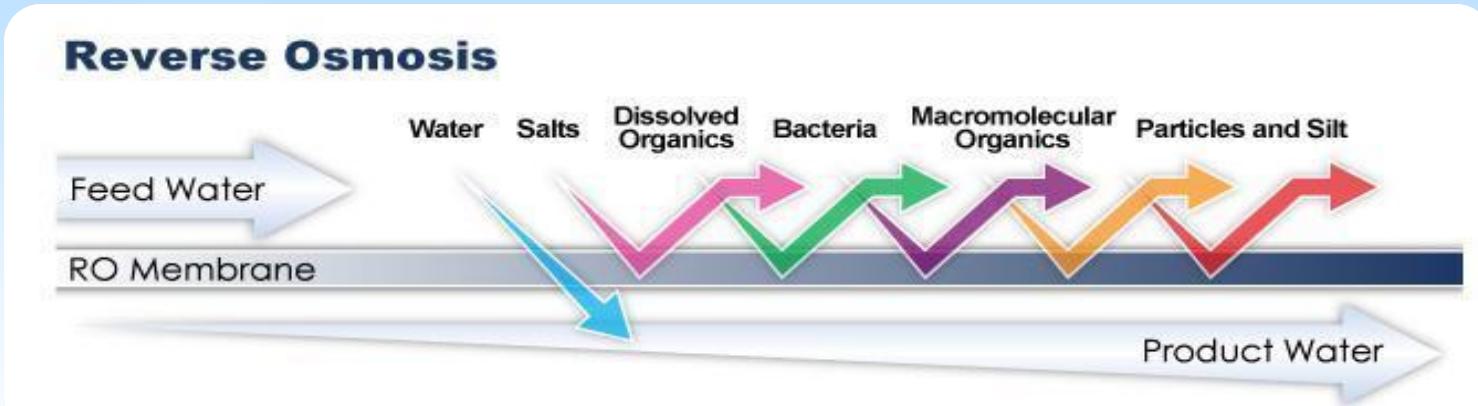
- Source of water – water analysis report
- Treated water use – domestic/process/agriculture
- Water demand – hourly or daily
- Hours of operation - continuous/intermittent/shifts
- Site conditions – access and space availability
- Power availability – alternative power options
- Project Budget - one-off or phased implementation
- Extras – automation and monitoring (SCADA/web & mobile apps, HMI display units, etc)

Pressure-driven Membrane processes

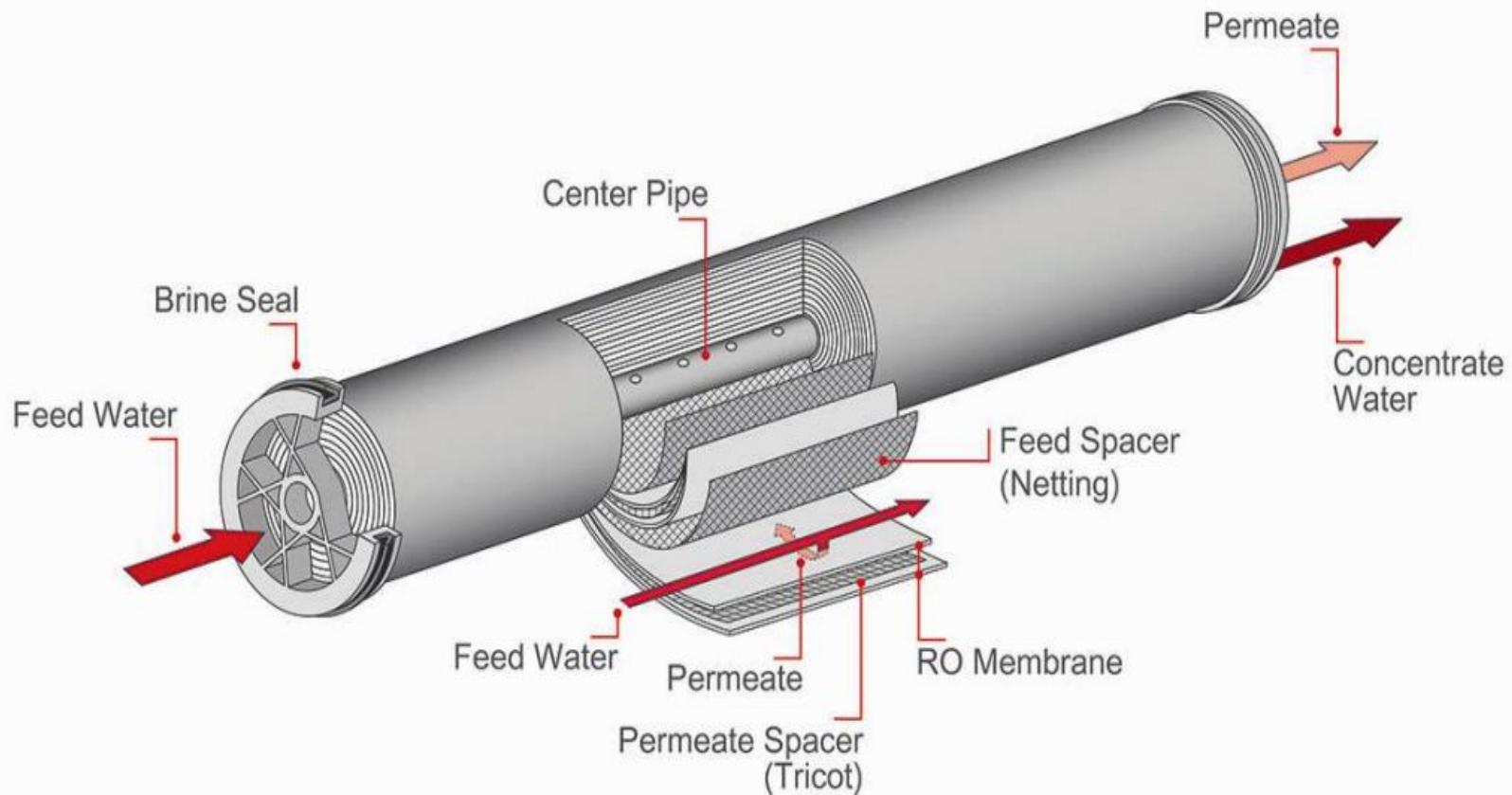


Reverse Osmosis (RO)

- Membrane separation process that uses a semi-permeable membrane
- Membrane pores small enough (0.0001micron) to allow water molecules while rejecting larger molecules -dissolved salts (ions) and other impurities such as bacteria
- High pressure required - overcome osmotic pressure
- Low tolerance for chlorine and suspended solids – **reason why pretreatment required!**
- Two output streams – permeate (clean) and concentrate (waste) water

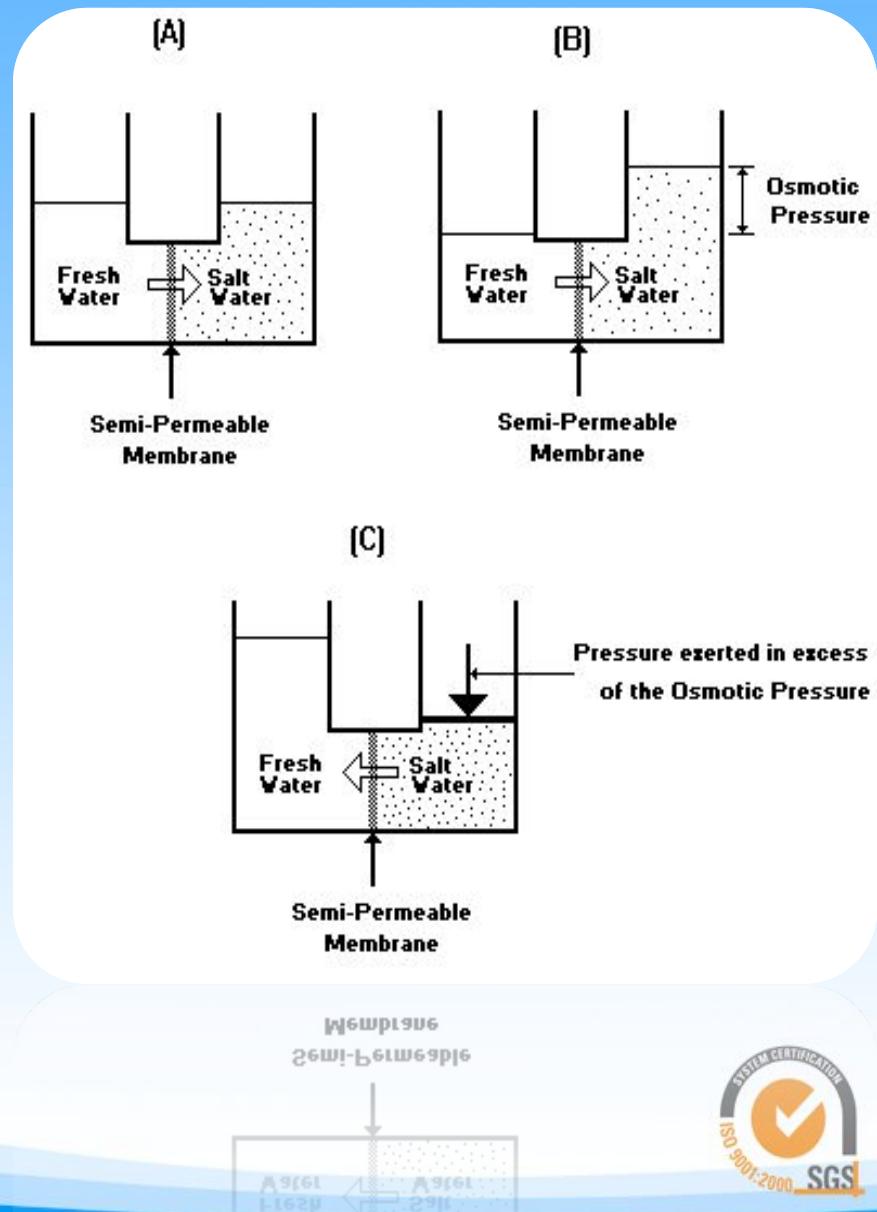


RO Membrane cut-away



Reverse Osmosis (RO)

- ▶ Water is forced through a semi-permeable membrane (0.001 micron/ μ) at **very high pressure** = **High energy costs**
- ▶ Reduction of **salinity** and removal of **fluoride** and other dissolved minerals
- ▶ Very high quality '**permeate**' water has $< 96.5\%$ of the original inlet mineral salt content.
- ▶ The '**concentrate**' reject water will carry many times the original inlet mineral salt content.



RO Feed Water Quality Guideline

Parameter	Typical Limits
Turbidity	Prefer < 0.2 NTU, 1.0 Max
SDI ₁₅	Prefer < 3, Up to 5 accepted
Iron	< 0.05 ppm
Manganese	< 0.05 ppm
Aluminum	< 0.1 ppm
TOC	< 3 ppm
Silica	<40 ppm
pH	TFC (5.0 – 9.0)
Temperature	55-85F (12.7 – 30C)
LSI	Use appropriate antiscalant
Barium	Use appropriate antiscalant
Strontium	Use appropriate antiscalant
Phosphate	Use appropriate antiscalant

Why Pretreat RO Feed water?

To prevent:

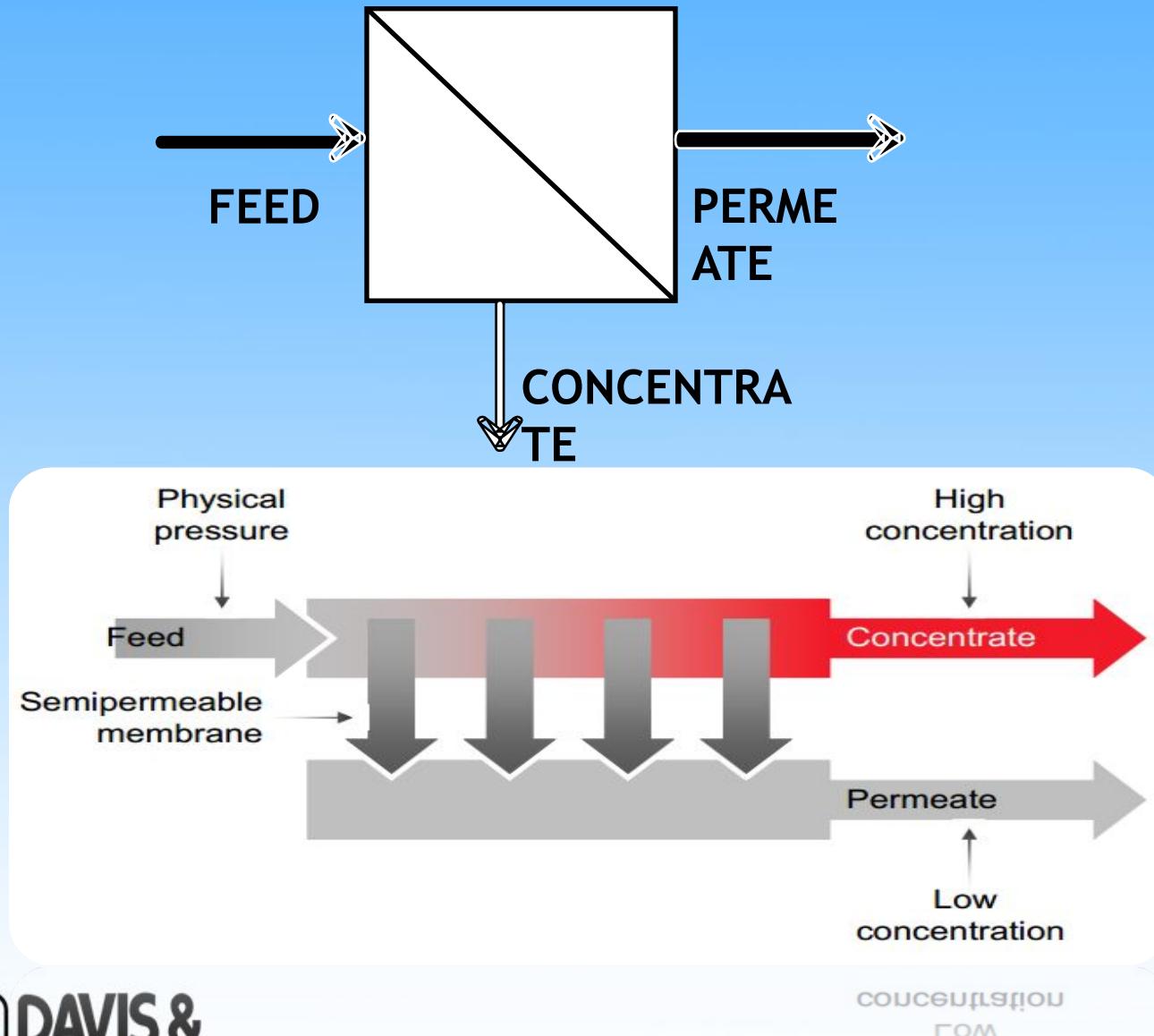
- **Scaling**
 - Precipitation of solutes onto membrane surface
 - Occurs at tail end
 - Heavy metals, Silica, Hardness etc
 - *Antiscalant dosage required for scale control – chemical selection and dosage simulator available from Genesys (MM5)*
- **Fouling**
 - Growth of bacteria on membrane surface forming slime layer
 - Occurs throughout membrane
 - COD & BOD
- **Clogging**
 - Deposits of silt in membrane
 - Throughout membrane but most common at front.
 - Metal Oxides, TSS (colloids, clays, silts, etc.)
- **Membrane Degradation**
 - Chlorine damages RO membranes through oxidation

Why Pretreat RO Feed water?

- RO is designed to filter out dissolved solids not suspended solids.
- Pre-treating the feed water will increase the life and recovery of the membranes.
- In the long run – you will **SAVE** money if you pre-treat.

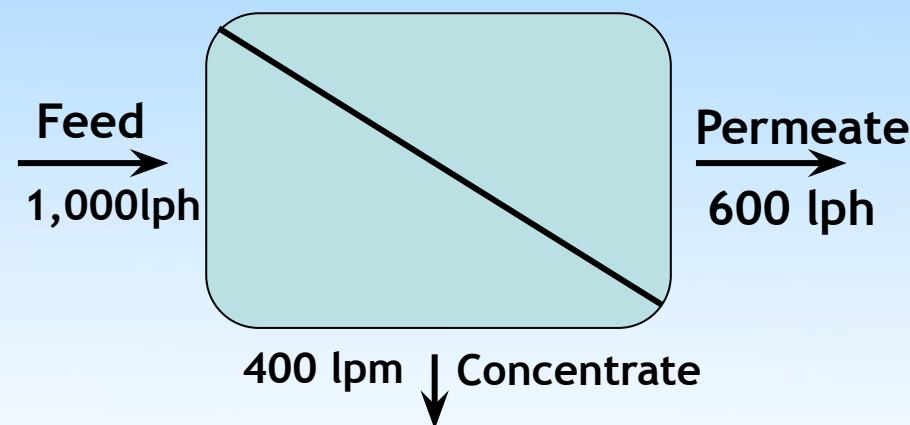
GOOD PRE-TREATMENT = GOOD RO PERFORMANCE

System Block Diagram - Crossflow



Basic definitions for RO performance

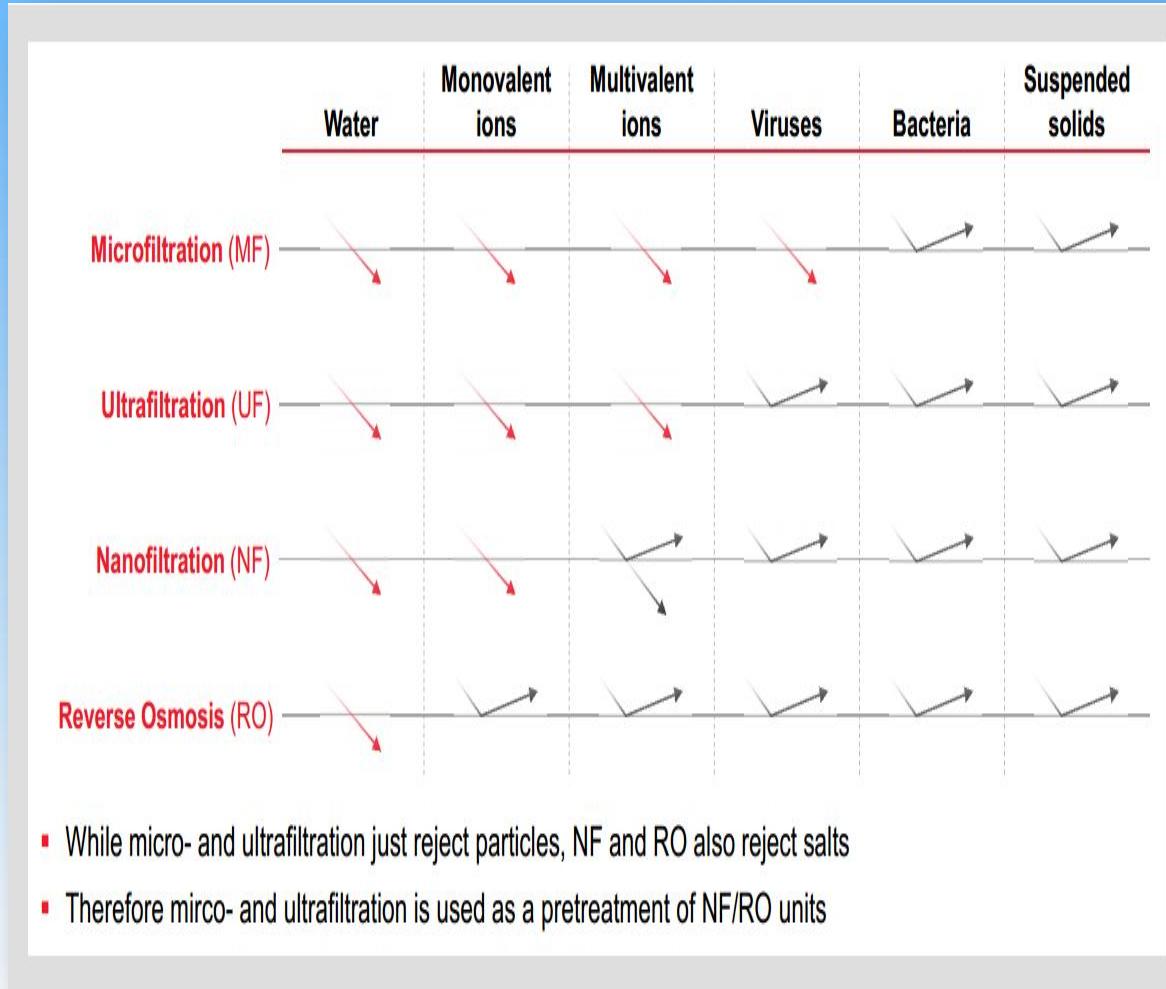
- 1) **Flux** - measure of membrane productivity, or how much volume of permeate can be prepared per unit of membrane surface area.
The units of flux are: l/m²/hour (lmh)
- 2) **Rejection** - percentage of solids that do not pass through a membrane.
Rejection = (1 - (Permeate Quality / Feed Quality)) x 100%
- 3) **System Recovery** - ratio of permeate flow to feed flow of an entire membrane system



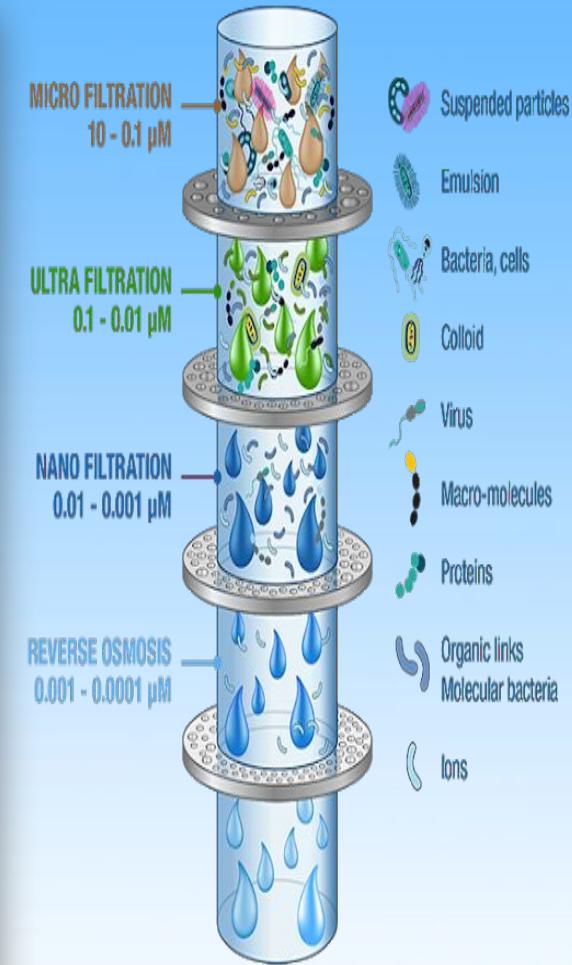
$$\% \text{ Recovery} = \frac{\text{Permeate Flow rate}}{\text{Feed Flow rate}} \times 100\%$$

$$\% \text{ Recovery} = \frac{600 \text{ lph}}{1,000} \times 100\% = 60\%$$

Pressure-driven Membrane processes



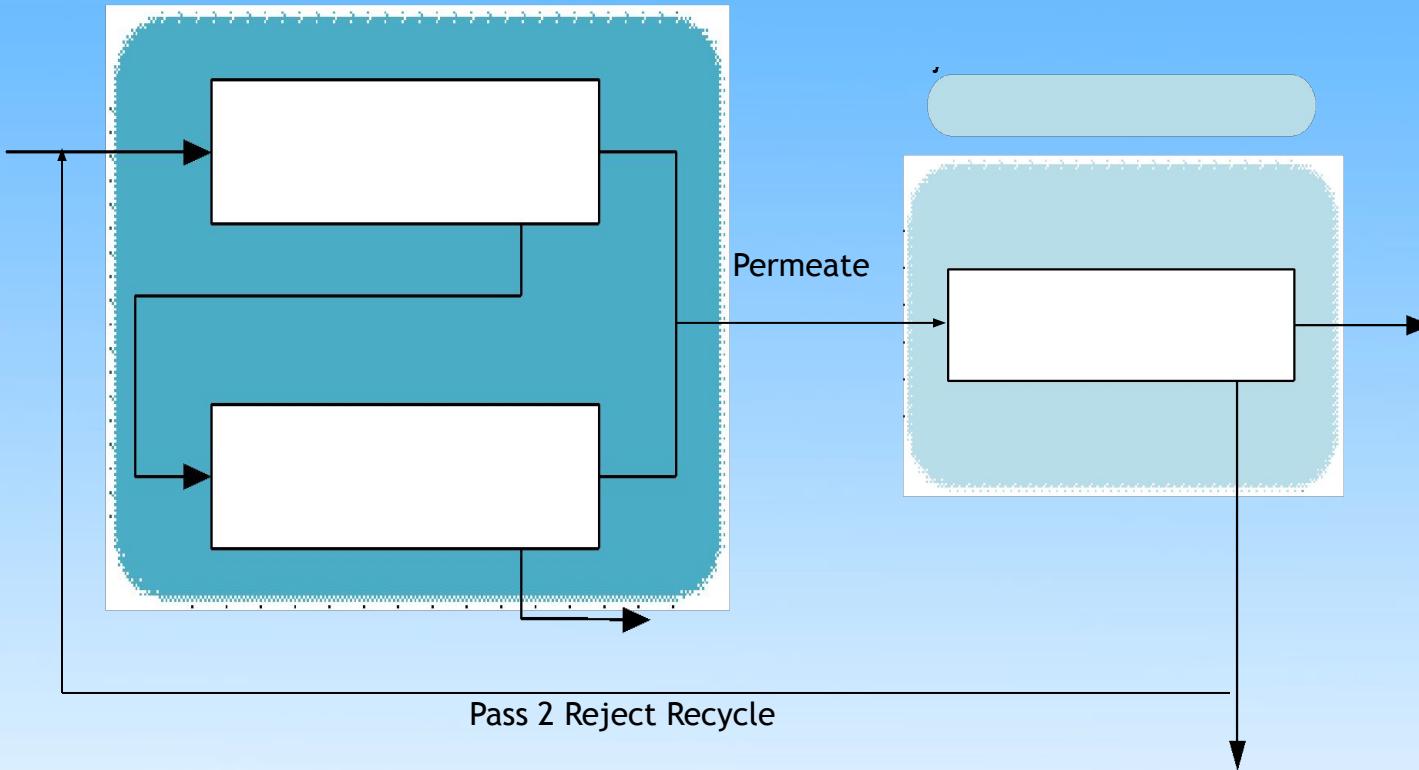
- While micro- and ultrafiltration just reject particles, NF and RO also reject salts
- Therefore micro- and ultrafiltration is used as a pretreatment of NF/RO units



Membrane Array

- The designed arrangement of membrane housings/vessels
- The number of housings placed in parallel and in series depending on the application
- Determines the **number of stages** and **number of passes** for an RO system

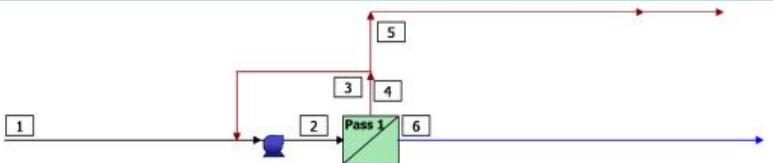
RO Stages and Passes



- **Stages** - improve recovery (less water wasted)
- **Passes** - improve treated water quality (compromise on recovery)

WAVE simulations used to optimize RO design based on feed water quality

Wave Simulation Report (Excerpts)



#	Description	Flow (m³/h)	TDS (mg/L)	Pressure (bar)
1	Raw Feed to Pump	1.14	114	0.00
2	Net Feed to Pass 1	1.56	138	5.08
3	Concentrate Recycle from Pass 1 to Pass 1	0.42	202	4.30
4	Total Concentrate from Pass 1	1.06	202	4.30
5	Concentrate from Pass 1 after Recycle to Pass 1	0.64	202	4.30
6	Total Permeate from Pass 1	0.50	1.62	0.00

RO System Overview

Total # of Trains	1	Online =	1	Standby =	0	RO Recovery	43.90 %
System Flow Rate (m³/h)		Net Feed =	1.14	Net Product =	0.50		

RO Flow Table (Stage Level) - Pass 1

Stage	Elements	#PV	#Els per PV	Feed				Concentrate			Permeate			
				Feed Flow (m³/h)	Recirc Flow (m³/h)	Feed Press (bar)	Boost Press (bar)	Conc Flow (m³/h)	Conc Press (bar)	Press Drop (bar)	Perm Flow (m³/h)	Avg Flux (LMH)	Perm Press (bar)	Perm TDS (mg/L)
1	LC LE-4040	1	1	1.56	0.42	4.77	0.00	1.30	4.62	0.15	0.26	29.7	0.00	1.40
2	LC LE-4040	1	1	1.30	0.00	4.42	0.00	1.06	4.30	0.12	0.24	27.5	0.00	1.85

RO Solute Concentrations - Pass 1

	Raw Feed	Concentrations (mg/L as ion)				Adjusted Feed				Concentrate		Permeate			
		Initial	After Recycle	Concentrate		Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Permeate		Total	
				Stage1	Stage2							Total			
NH ₄ ⁺	0.01	0.01	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
K ⁺	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Na ⁺	24.12	24.12	29.18	34.92	42.70	0.37	0.48	0.37	0.48	0.42	0.42	0.42	0.42	0.42	
Mg ²⁺	2.20	2.20	2.67	3.20	3.92	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
Ca ²⁺	5.60	5.60	6.79	8.14	9.98	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	
Sr ²⁺	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Ba ²⁺	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CO ₃ ²⁻	0.31	0.31	0.42	0.57	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
HCO ₃ ⁻	39.73	39.73	47.97	57.30	69.94	0.54	0.70	0.54	0.70	0.61	0.61	0.61	0.61	0.61	
NO ₃ ⁻	15.80	15.80	19.09	22.84	27.90	0.32	0.42	0.32	0.42	0.37	0.37	0.37	0.37	0.37	
Cl ⁻	19.00	19.00	23.03	27.59	33.79	0.12	0.16	0.12	0.16	0.14	0.14	0.14	0.14	0.14	
F ⁻	0.26	0.26	0.31	0.38	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
SO ₄ ²⁻	2.00	2.00	2.43	2.91	3.56	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	
SiO ₂	5.00	5.00	6.06	7.25	8.89	0.04	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04	
Boron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CO ₂	0.50	0.50	0.53	0.58	0.65	0.50	0.55	0.50	0.55	0.53	0.53	0.53	0.53	0.53	
TDS*	114	114	138	165	202	1.40	1.85	1.40	1.85	1.62	1.62	1.62	1.62	1.62	
pH	8.07	8.07	8.12	8.15	8.19	6.25	6.32	6.25	6.32	6.29	6.29	6.29	6.29	6.29	

RO Flow Table (Element Level) - Pass 1

Stage	Element	Element Name	Recovery (%)	Feed Flow (m³/h)	Feed Press (bar)	Feed TDS (mg/L)	Conc Flow (m³/h)	Perm Flow (m³/h)	Perm Flux (LMH)	Perm TDS (mg/L)
1	1	LC LE-4040	16.62	1.56	4.77	138	1.30	0.26	29.7	1.40
2	1	LC LE-4040	18.45	1.30	4.42	165	1.06	0.24	27.5	1.85

MM4 Sample Report

Recommended Product

GENESYS LF

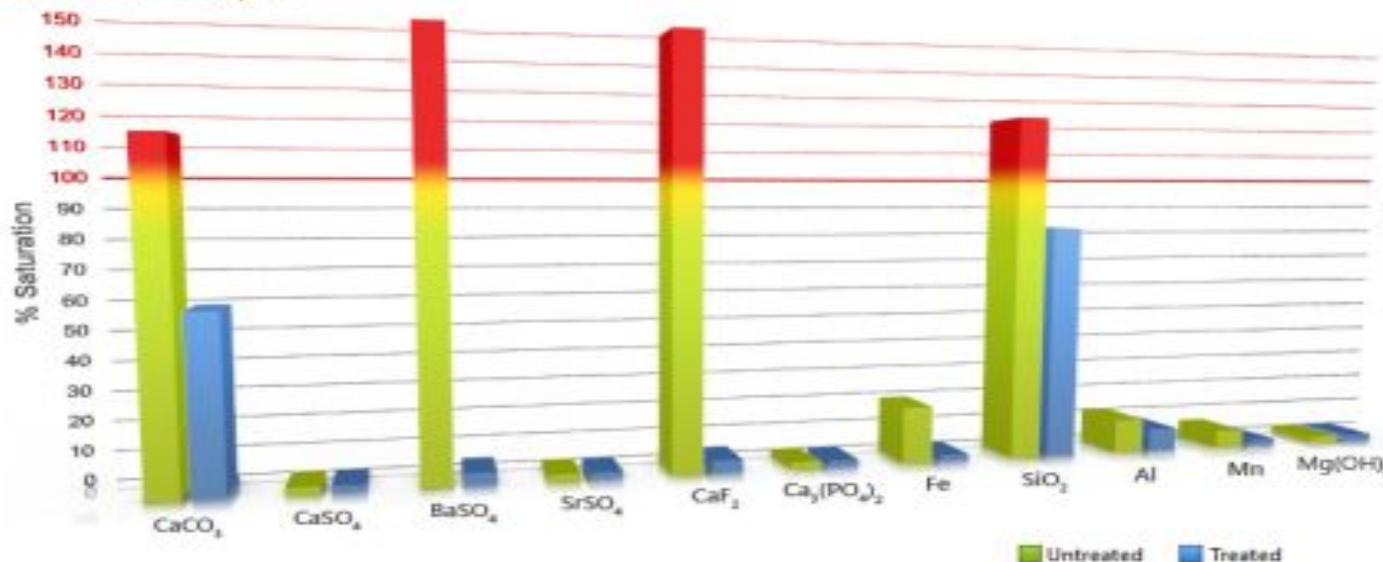
Dosing Data

For Scale Control - Feed	6.45 mg/l
For Iron Control - Feed	0.05 mg/l
Total Dosage	6.50 mg/l
Dose In Concentrate	13.00 mg/l
Set Dosing Pump To	9.77 ml/hr
Daily Requirement	0.23 l/day

Acid Dosing

Acid dosing is not required.

Saturation Graph



Scaling Indices

	CaCO ₃	CaSO ₄	BaSO ₄	SrSO ₄	CaF ₂	Ca ₃ (PO ₄) ₂	Fe(OH) ₃	SiO ₂	Al(OH) ₃	Mn(OH) ₂	Mg(OH) ₂
Conc. Untreated	113.27	0.08	157.42	0.04	497.74	0.00	19.80	121.89	11.11	6.60	0.00
Conc. Treat.	58.59	0.03	3.15	0.00	3.56	0.00	1.32	81.26	7.21	0.44	0.00
ΔICP	28.28	0.03	3.12	0.00	3.26	0.00	1.35	81.56	7.51	0.40	0.00
ΔICP	0.08	121.45	0.04	185.34	0.00	0.00	0.82	131.89	11.11	0.40	0.00
ΔICP	0.20	BP20 ^a	2120 ^a	C1E ^b	C1 ^b (b0) ^b	C1 ^b (b0) ^b	BP(HO) ^b	2101A	C1M ^b	C1M ^b	C1M ^b



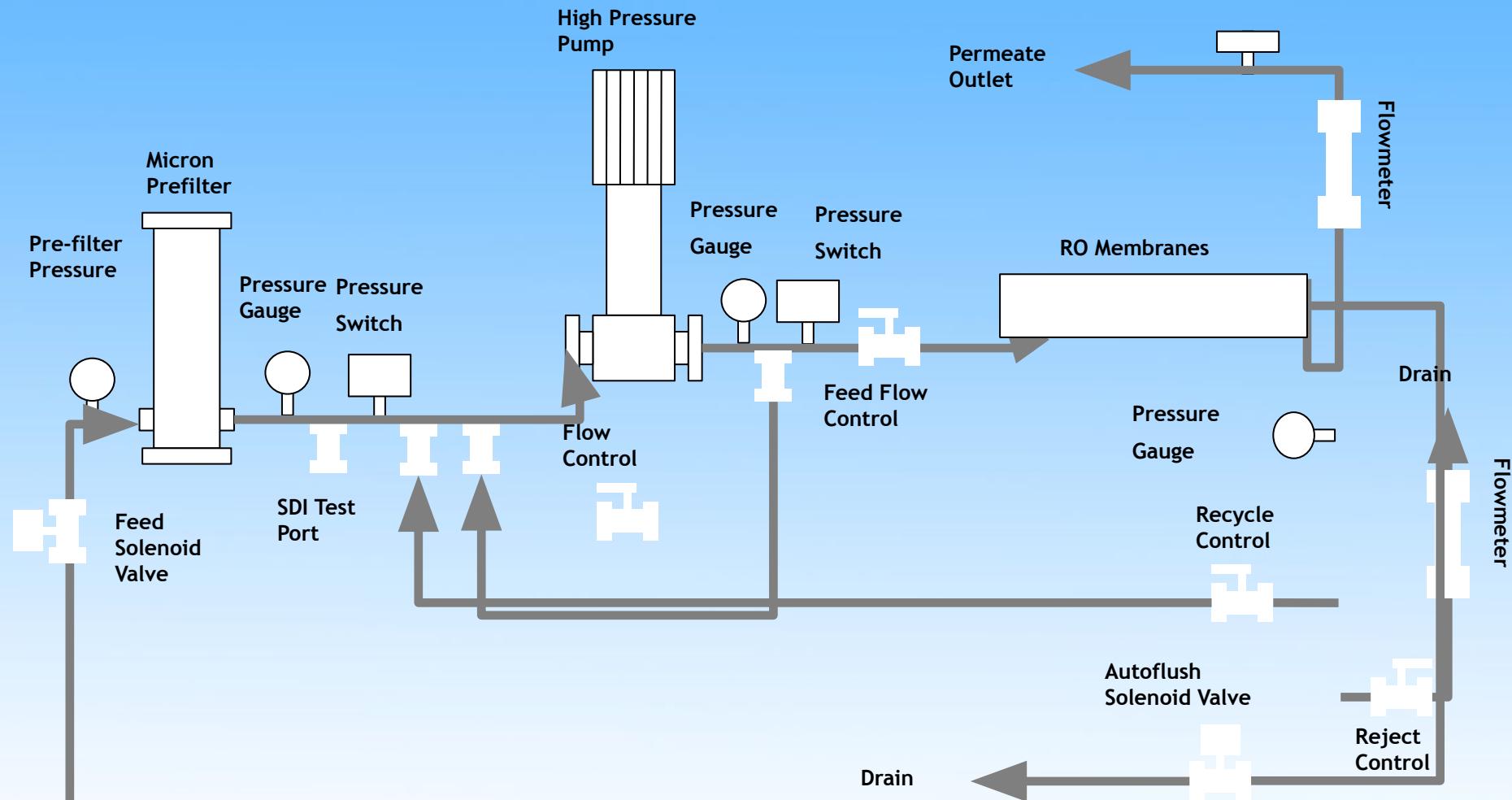
know H₂Ow through experience

CaCO₃ CaSO₄ BaSO₄ SrSO₄ CaF₂ Ca₃(PO₄)₂ Fe(OH)₃ SiO₂ Al(OH)₃ Mn(OH)₂ Mg(OH)₂

Scaling
Dissolving
Neutralizing



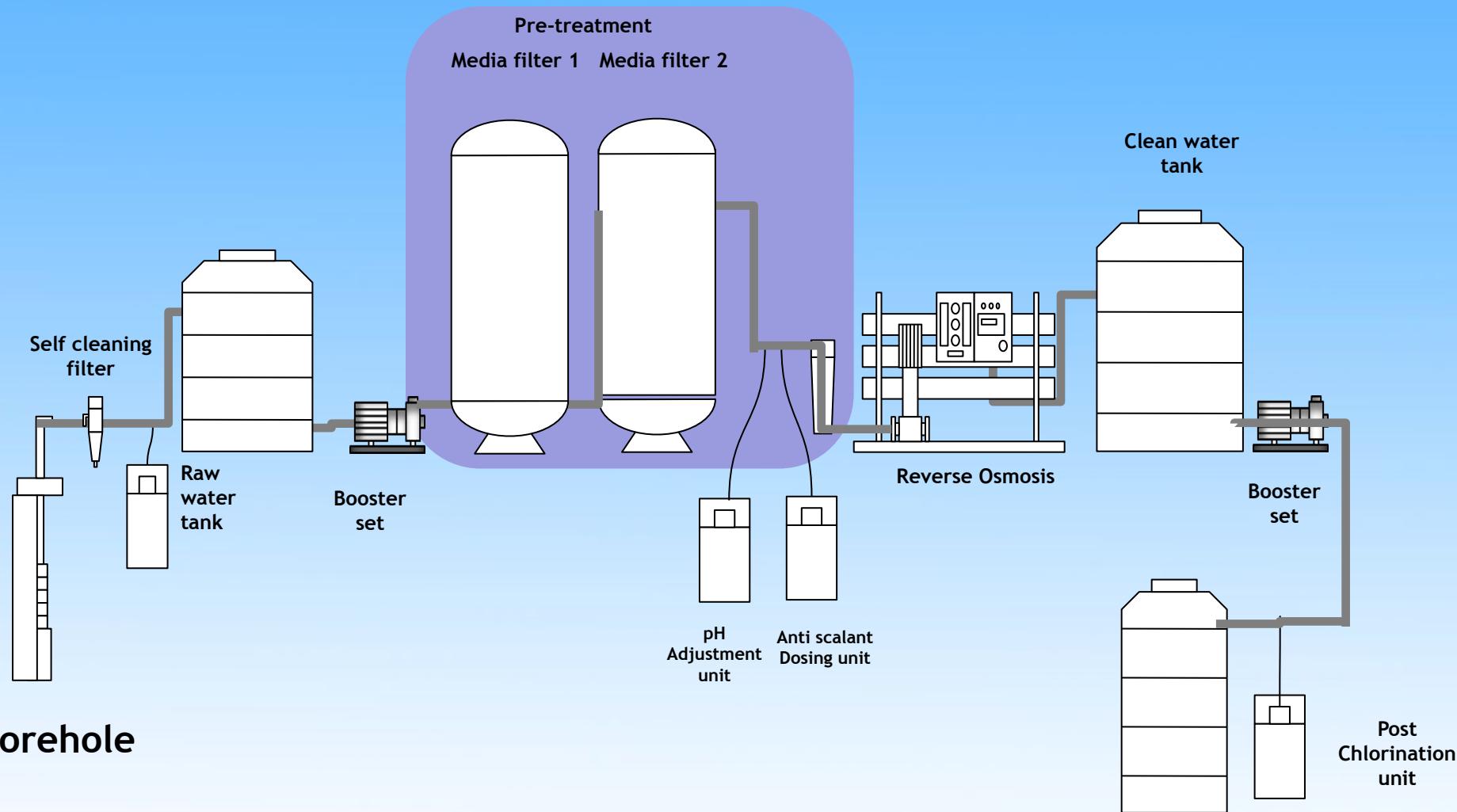
Typical Dayliff RO Schematic



Dayliff DRO Types

DRO Type	Specifications
Sea Water	TDS > 10,000ppm, Chlorides >1,000ppm; Min 250L/hr; SWRO membranes
Duplex	TDS5000, Chlorides >900ppm (with CRT pump option); Min 250L/hr; BW, ECOPRO, HRLE membranes
Standard	TDS2000, Chloride <350ppm; Min 250L/hr; BW, ECOPRO, XLE
Economy	TDS < 1,000ppm; 250 – 2,000L/h; LCLE membranes
BRO4	TDS < 500ppm; 250 – 1,000L/hr; Dayliff membranes

Sample Complete RO Process Flow



Solarized RO Installation



D&S DAVIS &
SHIRTLIFF
know H₂Ow through experience

D&S **DAVIS &
SHIRTLIFF**
know H₂Ow through experience

From remote locations to off-grid communities, Davis and Shirtliff's solarized reverse osmosis plants bring clean water to all, while reducing carbon emissions.

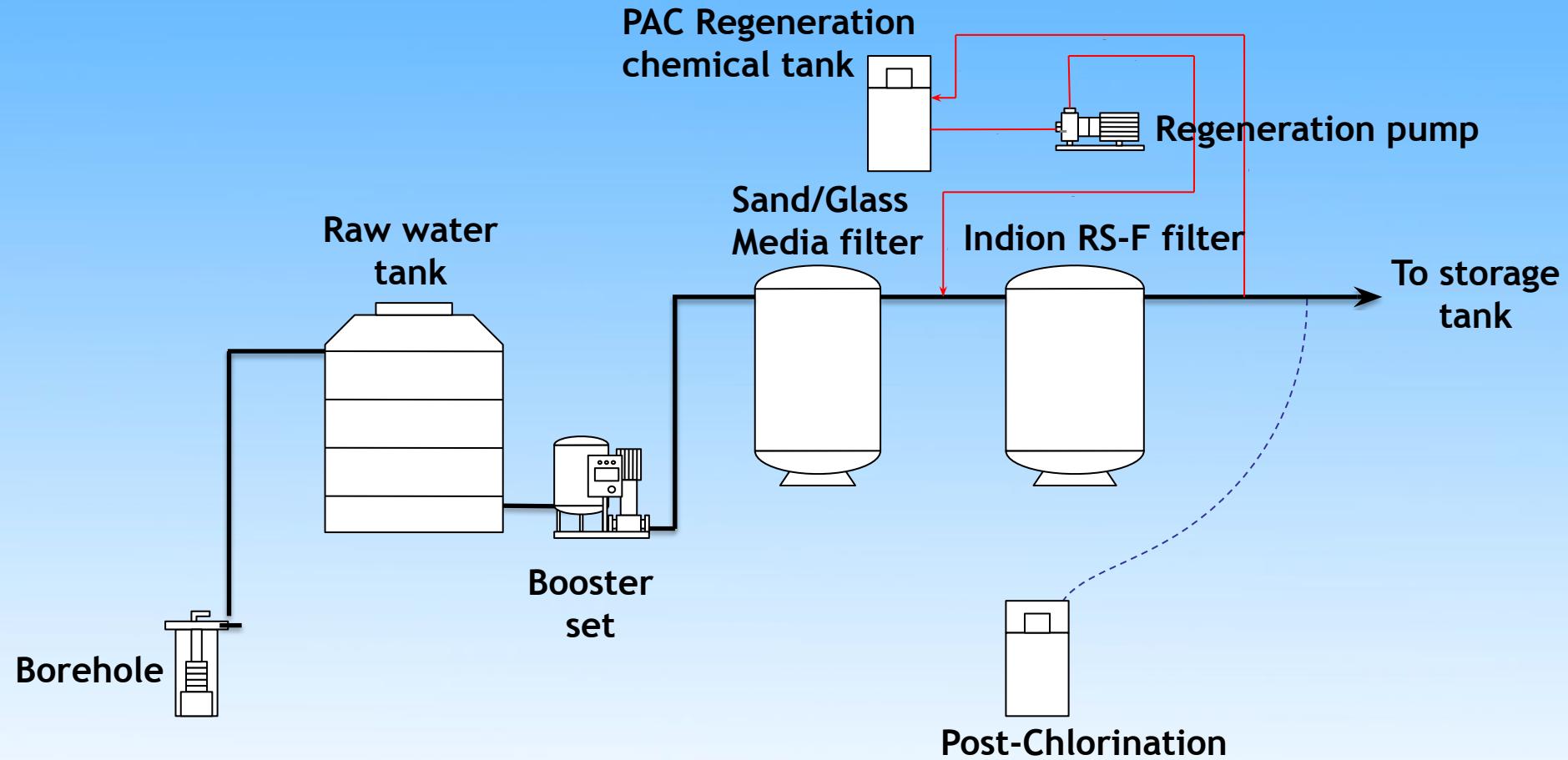


Sample RO Installation

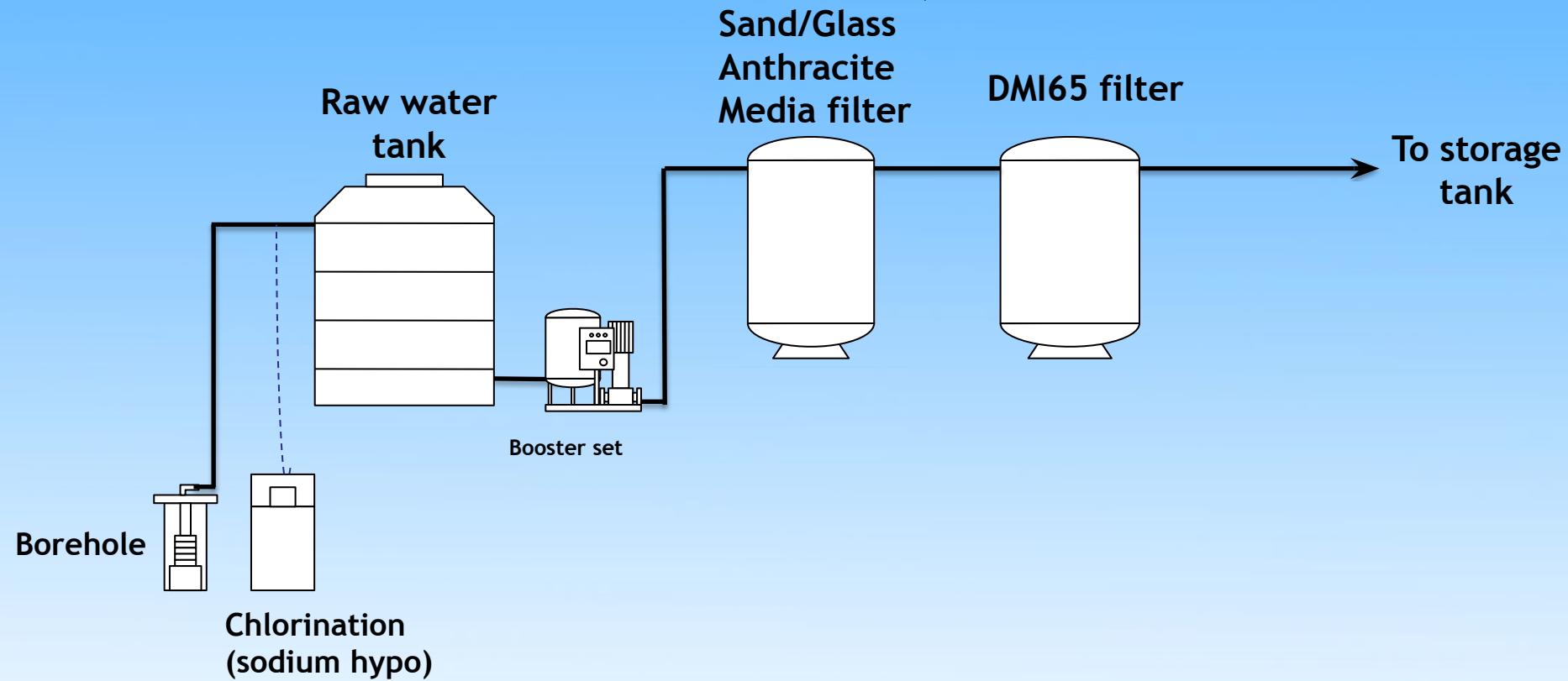


ION EXCHANGE SYSTEMS

Indion RS-F Fluoride Removal Process layout



DMI65 Fe/Mn Removal Process Layout

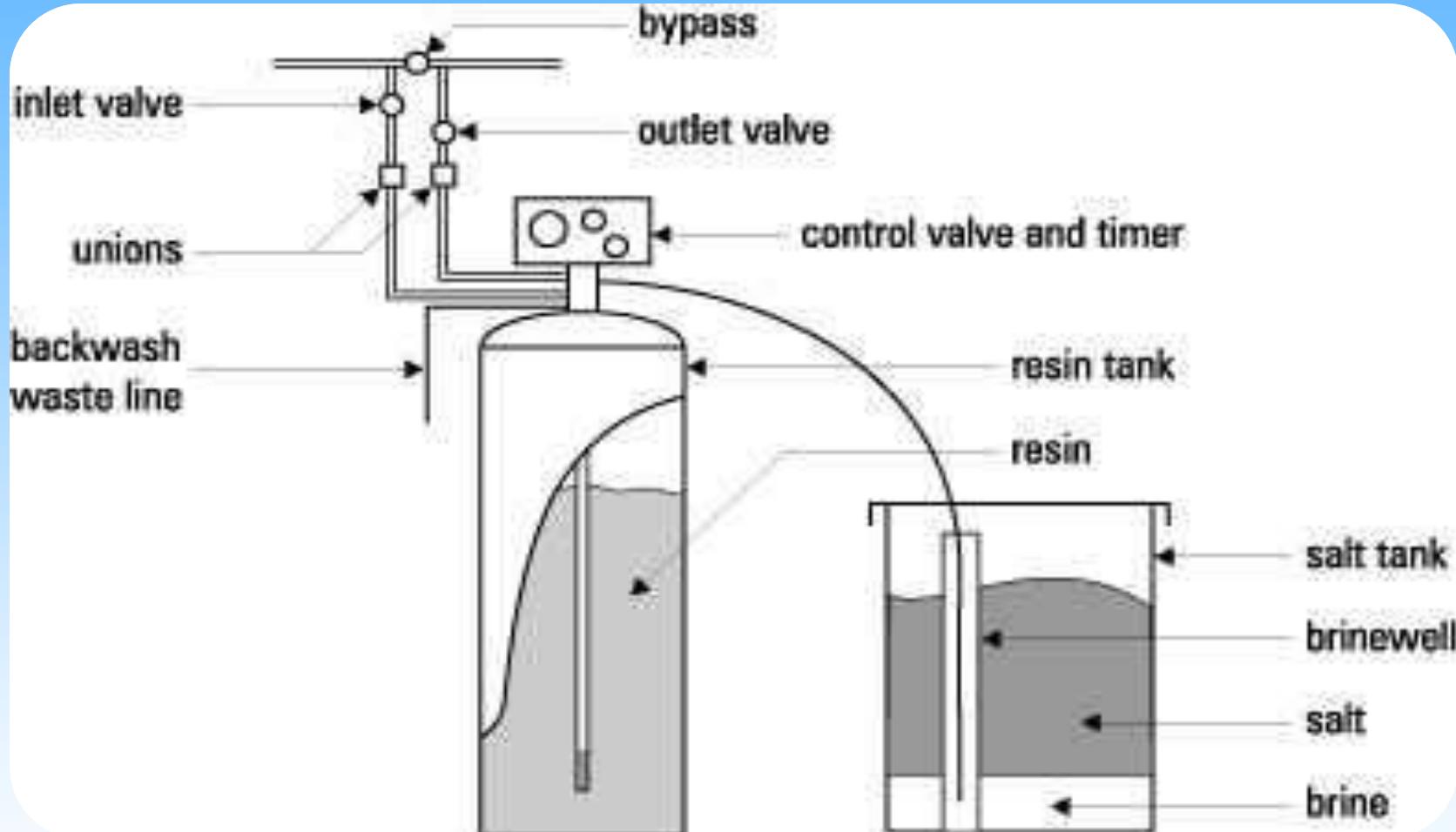


Water Softeners

- Hardness:
 - Calcium & Magnesium Ions
 - Scaling in kettles & boilers, solar water heaters
 - No Foam with Soap
- Softening - Removal of Hardness ions by Ion Exchange
- Ion Exchange Resin – **Indion 225Na**
- Regeneration with industrial salt – NaCl (Pool salt)



Softener Setup



DISINFECTION

Why Disinfect water?

- Micro-organisms are killed/ destroyed/ deactivated/ denatured, resulting in termination of growth and reproduction.
- Chlorination – the most common method
 - Chlorine available as Chlorine 65 powder
 - Has a **residual effect** ↑
 - Introduces smell and taste to water ↓
- UV sterilization
 - used for clear, micro-filtered water
 - UV has **no residual effect**
- Ozone – Strong oxidant generated in-situ. **Limited residual effect**
- Biocide - Online or offline dosing to eliminate microbial fouling on membranes, cooling towers, etc (Genesys/Kurita)

Chemical Dosing Pumps

Seko AMM/AML

- Max. Flow - 5l/hr
- Max. Pressure - 8bar



Grundfos Alldos

- Higher Flow Rates of 6 - 115L/hr (higher flows available on order)
- Max. Pressure of 3-10bar
- Grundfos Quality & Reliability



Automation

- Fully automated option available complete with ORP, Free Chlorine, pH, etc probes and controllers

Proportional dosing

Dosatron and Mixtron Range

- Proportional dosing pumps powered by water pressure only
- Dosing rate proportional to flow rate
- Sizing by **flow rate** on line and **percentage** of the dosage required
- Dosing range: 10 – 20,000L/hr
- Pressure range: 0.12 - 10bar

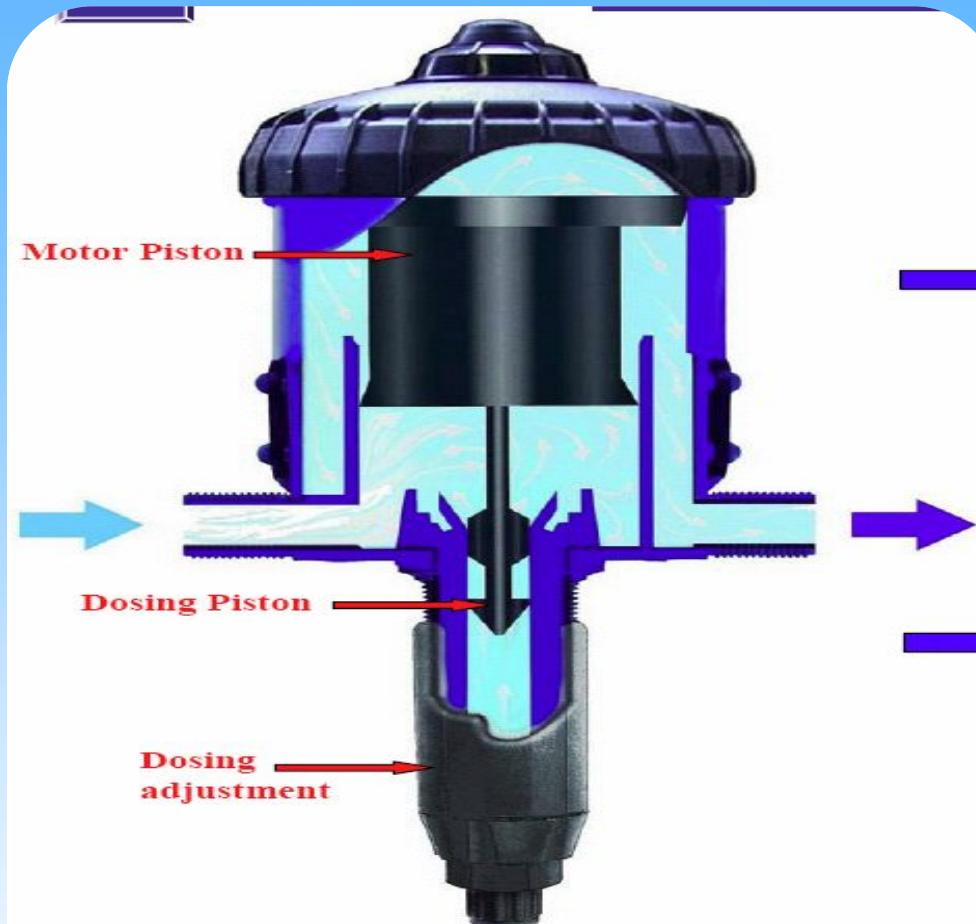


Dosatron



Mixtron

How A Dosatron Works



A unique principle without electricity...
A unique principle with electricity...

Buccaneer Inline Dosing Unit



- Simple, versatile and effective gravity-fed disinfection
- Uses calcium hypochlorite cartridges that dissolve as water flows
- Connected directly or on by-pass
- Dosage rate set by controlling flow thro' mixing unit or varying number of cartridges
- Dosage capacity – 6x1.9kg refill cartridges will dose 8000m³ at 1ppm
- Flow upto 7.2m³/hr
- Dosage between 1 - 250ppm depending on flow and no. of cartridges
- Max. Inlet pressure – 6bar

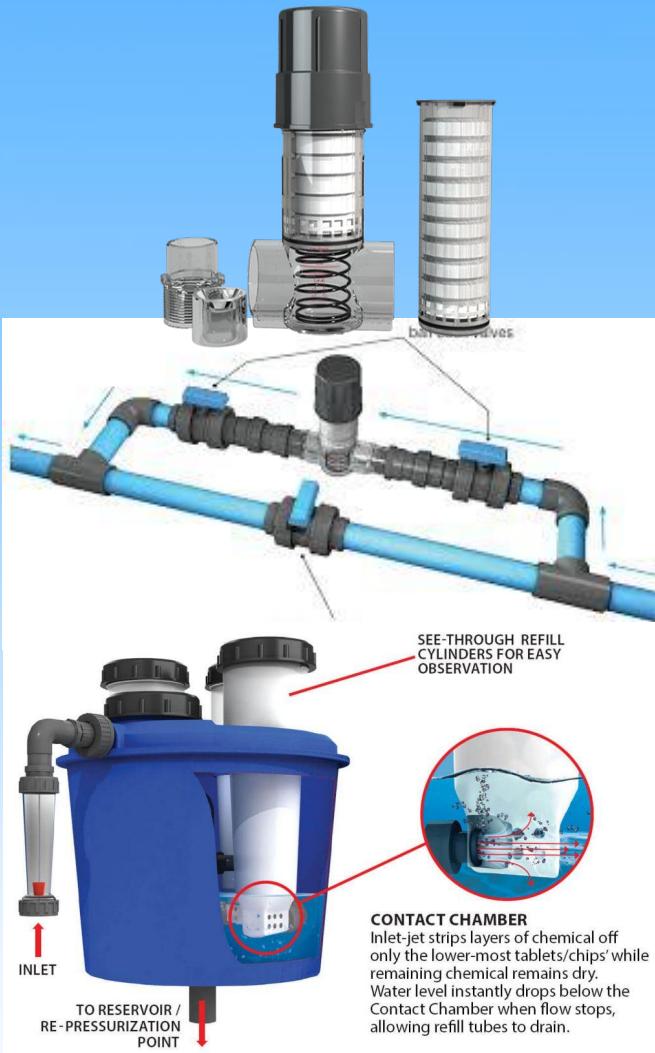
Aquatabs Chlorine Tablets



- Effervescent tablets that kill micro-organisms to prevent waterborne diseases
- Available in a range of tablet sizes. Each tablet size is formulated to treat a specific volume of water.



Klorman Dosing Unit



Klorman Inline

- Simple, inline point of use disinfection
- Uses calcium hypochlorite cartridges that dissolve as water flows
- Connected directly or on by-pass
- Dosage rate set by spring-loaded mechanism to adjust cartridge position
- Dosage capacity – a refill cartridge will dose 500m³ at 1ppm
- Flow upto 16m³/hr
- Dosage between 1 - 250ppm depending on flow and no. of cartridges
- Inlet pressure range – 0.5 - 6bar

Klorman 2000

- Larger capacity unit that used chlorine tablets
- Dosage capacity – 22kg refill tablets will dose 16000m³ at 1ppm
- Flow upto 5m³/hr
- Dosage between 50 - 350ppm depending on flow and no. of cartridges
- Inlet pressure range – 3bar

Klorman Applications

- Food processing facilities
- Shelf life enhancement
- Potable water disinfection
- Environmental hygiene
- Pre and post harvest
- Medical facilities
- Animal kennels

Sample Installation



UV Sterilization

- Stainless Steel chamber with sleeve sealing
- High efficiency 254nm (UV-C) lamp
- AL series with inbuilt controller (domestic applications)
- LCD and Rack series with external controller c/w LCD display - lamp working hours/ operating status and faults/ countdown hour meter/alarm indicator and relay for remote monitoring (iDayliff)



DOMESTIC/LIGHT COMMERCIAL WATER PURIFIERS

Domestic Purifiers



- Mineral water pot
- Dayliff UV purifier
- Dayliff Undersink RO
- Dayliff Compact RO
- Dayliff Treated Water Dispenser



*SoSafe being phased out due to supply challenges

- Atlas DP Sanic RO Purifier
- Replacement for SoSafe Mini ROs/Santeo

Filter Bodies & Cartridges



- Ion exchange - anion and cation resin cartridges
- Washable cartridges – Atlas Polyester and S/S cartridges
- Micron range – 0.2 – 50 mic
- Cartridge size: 10 – 30 inch; Standard and Jumbo options
- Other specialized cartridges available from Atlas and Pentair
- Filter bodies – 10inch, 20 inch and Jumbo options; Clear and Blue options
- Atlas silver impregnated filter bodies available from 2021

- Dayliff/Atlas options
- SoSafe being phased out
- For sediment removal - Wound sediment/ Spun Polypropylene (Melt-bown)/ Pleated /Ceramic
- For taste/odour/organics removal – Granular activated carbon (granular/ block/ dual)
- For bacteria removal – Atlas Sanic cartridges with antimicrobial properties
- For scale prevention – Atlas Polyphosphate crystals
- Atlas Hydra self-cleaning filter



Pure Water plants



- 5-Stage treatment with no chemical treatment – suitable for low TDS/municipal sources
- Available in GRP or S/S
- Available in 500, 1,000 and 2,000L/hr
- 1,000 and 2,000L/hr GRP units come c/w filling station
- For all S/S versions, filling station to be ordered separately

Pro RO plants (Modpro)



- 3-Stage light commercial Reverse osmosis system with recoveries of up to 25%
- Modular assembly with corrosion proof plastic housing for ore-treatment and RO cartridges
- S/S frame
- Available for flow rates between 100 – 400L/hr
- Uses special Pentair RO membranes and prefilter cartridges

AERATION BLOWERS

Aeration Blowers

- **For Fe/Mn removal + use in WWTP aeration**
- **Airmac DBMX blowers** (replacement for Hiblow)
 - Operation curves/application similar to Hiblow
 - For use in small STPs and aeration systems for Fe/Mn removal + fish ponds
 - Noise levels: 35 - 46 dB
- **Mapro Blowers** – centrifugal blowers with vane type impellers used for air scouring in DUF design + various applications for aeration systems.
 - Preferable for short to medium operation duration.
 - Noise levels: 55 – 80dB
- **GTB Blowers** – heavy duty positive displacement blowers. Vertical configuration saves space and reduces vibration.
 - Noise levels: maximum 58 - 75dB



MOBILE/CONTAINERIZED SYSTEMS

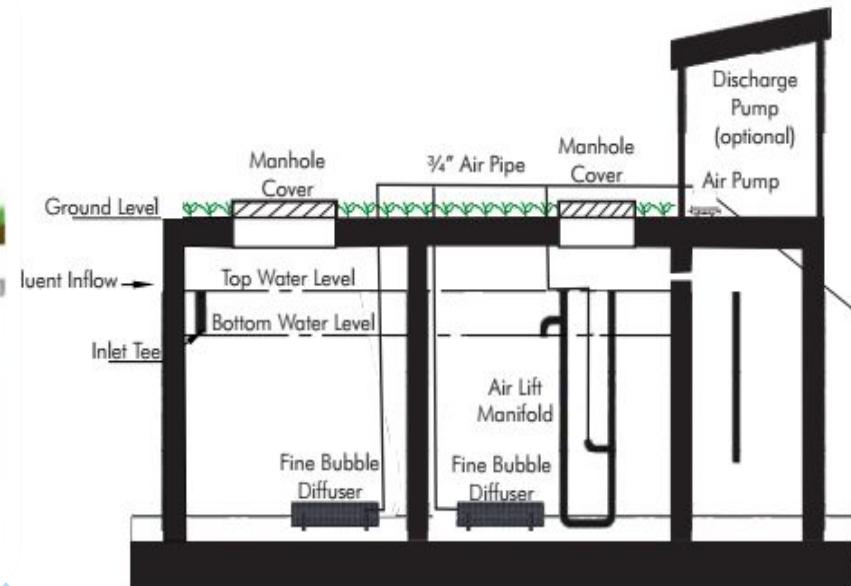
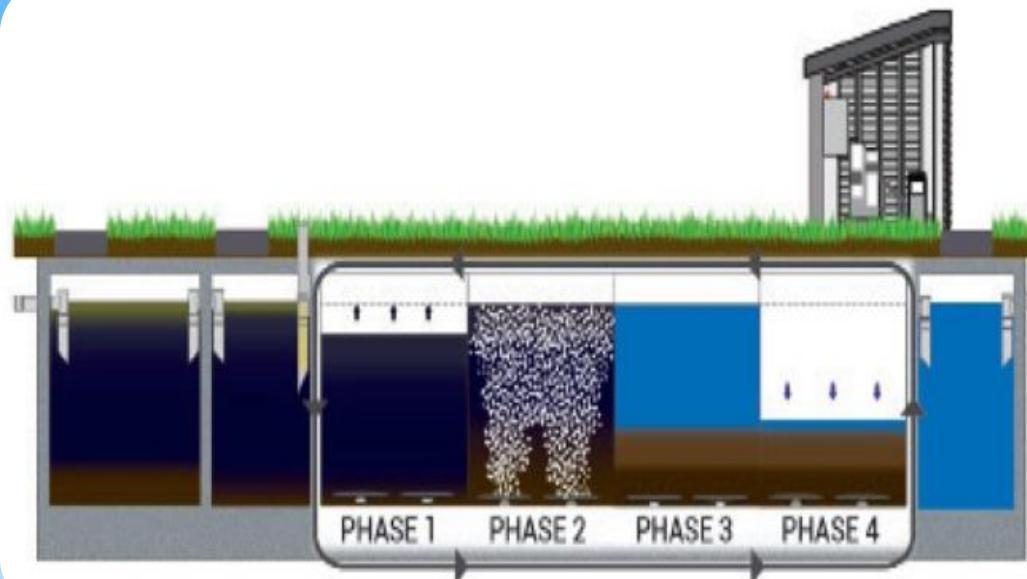
Mobile/Containerized Systems

- Combines various WT technologies for application in varied water sources
- Quick deployment for temporary/ emergency/ permanent applications
- Powered by portable diesel generator
- Optional trailer mounted/solar powered solutions available
- Rugged design engineered to survive heavy vibrations and resist corrosion



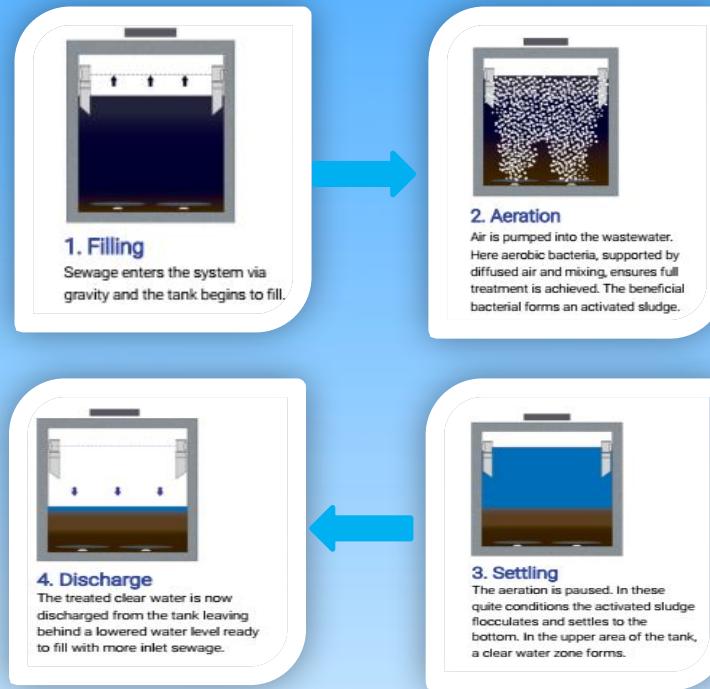
WASTEWATER TREATMENT (SEWAGE TREATMENT PLANT)

SBR/SBR Mini WWTP



- Bioliff SBR wastewater treatment plants use the Sequential Batch Reactor process.
- SBR process provides for full Carbon and Nitrogen removal - produces high quality effluent.
- SBR Process:
 - a) Primary Treatment
 - b) Secondary Treatment - Aeration, Biodegradation and Settlement and Storage

Biopure Compact WWTP

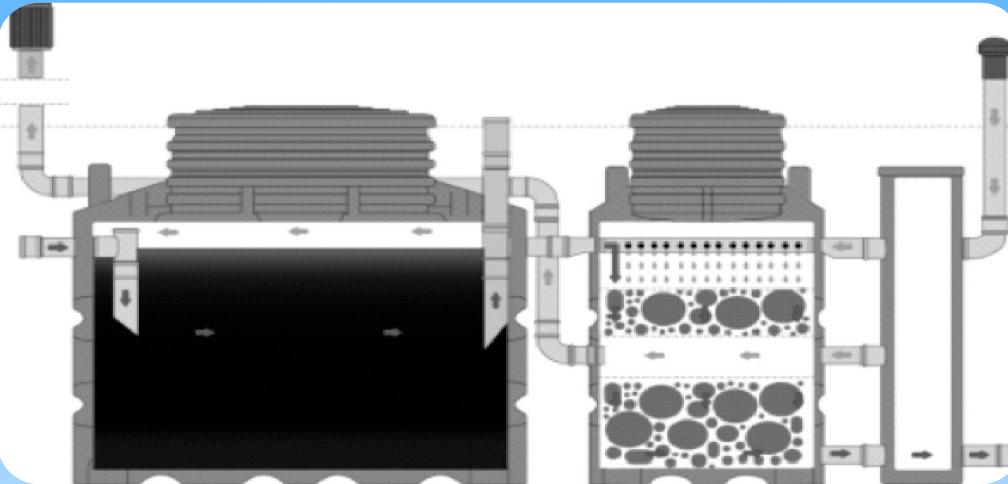


Features

- Low cost – minimal civil works (excavation, backfill and plumbing)
- Compact – low footprint
- Near silent energy efficient air pump connected to fine bubble diffuser
- Onsite sludge digestion – no need for exhausters

Model	6PE	10PE
Population Equivalent (PE)	6	10
Flow (m ³ /day)	0.9	1.5
Organic Loading (kg/BOD ₅ /day)	0.36	0.6
Nitrogen Loading (kg/NH ₃ /day)	0.05	0.1
Tank Dimensions - Diameter x Height (m)	1.6x2.1	2x2.1
Total Tank Volume (m ³)	3.3	5.2
Installed Power(Watts)	58	
Inlet	Invert level (mm)	600
	Pipe Size(mm)	110

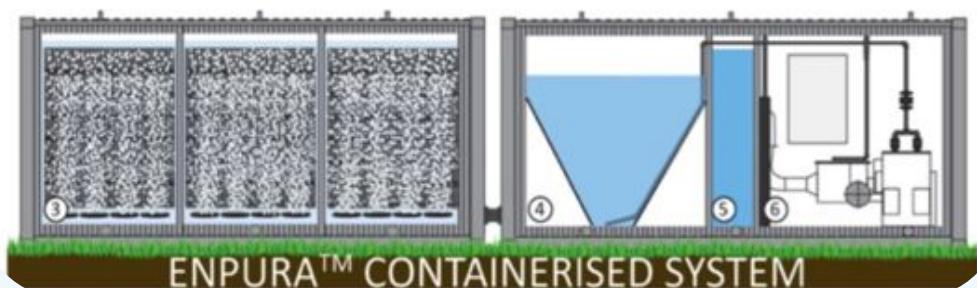
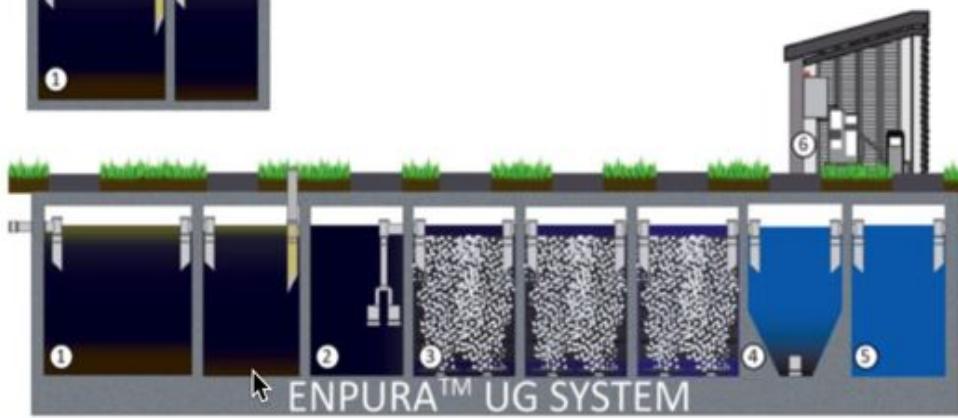
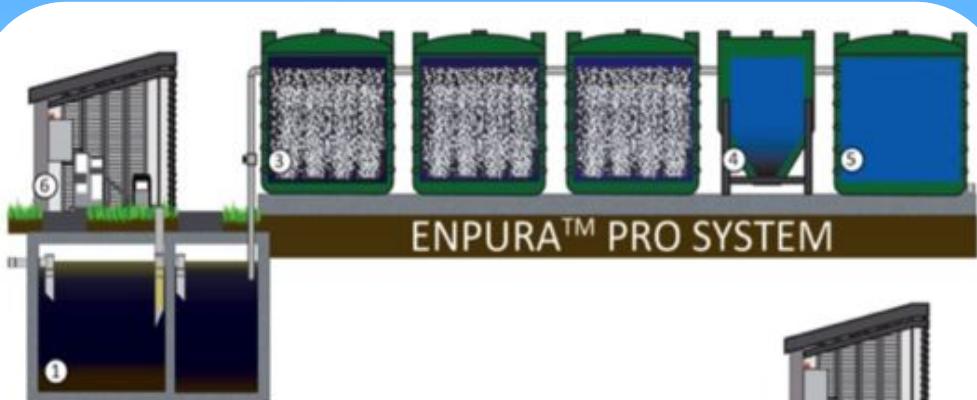
Biorock WWTP



- Revolutionary compact WWTP system.
- No need for power.
- No moving parts.
- Silent operation.
- Minimal maintenance.
- Ease of handling and installation
- Suitable for domestic applications and holiday homes



Enpura WWTP



- Highly Stable Fixed Film Technology
- Incredibly Versatile but also Simple
- Excellent process control
- Robust Process – Survives difficult conditions e.g. power cuts, flooding, toxic shock, poor design
- Low sludge wasting frequencies
- Quick delivery times - 1 month
- Modular configuration
- Customizable design
- Enpura Process: Primary Treatment
 - Buffer Tank
 - Aeration Reactor
 - Clarifier Tank
 - Storage Tank

DAYLIFF CHEMICALS

- **Standard Water Treatment Chemicals**
- **Genesys Antiscalant & Membrane Cleaners**
- **Kurita Boiler Chemicals**
- **Kurita Cooling Tower Chemicals**
- **HACH Equipment and Reagents**

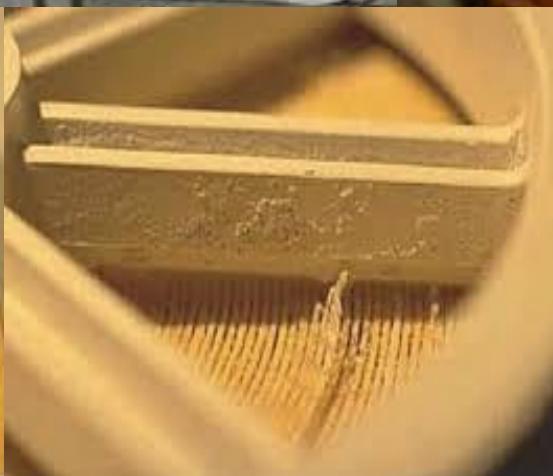
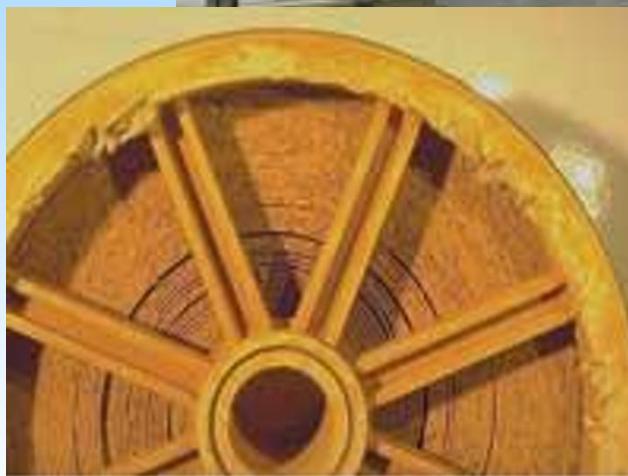
AREAS OF OPPORTUNITIES FOR CHEMICAL SALES



STANDARD WATER TREATMENT CHEMICALS

- Chlorine 65 – Disinfection comes in 5kg,20kg & 45kg
- Flocculants – Alum, Sudfloc, Genfloc GPF,
- Poly Aluminium Chloride (PAC) – Flocculant or Regenerant in Fluoride Removal.
- Caustic (NaOH)-...High pH Adjuster/CIP/ CEB
- Sodium-hypochlorite-...Liquid Chlorine conc. 10-5%L
- Sodium-Metabisulphite- Membrane preservation/ Dechlorination

Genesys Antiscalant and Membrane Cleaners



Genesys Anti-scalant and Membrane Cleaners

Antiscalant	Application
Genesys LF	RO systems with Broad Spectrum for brackish/seawater feed water
Genesys RC	RO systems with generally low Total Dissolved Solids
Genesys SI	RO Systems With High Silica Feedwater
Genesys BS	RO System With High Barium Sulphate Feedwater

Cleaners	Application
Genesol 37	Reverse Osmosis Low pH Membrane Cleaning- Strong acid
Genesol 38	Reverse Osmosis Low pH Membrane Cleaning
Genesys 704	Reverse Osmosis High pH Membrane Cleaning - Microbubble technology
Genesys 703	Reverse Osmosis High pH Membrane Cleaning

ANTI-SCALANT DOSING

NOTE: *It is recommended to use a DDE 6-10 without dilution with water.*
If dilution is necessary, use treated water with the recommended ratios

Recommended Product

Genesys LF

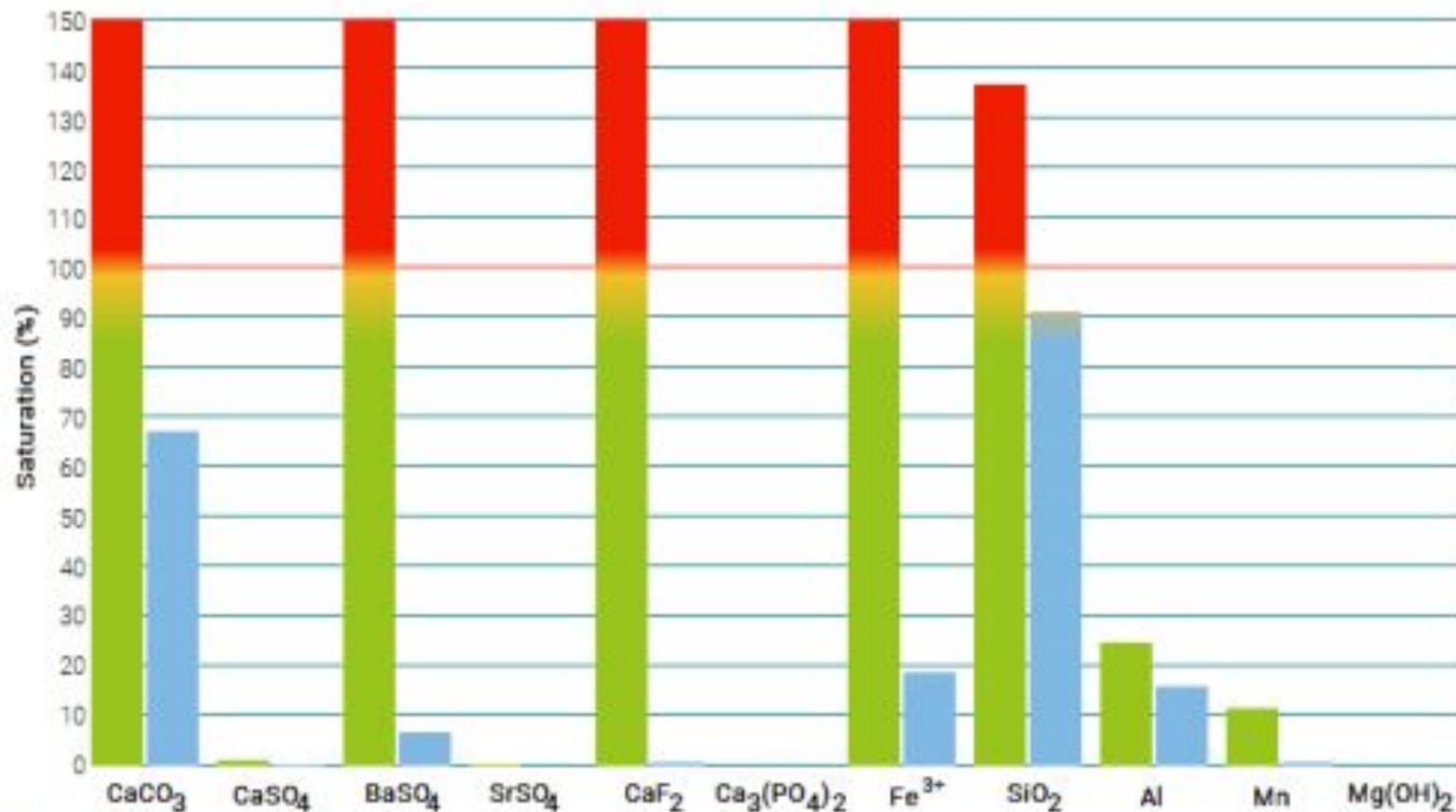
Dosing Data

For Scale Control - Feed	5.10 mg/l
For Iron Control - Feed	0.69 mg/l
Total Dosage	5.79 mg/l
Dose In Concentrate	19.31 mg/l
Set Dosing Pump To	15.32 ml/hr
Daily Requirement	0.50 kg /day

Acid Dosing

Acid dosing is not required.

Saturation Graph



Recommended Product

Genesys RC

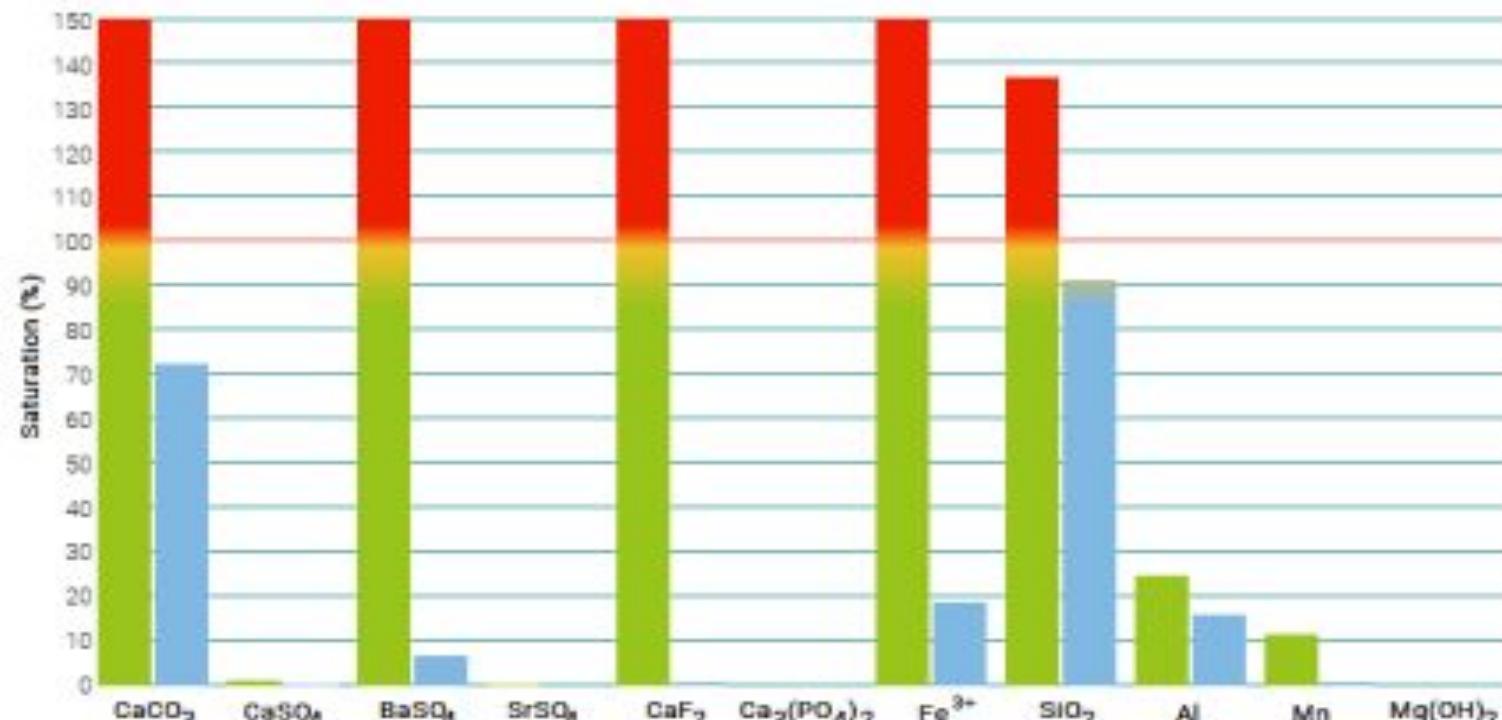
Dosing Data

For Scale Control - Feed	14.29 mg/l
For Iron Control - Feed	1.93 mg/l
Total Dosage	16.22 mg/l
Dose In Concentrate	54.06 mg/l
Set Dosing Pump To	52.65 ml/hr
Daily Requirement	1.39 kg/day

Acid Dosing

Acid dosing is not required.

Saturation Graph

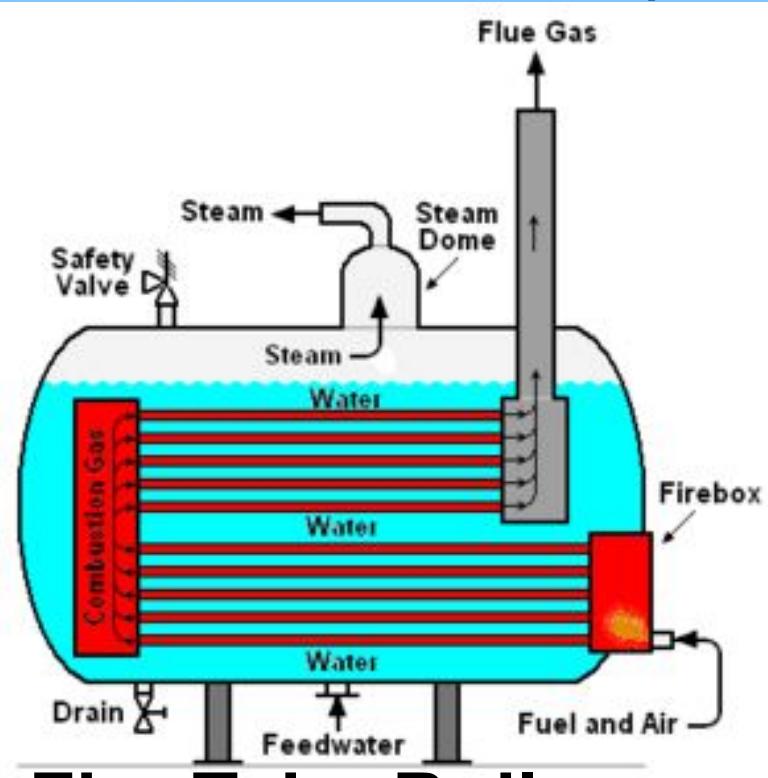


Scaling Indices

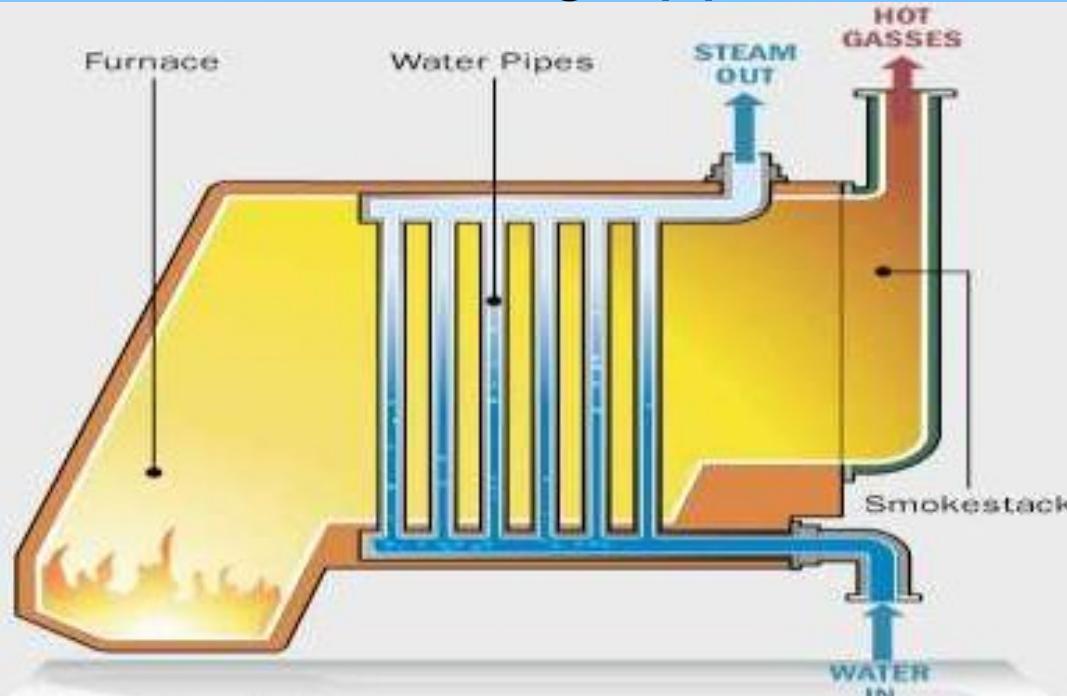
	CaCO ₃	CaSO ₄	BaSO ₄	SrSO ₄	CaF ₂	Ca ₃ (PO ₄) ₂	Fe(OH) ₃	SiO ₂	Al(OH) ₃	Mn	Mg(OH) ₂
Conc. Untreated	162.87	1.13	330.28	0.22	212.97	0.00	282.59	136.98	24.91	11.77	0.04
Conc. Treat.	72.54	0.40	6.61	0.02	0.61	0.00	18.84	91.32	16.17	0.78	0.00

Kurita Boiler Chemicals

A boiler is a closed vessel in which fluid (water) is heated. The heated or vaporized fluid exits the boiler for use in various processes or heating applications



Fire Tube Boiler



Water Tube Boiler

Challenges in a boiler

1. Corrosion- Weak acid formation corrodes boiler tubes and condensate line-**High pH Corrosion Inhibitor**
2. Corrosion caused by presence of dissolved oxygen in boiler feed water-**Oxygen scavenger/Dearators.**
3. Scaling caused by heavy metal compounds(Ca/Mg/Fe)
- Scale inhibitors.

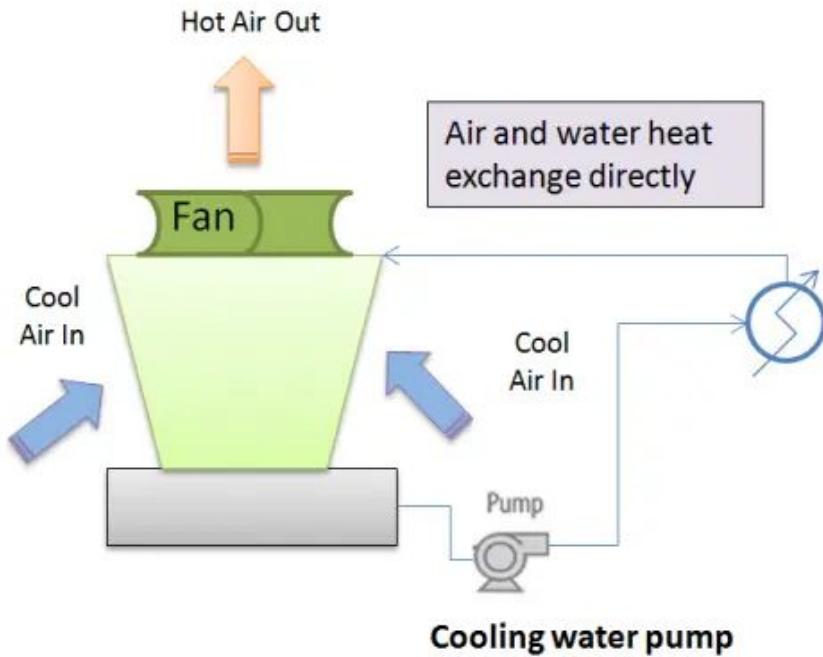


BOILER CHEMICAL CETAMINE G818

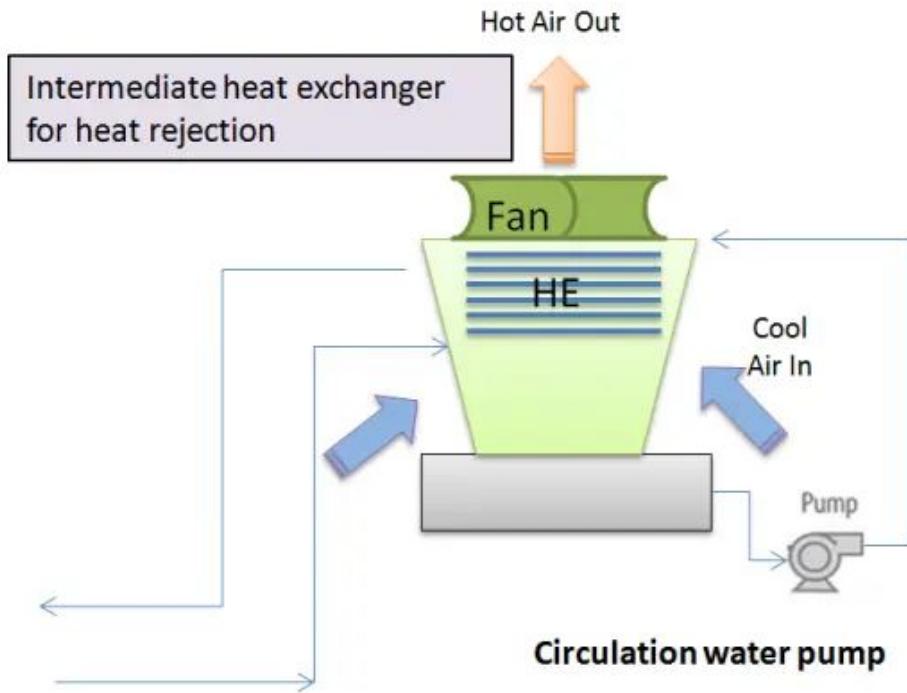
- Prevents/removes existing scales- Contains DReeM polymer; Dispersion & removal of heavy scales
- Prevents Corrosion- Contains film-forming amines that coats boiler surfaces.
- Prevents Acidic corrosion- Contains Alkalizing amines; neutralizes acidic gases (CO_2 , SO_2 , SO_3).

TYPES OF COOLING TOWER

Cooling Tower



Open Loop



Closed loop

COOLING TOWER CHEMICALS

Product	Application
Aktiphos 6300 /Ferrofos 8549	Corrosion and scale Inhibitor for Open Cooling water
Korrodex 8577	Corrosion Inhibitor for closed systems
Ferrocid 8585	Biocide for cooling and process water system
Kurita F-5106	Biocide for cooling and process water system
Kuriverter IK 110	Biofilm control agent for membrane systems(In-line)

Challenges in Cooling Towers/Chillers

1. Scale build up-Scale Inhibitor(Silica, Heavy metals)
2. Corrosion- high/low pH, High Chloride levels.
3. Biofouling from bacteria, algae or other micro organisms- Biocides.





Equipment

❖ Laboratories and Test kits



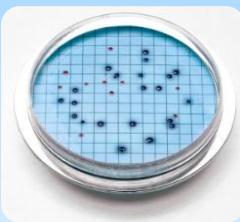
❖ Portable Field





Reagents

- ◆ Physiochemical tests
- ◆ Bacteriological tests
- ◆ Wastewater tests – BOD, COD, Total Nitrogen and Total Organics.
- ◆ Heavy Metals - Arsenic & Chromium
- ◆ Standard solutions



THANK YOU