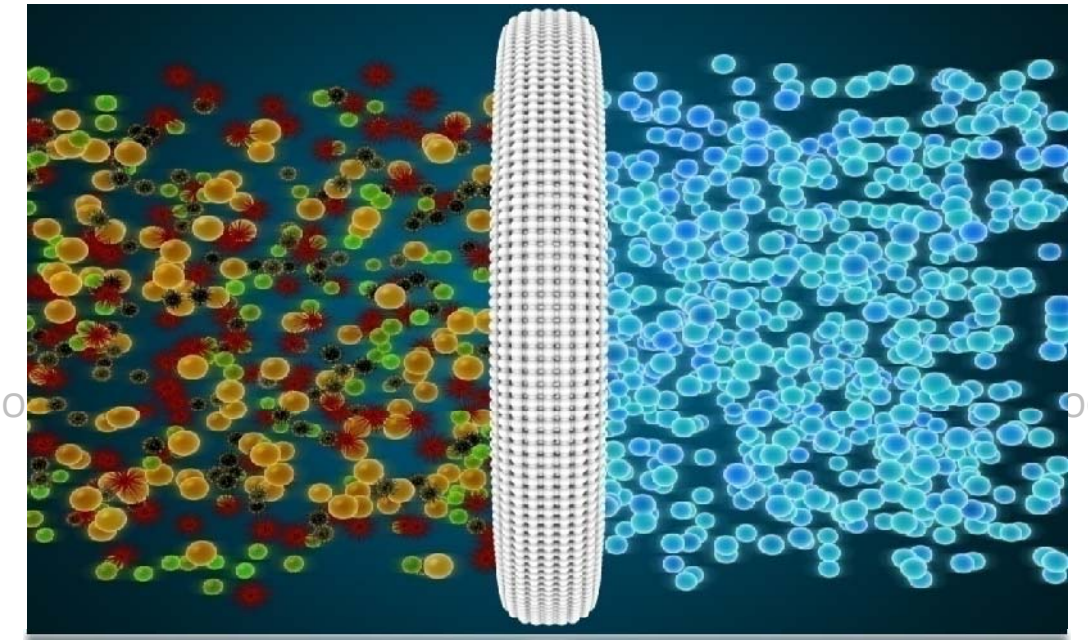
Shubham™
transformative ideas



A Brief about Reverse Osmosis & Ultrafiltration !!

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Shubham is in the business of making this planet water secure…….

Shubham Inc. is the leading EPC contractor of Water and Sewage Water Treatment Plants. We use the best-in-class technology and cutting-edge tools to foster high-quality, sustainable, community-level water supply projects.

We design, engineer, and deliver the most innovative, cost-effective solutions for managing your most challenging water woes!

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Product Portfolio

Membrane and separation

- Reverse Osmosis Plant
- UF Plants

Media Filters

- Activated Carbon Filters
- Dual Media Filters
- Multigrade Filters
- Pressure Sand Filters
- Side Stream Filters

ION exchange

- DM Plants
- Softening Plants
- Mixed Bed units

Waste Water Treatment

- Septic Tanks
- Sewage Treatment Plants [Civil & Modular]
- Bio Accelerator 360°™
- Electra Rapid™
- Bio Memclean™
- Bio Synthesis
- Effluent Treatment Plant (ETP)
- Grey Water Treatment (GWT)
- Laundry Water treatment

- Swimming Pool
- Operation & Maintenance

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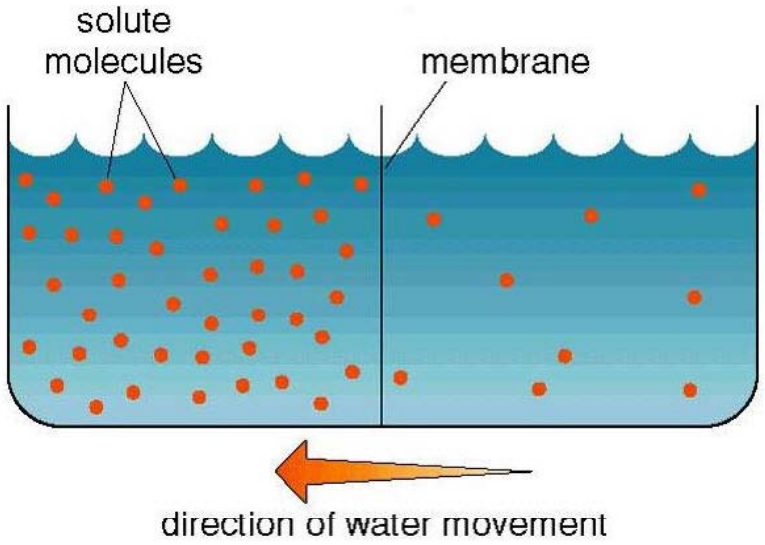
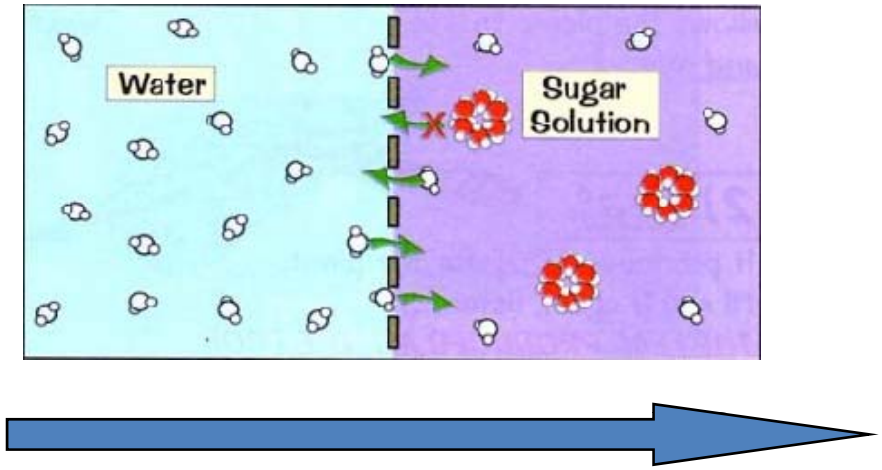
- Osmosis is a natural phenomenon that provides water to all animal and vegetable cells to support life
- Water moves from a high concentration of water (less sugar/salt dissolved in it) to a low concentration of water (more salt/sugar dissolved in it) across a semi-permeable membrane
- This means that water can cross a selectively permeable membrane from a dilute solution (less dissolved in it) to a concentrated solution (more dissolved in it)





▪Net Movement of Water Mol A semi-permeable membrane is a membrane which will allow only certain molecules or ions to pass through

- Osmosis is very important in biology as it provides the primary means by which water is transported in and out of cellsecules

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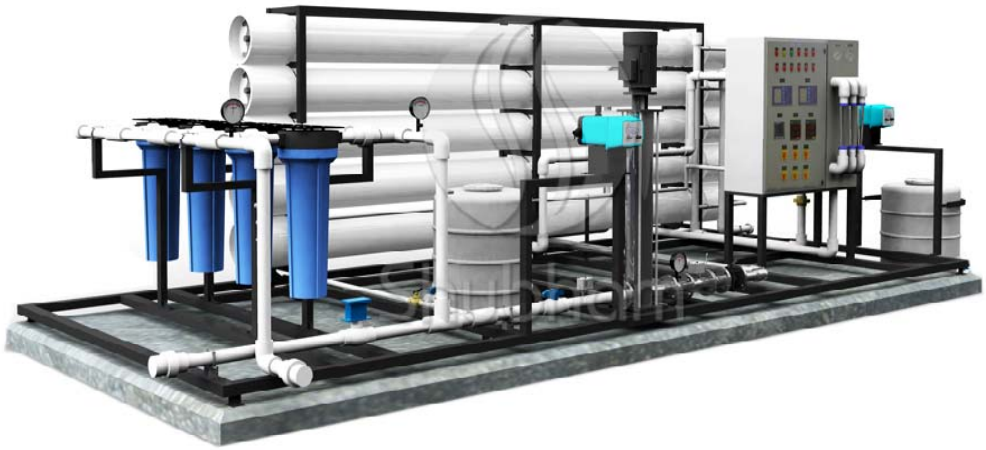
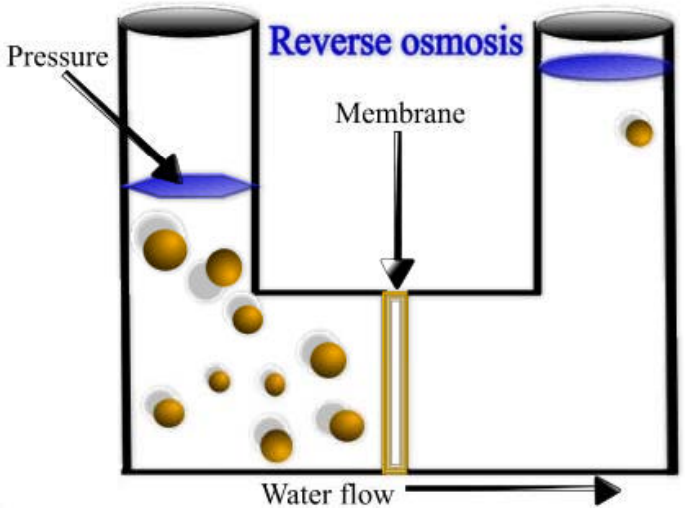


- RO is a form of filtration using osmosis in reverse
- Water passes from a more concentrated solution to a less concentrated solution
- To accomplish this a force or pressure MUST be applied

- RO is used to remove dissolved solids from water but it can also improve taste, odor & color of water
- RO membranes have the capability to remove particles as small as ions i.e. magnesium ions or sodium ions
- RO membrane will reject most compounds based largely on size
- Dissolved ions, such as salts, carry an electric charge and will also be rejected by membrane

- Feed water flows into RO unit with the force of line pressure
- Water is forced through membrane by cross flow filtration
- Cross flow filtration is most commonly used in RO as it allows membrane to continually clean itself
- Membrane then either rejects or repels contaminants
- Two exit streams generated: waste & product stream
- Waste stream consists of: A concentrate (reject) stream which carries contaminants (compounds too large to pass through membrane)
- Permeate stream consists of: Product water which has been forced through the membrane & is virtually free of TDS

PNID or Process flow chart



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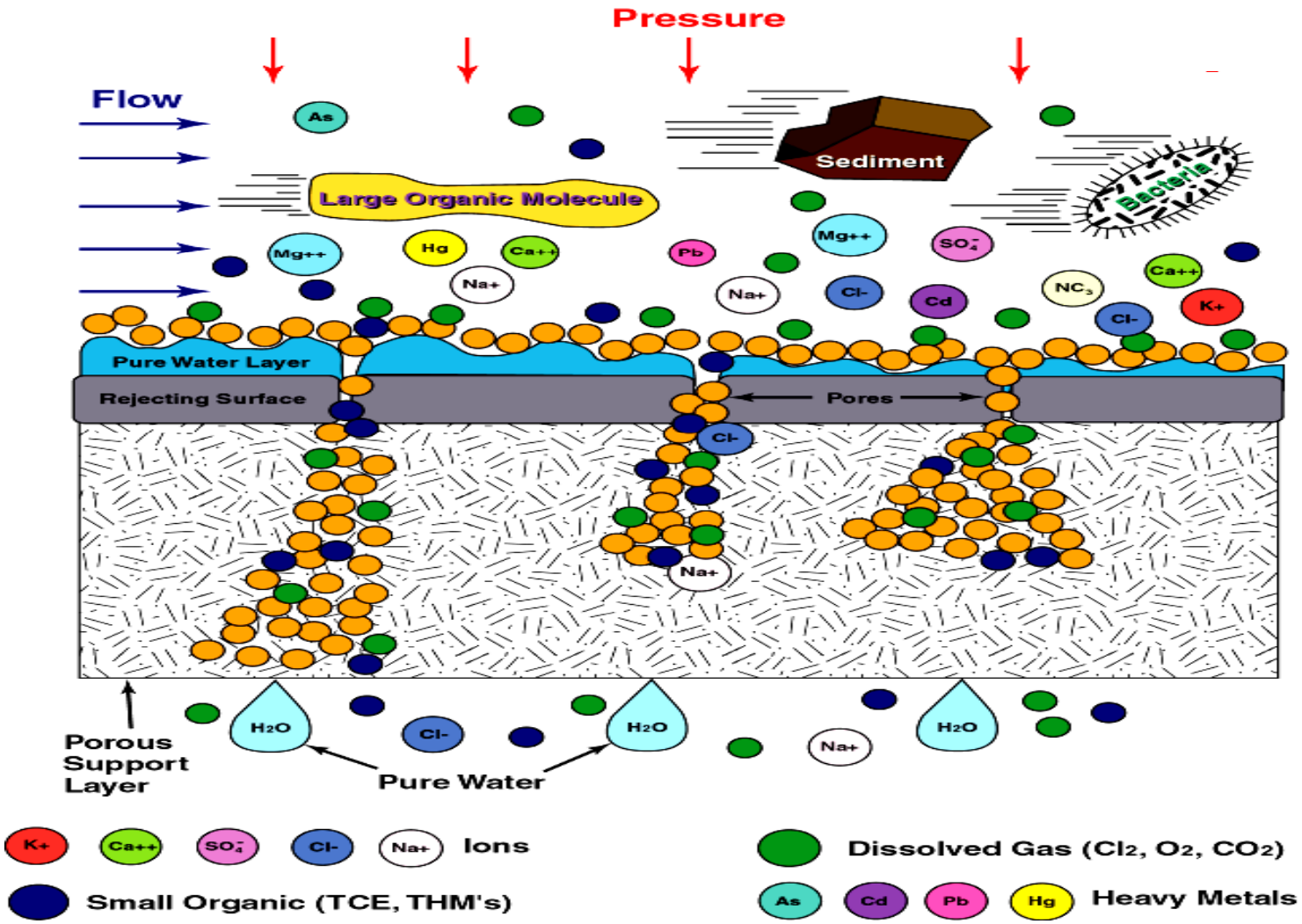
Pressure
Flow
As
Large Organic Molecule
Sediment
Bacteria
Mg++
Hg
Ca++
Na+
Pb
Mg++
SO4
Cl-
Cd
NC3
Ca++
K+
Cl-
Pure Water Layer
Rejecting Surface
Pores
Cl-
Na+
H2O
Cl-
H2O
Na+
H2O
Porous Support Layer
Pure Water
K+
Ca++
SO4
Cl-
Na+
Ions
Small Organic (TCE, THM's)
Dissolved Gas (Cl2, O2, CO2)
As
Cd
Pb
Hg
Heavy Metals

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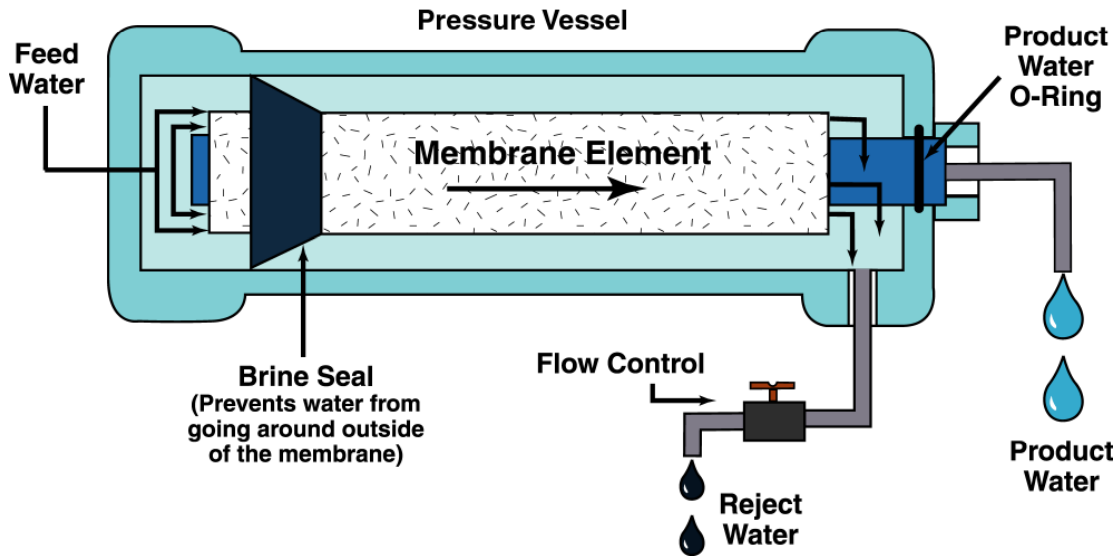

FEED WATER	Main flow of impure water to be treated
PRODUCT WATER	Portion of feed water which passes through membrane as permeate
REJECT WATER:	Portion of feed water which did not pass through membrane; carries impurities to drain
MODULE	Combination of spiral round membrane element & pressure vessel

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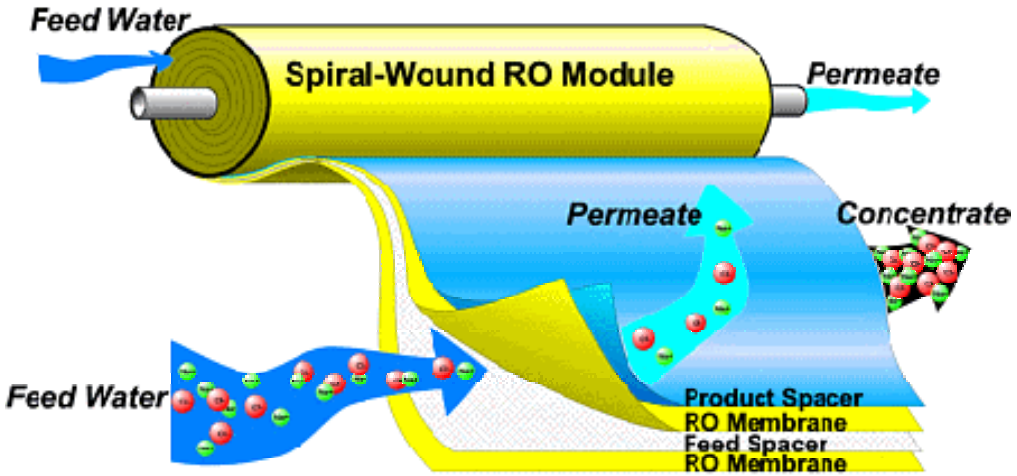

Thin Film Composite Membrane (TFC)

- RO membrane is a method of fine filtration but much smaller
- Membrane consists of tiny pores which are approximately 0.0005 microns in size
- THEREFORE reverse osmosis membranes are capable of rejecting contaminants as small as 0.0001 to 0.00001 microns

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- Membrane is the work-horse of an reverse osmosis system
- When choosing an RO system you must do so wisely – taking into account water quality is very important
- Three main types of membranes:

CTA membrane: Cellulose acetate/triacetate blend

- Provides lowest cost per gallon of water
- Resists chlorine but has a lower flow rate limit in applications of high water consumptio

TFC membrane: Thin film/thin layer composite

- Can handle high flow, has a high rejection rate & can handle high water consumption
- Cannot handle chlorine concentrations; water must be carbon pre-filtered

- Water Temperature: RO system ratings are based on 77^0F/ 25^0C water temperature
- i.e. : RO system rated at 20 GPD (gallons per day) at 34^0F/1^0C will only produce 6 GPD
- Feed Water Pressure: A lack in water pressure (less than 40 PSI) will reduce product water; this can be helped with the aid of a booster pump
- Contaminants in Feed Water: Large particles, iron concentration or high levels of hardness in feed water can cause clogging of the membrane Clogging of the membrane can decrease its life
- Microorganisms: RO membranes can filter out bacteria, depending on the bacteria size, however this may cause fouling of the membrane as bacteria can begin to grow through pores of membrane causing
- BACTERIA CREEP – RO systems should not be installed on non-potable water

Feedwater Temp ° F	TDS ppm	Feed Pressure (psi) 30	40	50	60	70	
40	**50**	7.06	9.70	12.05	14.41	17.05	19.40
	250	6.76	9.11	11.47	14.11	16.46	18.82
	500	6.17	8.53	10.88	13.52	15.88	18.23
	750	5.59	7.94	10.29	12.94	15.29	17.64
	1000	5.00	7.35	9.70	12.05	14.70	17.05
	1500	3.53	6.17	8.53	10.88	13.52	15.88
	2000	2.35	5.00	7.35	9.70	12.05	14.70
45	**50**	8.53	11.47	14.41	17.35	19.99	22.93
	250	7.94	10.88	13.82	16.76	19.70	22.34
	500	7.35	10.00	12.94	15.88	18.82	21.76
	750	6.47	9.41	12.35	15.29	18.23	20.87
	1000	5.88	8.82	11.47	14.41	17.35	20.29
	1500	4.41	7.35	10.00	12.94	15.88	18.82
	2000	2.94	5.88	8.82	11.47	14.41	17.35
50	**50**	10.00	13.23	16.46	19.99	23.23	26.75
	250	9.11	12.64	15.88	19.40	22.64	25.87
	500	8.53	11.76	14.99	18.52	21.76	25.28
	750	7.64	10.88	14.11	17.64	20.87	24.40
	1000	6.76	10.00	13.52	16.76	19.99	23.52
	1500	5.00	8.53	11.76	14.99	18.52	21.76
	2000	3.23	6.76	10.00	13.52	16.76	19.99

- Dissolved solids = TDS (salts & minerals) – UP TO 2000 ppm
- Most Heavy metals (lead, mercury, silver)
- Most radioactive elements
- RO systems may **not** be capable of removing nitrates to recommended levels

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Typical Rejection Range		
Inorganic Contaminant	RO System-CTA (No postfilter)	RO System-TFC (No postfilter)
Aluminum	85-95%	88-98%
Arsenic III	30-50%	50-70%
Arsenic V	70-90%	80-95%
Barium	80-90%	85-95%
Cadmium	75-90%	85-95%
Calcium	85-95%	88-98%
Chloride	80-90%	83-95%
Chromium III	85-95%	88-98%
Copper	85-95%	88-98%
Fluoride	80-90%	83-95%
Iron	85-95%	88-98%
Lead	85-95%	88-98%
Magnesium	85-95%	88-98%
Manganese	85-95%	88-98%
Mercury II	50-70%	60-80%
Nitrate	30-50%	80-90%
Potassium	80-90%	83-95%
Selenium IV	80-90%	83-95%
Silver	75-85%	88-98%
Sodium	80-90%	83-95%
Strontium	85-95%	88-98%
Sulfate	85-95%	88-98%
Zinc	85-95%	88-98%
Total Dissolved Solids	85-95%	88-98%
Asbestos	>99%	>99%
Organic Contaminant		
Endrin	>85%	>90%
Methoxychlor	>80%	>90%
Lindane	>30%	>40%
PCB	>80%	>90%

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- RO systems will remove up to 97% (depending on parameters) of salts in water bringing it closer to a level of 'pure water'
- The purer the water, the more aggressive it will be with materials it comes in contact with
- THEREFORE RO can be slightly corrosive
- It's recommended NEVER to use copper piping on RO water

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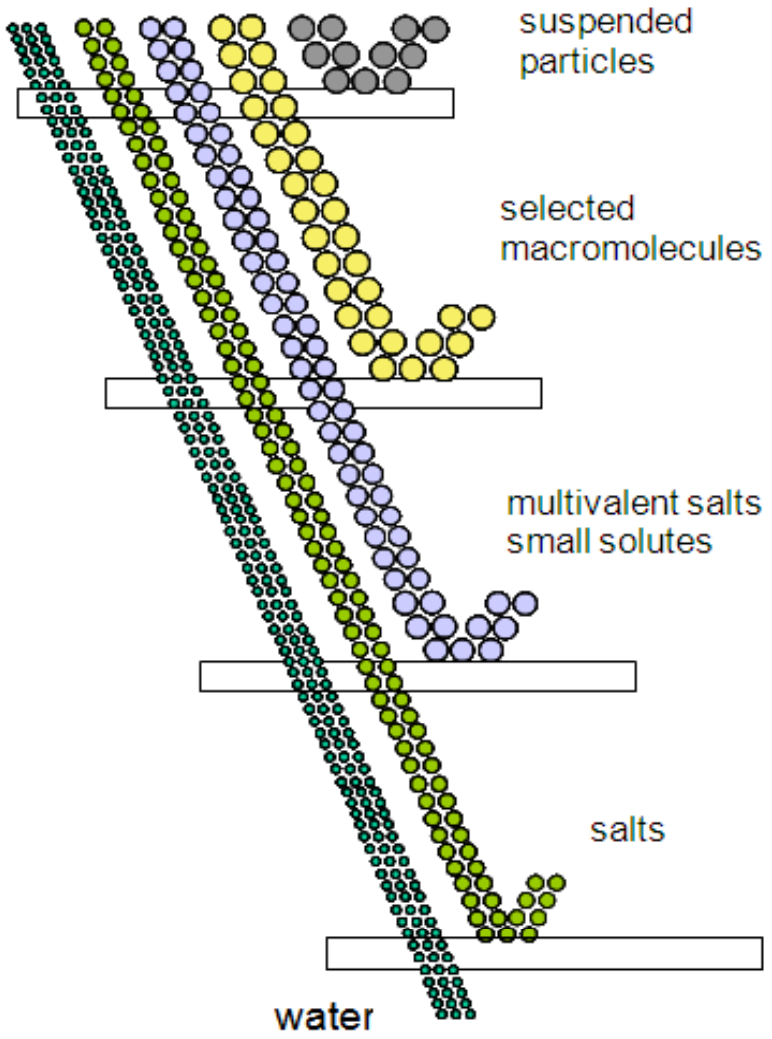
	ED	MF	UF	NF	RO
Retained	Water, TSS, microbes uncharged molecules	Larger particles	Larger molecules	Higher charged ions	almost everything
Transported	Dissolved salts	Dissolved salts, small particles	Small molecules and ions	Mono-valent ions, small molecules	Very small uncharged molecules

MF	0.1 - 3 bar 0.1 - 5 µm
UF	2 - 10 bar 20 nm - 0.1 µm
NF	5 - 30 bar » 1 nm
RO	10 - 100 bar 0.1 - 1 nm (close)



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Ultrafiltration

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- Primarily a concentration process
- Pumping energy is required to force liquid through the membrane
- Relatively large size particles (MW 10000 – 40000<) are retained and concentrated
- Potential use in the recycling of metal containing alkaline cleaner wastes and paints (concentrate)
- Reduction of metals in industrial wastes

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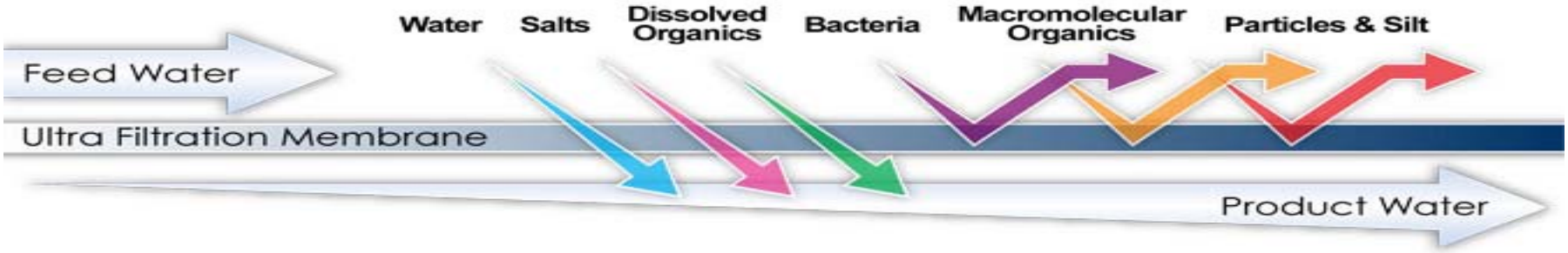
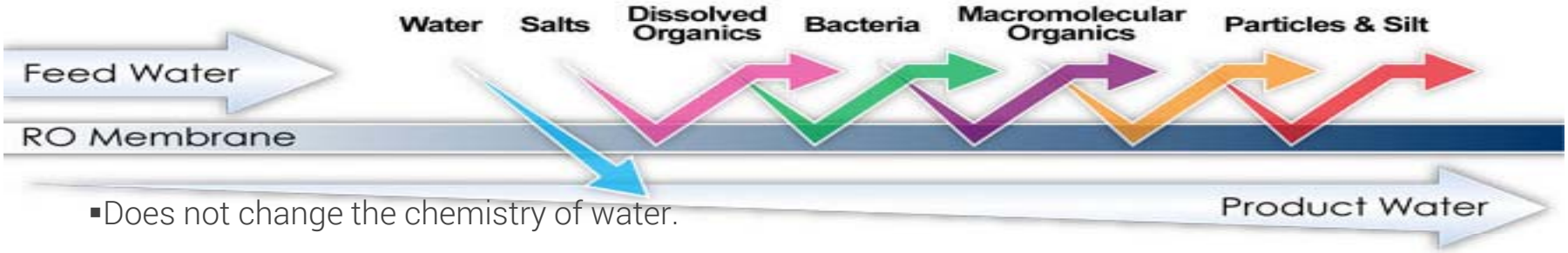
UltraFiltration

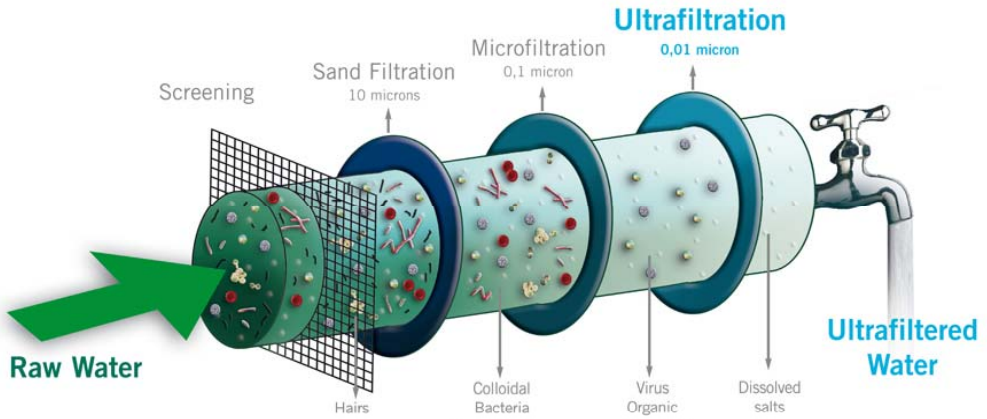


Reverse Osmosis



- Does not change the chemistry of water.
- For example to obtain potable water from surface water, which is chemically clean, but contains algea and bacteria, UF can be used.
- Same water quality with coagulation / flocculaltion → Removes turbidity
- UF removes larger organics, colloids, bacteria while allowing most ions and small organics to permeate the porous structure.
- Larger pore size → Requires much lower differential operating pressure.

- Cross flow or transverse flow
- Any membrane configuration
- Use re-circulation for high TSS
- Operating pressures ~ 50 psi
- Uses back flush to loosen fouling
- Excellent pretreatment for RO or
- Post treatment for ED



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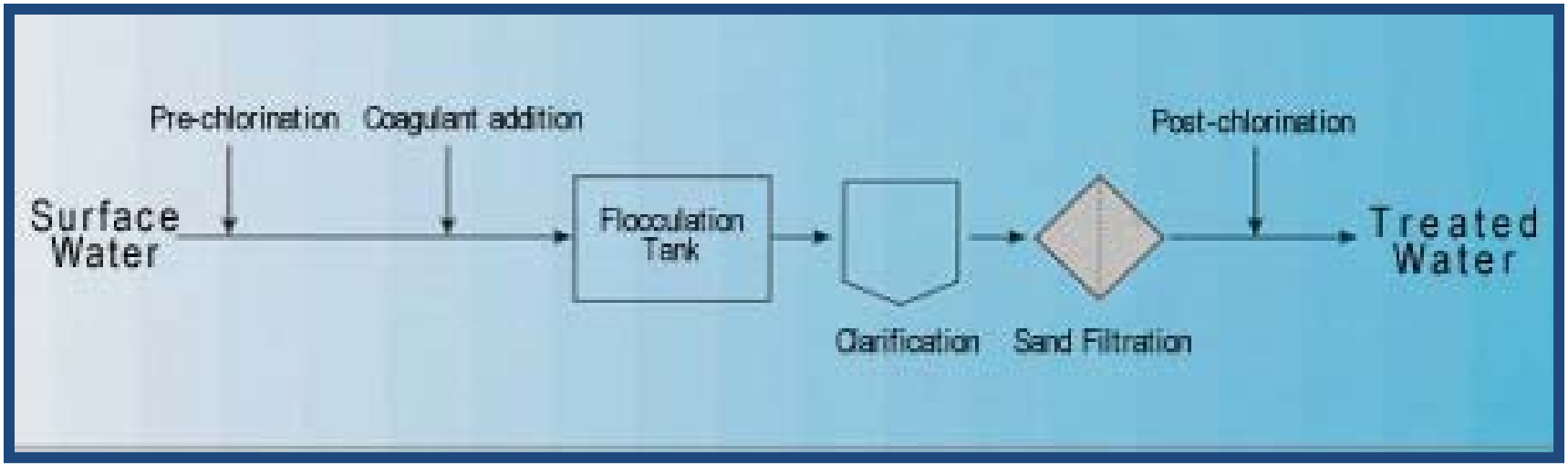
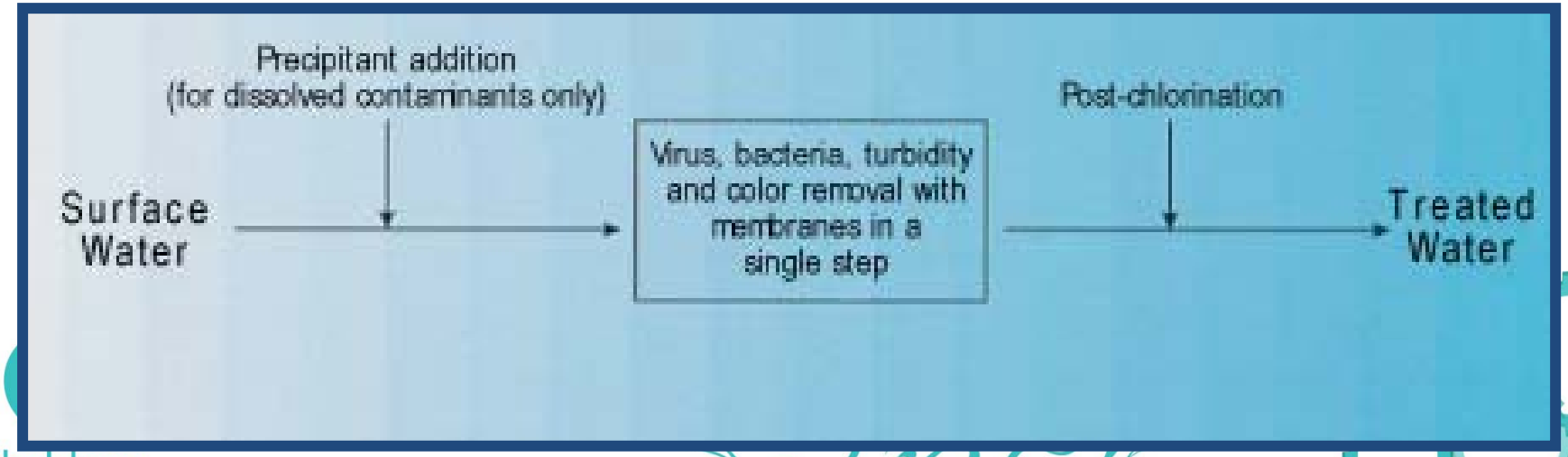
UF can replace several conventional processes





May be considered as pre-treatment before R/O to prevent clogging of membranes.

Applications in industrial wastes:

- Metal industry → Seperation of water-oil emulsions
- Automotive painting industry → to seperate dye from washing water
- Pharmaceutical industry → Seperation of enzymes
- Food industry → Cheese waste

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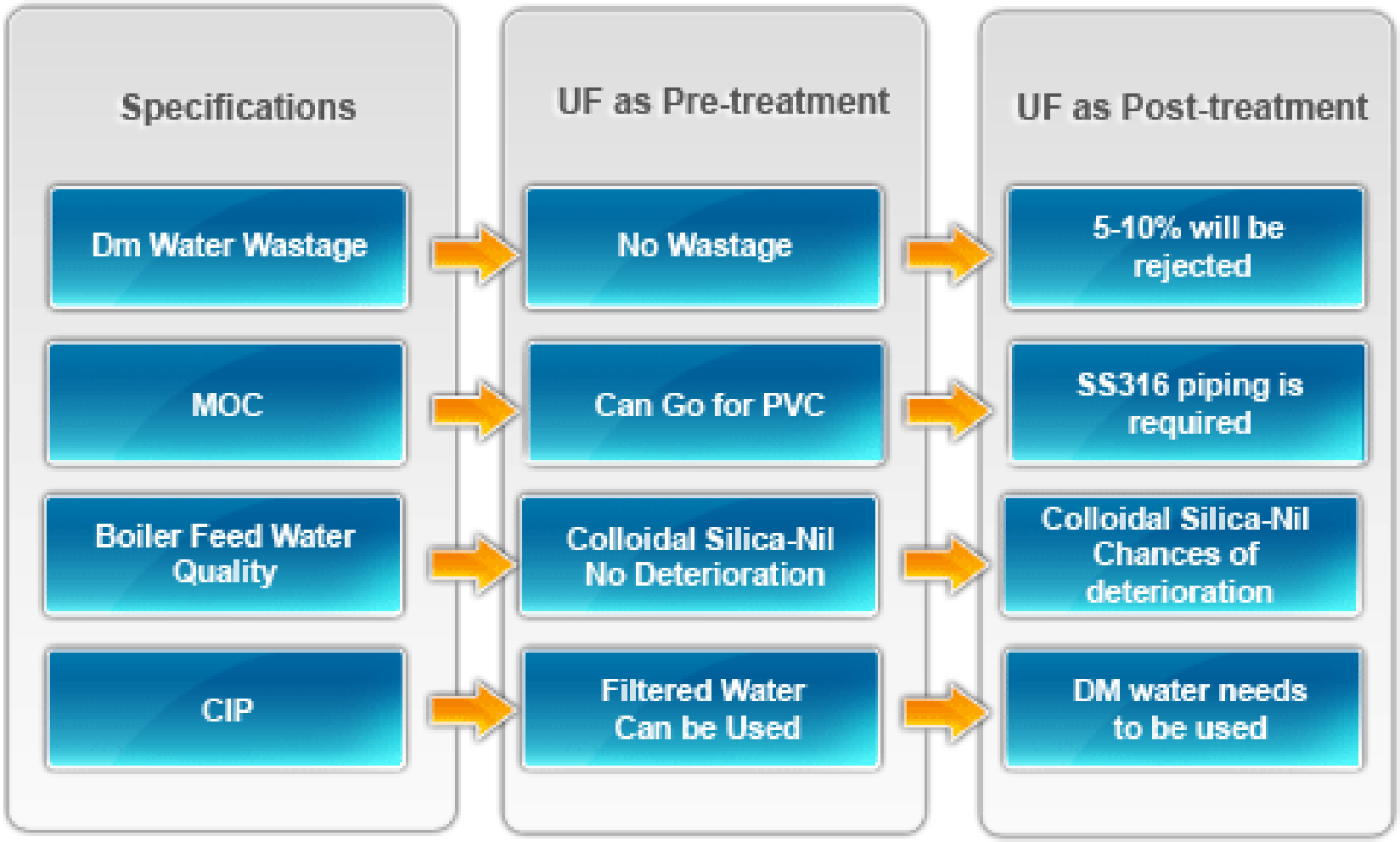
UF as Pre or Post Treatment ?



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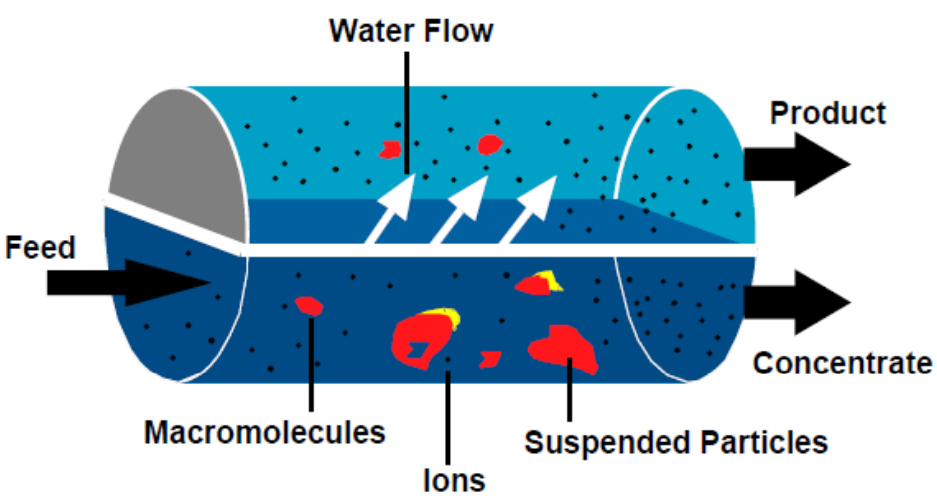
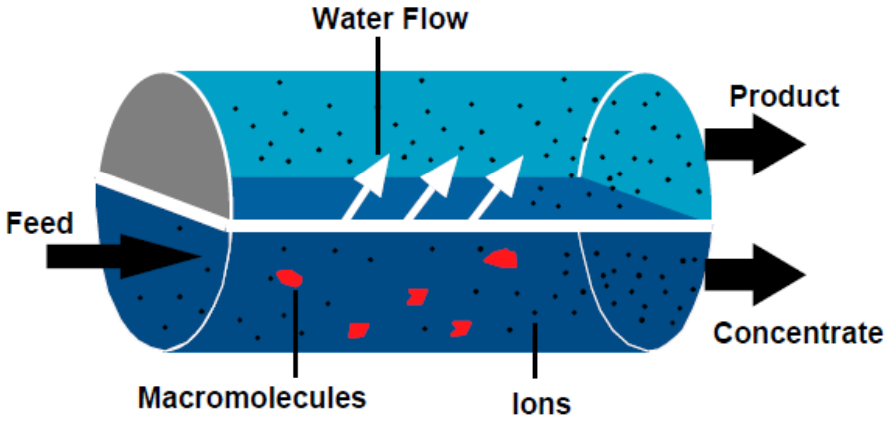
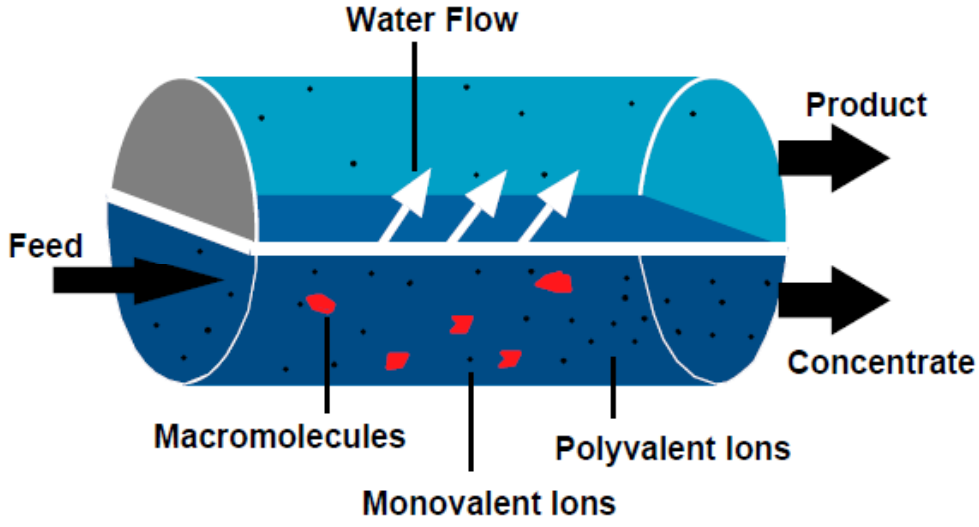
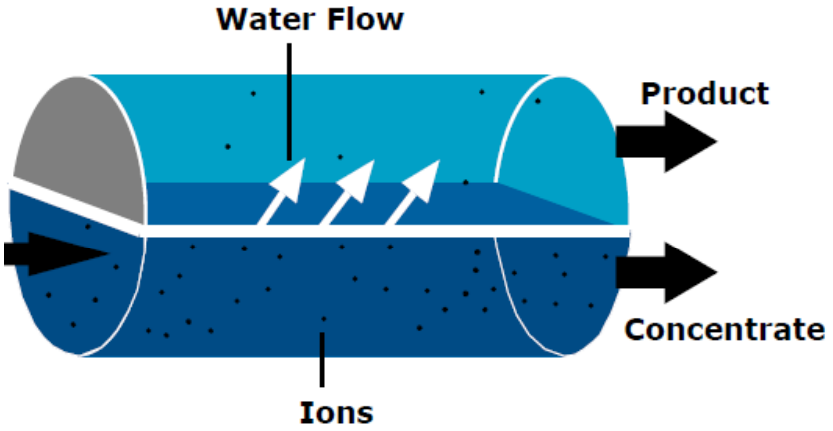

Water Flow
Product
Feed
Concentrate
Macromolecules
Ions
Suspended Particles


Water Flow
Product
Feed
Concentrate
Macromolecules
Ions


Water Flow
Product
Feed
Concentrate
Macromolecules
Polyvalent Ions
Monovalent Ions


Water Flow
Product
Concentrate
Ions

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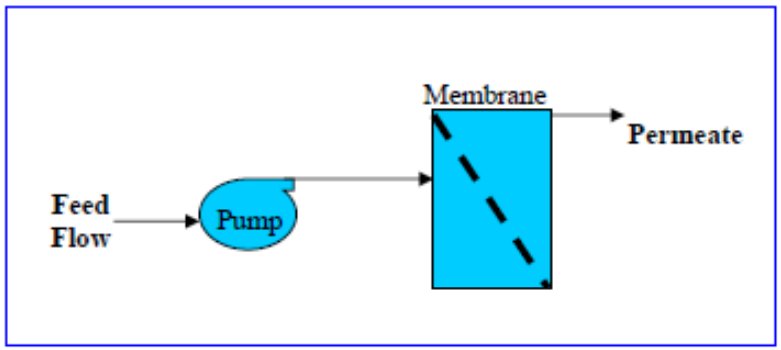
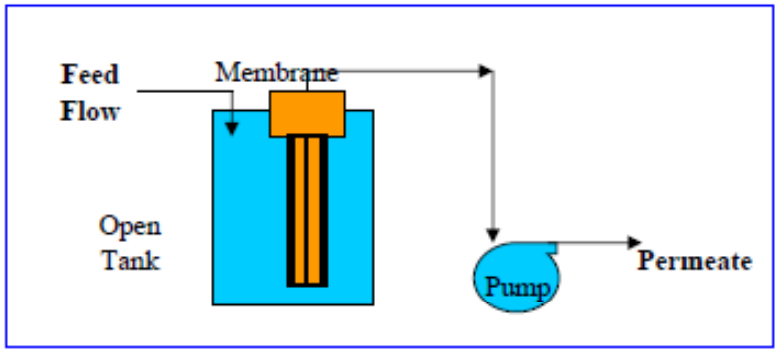
There are two basic UF configurations:



– **Pressurized**

Hollow fiber modules where water is forced either into or out of the lumen under pressure



– **Submerged (or Immersed)**

Hollow fiber configurations where water is pulled into the fiber lumen by suction

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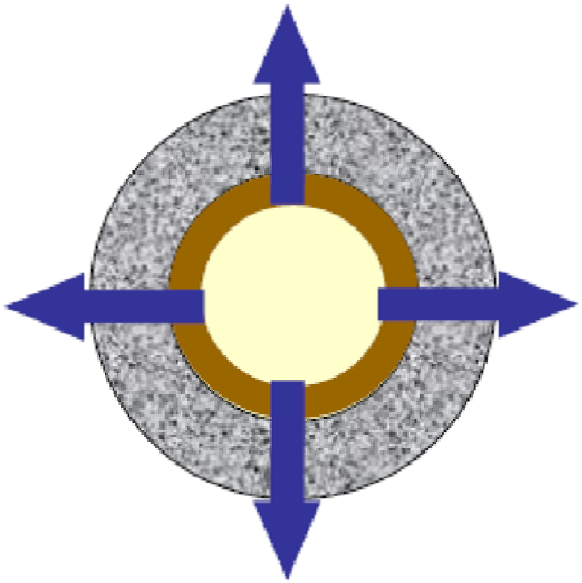
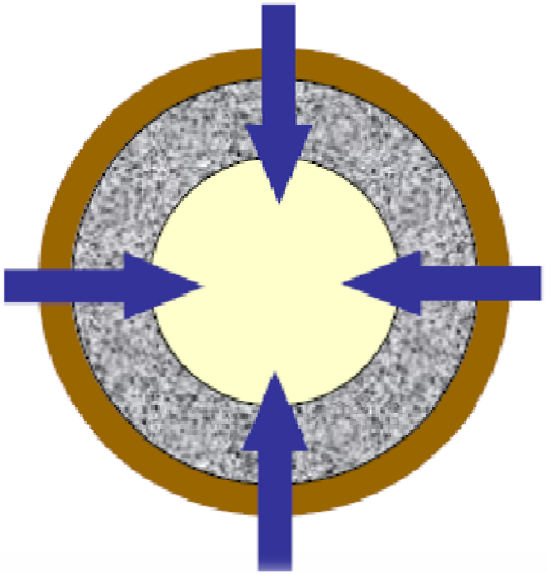
Inside-Out versus Outside-In filtration



Inside / Out

Outside / In



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Sl.No	Operation Sequence	Ground water	Jal Board	Surface water	Treated wastewater
1	Filtration	Yes	Yes	Yes	Yes
2	Forward Flush	Not requried	Not requried	Not requried	Yes
3	Backward Flush	Yes	Yes	Yes	Yes
4	CEB	Not Required	Optional	Optional	Yes
5	Forward Rinse	Not Required	Optional	Optional	Yes
6	Air Scouring	Optional	Optional	Optional	Yes

Time Settings - for STP/ETP Waste Water	
T= 0	Start of Filtration
T= 0-9.5	Filtration
T=9.5- 9.75	FWD Flush
T=9.75-19.25	Filtration
T= 19.25-19.50	FWD Flush
T=19.5 - 29	Filtration
T=29 - 30	Backwash with Permeale

Synopsis of time every cycle	
Cycle Time	30 Min
No of cycles/Day	44
Eff filtration time /Cycle , min	28.5
Effective B/w time / cycle, min	1
Effective FWD flush / Cycle, min	0.5

Synopsis of time every day	
Eff filtration time /day , min	1254
Effective B/w time / day, min	44
Effective FWD flush / day, min	22

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