Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

FREE DRINKING WATER PROVIDED

In our institution, the drinking water has been purified by modern treatment technology using Filtration, Ion exchange and Reverse osmosis.

Filtration

Filtration is a process of separating two substances of two different physical states. It separates solids from turbid liquids (filtrate), pure gases or solids. Filtration is classified in two ways based on the principle of operation as follows (Fig1).

1. Dead end filtration

2. Tangential Flow Filtration

In Dead-end filtration, all the flows are directed through the membrane, with material building up on the surface of the filter. As these particles build-up, flow through the filter is quickly reduced, and finally, it ceases completely. In tangential flow filtration, the flows are directed across the membrane surface. This sweeping action helps to keep the retained material from settling on the membrane surface and thus will help the membrane to perform effectively for long periods. They are so-called depth filters whose effectiveness is influenced by the whole complex of the following characteristics: mechanical retention of particles, absorbability, pH values, surface quality, thickness and strength of the filter paper and the shape, density and quantity of particles to be filtered.

Tangential Flow Filtration

The cross-flow technology is commonly used during the downstream processing of proteins. Various applications, such as product clarification and concentration, are best achieved by the use of cross-flow filtration. Cross-flow technology is often the last processing step for many products before the final formulation for heat-labile products. There are two types of filtration in separation. Normal Flow filtration (NFF) and Tangential Flow Filtration (TFF). In normal filtration all flows is directed to the membranes with retained material building up on the surface of the filter. As these particles build up, the flow through the filter is slowly reduced until it ceases completely.

In tangential Flow Filtration, flows are directed across the membrane surface. The sweeping action of the fluid restricts retained material from settling and eventually reduces flow. Tangential Flow Filtration is a pressure-driven membrane process used to concentrate, separate, or purify macromolecules. Membrane selection for Crossflow filtration is determined by the target molecule's properties and the step's aim. Cross-flow filtration modules are available from manufacturers for carrying out laboratory or pilot plant tests. The size of a plant unit can be determined by a direct scaleup of the filtration area based on the feed or output flow rate.

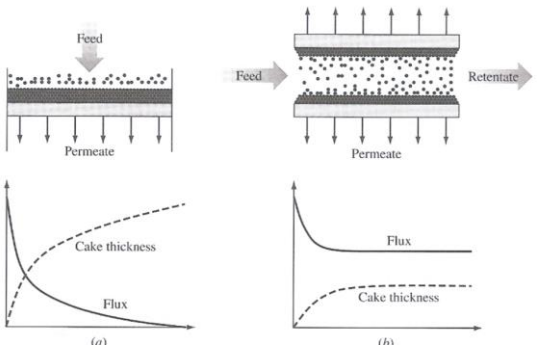

Figure -1 Schematic diagrams for (a) dead-end or conventional filtration and (b) cross-flow filtration

ION EXCHANGE

Ion exchange resins are polymers capable of exchanging particular ions within the polymer with ions in a solution passed through them. This ability is also seen in various natural systems, such as soils and living cells. Synthetic resins are used primarily for purifying water and various other applications, including separating out some elements. In water purification, the aim is usually either to soften the water or to remove the mineral content altogether. The water is softened by using a resin containing Na^+ cations but which binds Ca^{2+} and Mg^{2+} more strongly than Na^+. As the water passes through the resin, the resin takes up Ca^{2+} and Mg^{2+} and releases Na^+, making for a 'softer' water. If the water needs to remove the mineral content entirely, it is passed through a resin containing H^+ (which replaces all the cations) and then through a second resin containing OH^- (which replaces all the anions). The H^+ and OH^- then react together to give more water. The process has some disadvantages in that substances are occurring in some water (such as organic matter or Fe^{3+} ions) which can foul the resin, but in general, the advantages of the process (long life of resins, cheap maintenance etc.) outweigh the disadvantages. In addition, the process is very environmentally friendly because it deals only with substances already occurring in water.

REVERSE OSMOSIS

Reverse Osmosis (RO) is a separation technique suitable for a wide range of applications, especially when salt and/or dissolved solids need to be removed from a solution. Accordingly, RO can be used for seawater and brackish water desalination to produce both water for industrial application and drinking water. It can also be applied for the production of ultrapure water (e.g. semi-conductor, pharmaceutical industries) and boiler feed water. In addition, RO membrane systems are used for wastewater and water reuse treatments.

RO is currently considered one of the most economical and effective processes for water desalination. Accordingly, it is often the appropriate technique to treat solutions having salt concentrations from 100 to over 50,000 mg/litre. Solutions with salinity from surface water to seawater, and even brine, can be treated by RO membrane.

Cross flow is the configuration applied for membrane separation using RO membrane. The feed water stream flows tangentially to the membrane surface. A fraction of the water in this feed stream passes through the membrane, whereas most of the feed flow travels along the surface. Thus, two streams are collected:

- permeate, almost pure water containing a low concentration of ions
- concentrate, having a high concentration of small particles and dissolved ions

The RO membrane system is continuously supplied with feed water, producing constant water movement from feed to concentrate. In cross-flow operation, there is little accumulation of the rejected solutes and fouling or scaling can be minimized.

Seven R.O. plants are in operation to cater for the drinking water needs of all the students, staff members, supporting staff and visitors. The raw water with an average total dissolved solids [TDS] of 750-2000 ppm is treated to reduce the TDS content to less than 100 ppm, which is generally the acceptable upper limit of the TDS.

The RO-treated drinking water is dispensed through **110 Water Coolers** in the College is provided at various locations that include Class Room Blocks, Laboratory Blocks, Administrative Block and other Centres.

The rejected water from the treatment plants has been used for gardening and washing. These plants not only facilitate the supply of safe drinking water but also obviate the otherwise involved huge expenditure for procuring drinking water for the large number of people in the campus. Now the institution can be liberal in providing our

own made RO water. This RO-treated water is used for drinking purposes as well as cooking purposes. Coolers connected to this plant provide cold drinking water on every floor of classroom blocks, administrative blocks, libraries, laboratories, hostels, etc. In addition, water heaters are also available in classroom blocks to provide hot drinking water for the students in need.

DESIGN CRITERIA (VTU)

RO plant operation: 12 hours/day

Flow Rate: 2000 LPH

Total water supply of water at VTU: 24000litres

S.No.	Plant Location	Plant Capacity Litres/ Hours	Total Litres
1	VTU	2000/12	24000
2	B3Hostel	1000/15	15000
3	Prince Hostel	1000/13	13000
4	Queens Hostel	1000/11	11000

S.No.	Plant Location	Plant Capacity Litres/Hours	Total Litres
5	Leaders Hostel	1000/ hr X 13	13000
6	Vel Vinayaga Hostel	1000/ hr X 11	11000
		Total	**87000**

Volume of water consumed is 87 KLD

Actual quantity of water supplied to the RO plant is 210 KLD (60%rejections)

Fig- 1. Different RO Water Dispensers are Located at different locations in Vel Tech

REVERSE OSMOSIS WATER QUALITY REPORT

Introduction

Raw water from the storage tank is chlorinated and then pumped using the raw water pumps. Then, it is passed through a pressure sand filter to remove the coagulated particles and achieve filtered water. The filtered water is then passed through an Activated Carbon filter to remove residual chlorine and organics. The dechlorinated water from the outlet of the Activated carbon filter then passes through Anti Scalent for reduction of Scale. Then, it will be passed through 5-micron cartridge filters that act as a guard filter to protect the RO membranes in case of any upset in the filtered water quality. Vertical Multistage high-pressure pumps pressurize the feed to the RO to about 8 to 10 kg/cms., the pressurized feed is separated into two streams in the RO, the reject stream containing higher dissolved solids and the permeate, which contains the pure water, the permeate is stored in dedicated Storage tank in RCC or Sintex material construction.

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Process and Instrumentation Diagram

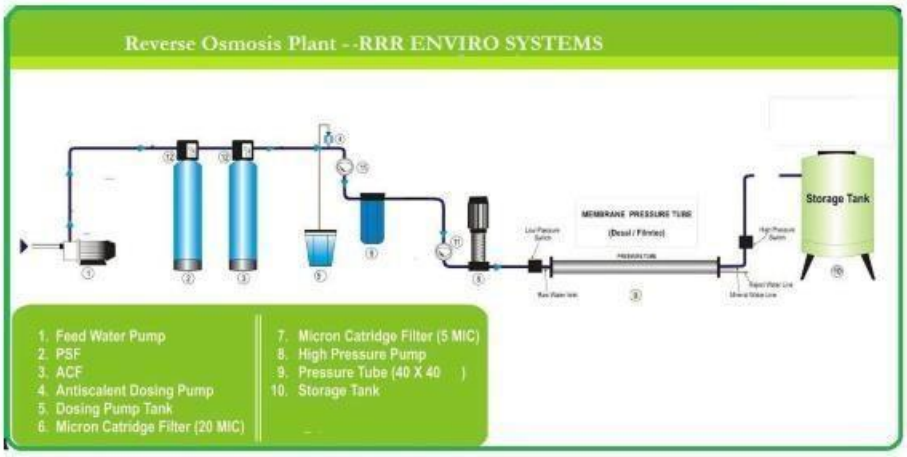

Fig- 2. Reverse Osmosis Plant

Fig- 3. Reverse Osmosis Plant Including Pressure Sand and Activated Carbon Filter

Fig- 4.Stainless Steel Water Collection Tank

Fig- 5.Reverse Osmosis and Control Unit

Technical Details

3.1 Raw Water Pump		
Purpose	To feed the PSF & ACF Filters at pressure more than 1.0 bar, this is min. operating pressure for filter.	
Specification 	Make	Kirlosakr or CG
	Type	Monobloc
	Discharge Cu.m/Hour	4000 LPH
	Discharge Pressure	1-1.5 PSI
	Total head in metre	10 meter
	Rating in HP / Kw	1.0 HP
	Quantity	One
	MOC	Cast Ion
	Impeller	Cast Ion

3.2 pressure Sand Filter		
Purpose	To remove the total suspended solids, dirt and Reduce silt density index, which can foul the membranes.	
Specification 	Quantity	One
	Type of the vessel :	Vertical Pressure Vessel
	Flow rate	4 cum/hr
	Dia of the vessel	18 inch
	Height of the vessel	65 inch
	MOC	FRP
	Model	FRP 2.5 opening
	Multiport valve 25 mm	1 nos
	Max Operation pressure	3.0 PSI
	Volume Of vessel	240 liter
	Make	Starlite or Pentair /alfa ae
	Service Cycle	8 hours
	Backwash duration	30 minites
	Filter media	Sand
	Supporting media	bebbles

3.3 Activated Carbon Filter		
Purpose	To remove the total color, smell, odor, from the water.	
Specification 	Quantity	One
	Type of the vessel :	Vertical Pressure Vessel
	Flow rate	4 cum/hr
	Dia of the vessel	18 inch
	Height of the vessel	65 inch
	MOC	FRP
	Model	FRP 2.5 opening
	Multiport valve 25 mm	1 nos
	Volume Of vessel	240 liter
	Make	Starlite or Pentair /alfa ae
	Service Cycle	8 hours
	Backwash duration	30 minites
	Filter media	Activated Carbon 450 IU
	Supporting media	Bebbles

3.4 Anti scalant Dosing Systems & Ph booster dosing systems		
Purpose	To dose anti scalant chemical to protect the scaling Formation on RO membranes.	
Specification 	Make	Aqua or I dose
	Type - Horizontal/ Monobloc/ E dose	E dose
	Discharge in Cu.m/Hour	6 LPH
	Discharge Pressure	1-1.5 PSI
	MOC	PP
	Quantity	Two
Specification 	Storage Capasity	100 Liter
	Quantity	Two
	Dia X Height	300 X 330 mm
	MOC	PVC/PP

3.5 Micron Filter Systems		
Purpose	To remove the fine particles up to 05 microns and reduce silt density index levels to acceptable level.	
		
	Type	Pressure Hosing
	Discharge in Cu.m/Hour	4000 LPH
	Dia X lenth	20" X .2.5 "
	MOC	PP
	Quantity	One
	Type	Wound
	Dia	2.0"
	Hight	20 "
	Material of Construction	Poly Propylene
	Micron Rating	05 micron
	Quantity	One

3.6 High Pressure Pump		
Purpose	To feed the Reverse Osmosis Membrane at pressure More than the osmotic pressure taking into consideration flux rate, flow and recovery.	
Specification 	Make	Point /CG/CRI or equivalent
	Type	Vertical Multistage Pump
	Discharge Cu.m/Hour	4000 LPH@ 8 kg
	Discharge Pressure	7 kg/cm2
	Total head in metre	30 meter
	Rating in HP / Kw	4.0 Hp
	Quantity	One
	MOC	CI
	Impeller	SS 304

3.7 Reverse Osmosis Systems		
Purpose	To remove the major part of TDS up to 90% by Reverse Osmosis Membranes arranged and designed to give adequate flow and recovery.	
Membrane Specification 		
	Type	Pressure Housing
	Size	8040 End Port
	Dia	8 "
	MOC	FRP
	Type	Spiral Wounded
	Dia	8"
	Lenth	1 meter
	Recovery per Membrane	10 – 15 %
	Salt Rejection per Membrane	90 %
	MOC	Thin film Composite
	Qty	2 Nos
	Make	CSM/GE/equivalent.,

3.8 Flow Meter- Rota meter		
Purpose	To measure the permeate & reject flow of water	
	Make	Max flow or equivalent
	Type	Panel Mount
	Flow Range	500– 4000 LPH
	Float Material	:- PVC
	Pressure Limit	≤ 10.19 Kg/cm²
	Quantity	One

3.9 Pressure Switch – Low & High		
Purpose	Low Pressure Switch: To protect RO pump from dry Running- High Pressure Switch: To protect RO pump from back pressure	
Specification 	Make	Donfoss or equivalent
	Type	Box Type
	Pressure Range	0 – 5 kg/cm2
	Make	donfoss or equivalent
	Type	Box Type
	Pressure Range	5 – 15 kg/cm2

3.10 Control Panel , RO skid & Plumping		
Control Panel	Manual operated Control Panel	
RO Skid	Make	RRR ENVIRO SYSTEMS
	MOC	MS with epoxy paint
Plumping	Low preussre Pipe Line	PUC a As per IS Specification
	High pressure Pipe line	UPUC a As per IS Specification
	Pipe Pressure	6 kg / cm^2
	Pipe Make	ISI / (Finolex) or Equivalent

3.11 UV		
UV Housing	Make	RRR ENVIRO SYSTEMS
	MOC	SS 304
Lamp	Make	Philips
	Watts	40 watts
	In & out	1 inch
	Qty	01

3.12 SS storage tank		
	Make	RRR ENVIRO SYSTEMS
	MOC	SS 304
	Capasity	5000 Liters
	Qty	01