RO Type

Reverse Osmosis:

Reverse osmosis is a process by which pressure is applied to take out water from its low concentration to its high concentration.

Basically, reverse osmosis is a special type of filtration process where a semi-permeable, porous membrane is used which allows only pure water to pass through it by filtering the larger molecules of impurities.

It was early noted that, osmosis is a process where no energy is required. It means that if we want a reversal process then we must need to apply a force against it.

Reverse Osmosis Membrane is such kind of membrane which allows only water molecule to pass through it. As the osmosis process is non force activities, so for the reverse osmosis a high pressure is applied to perform the process.

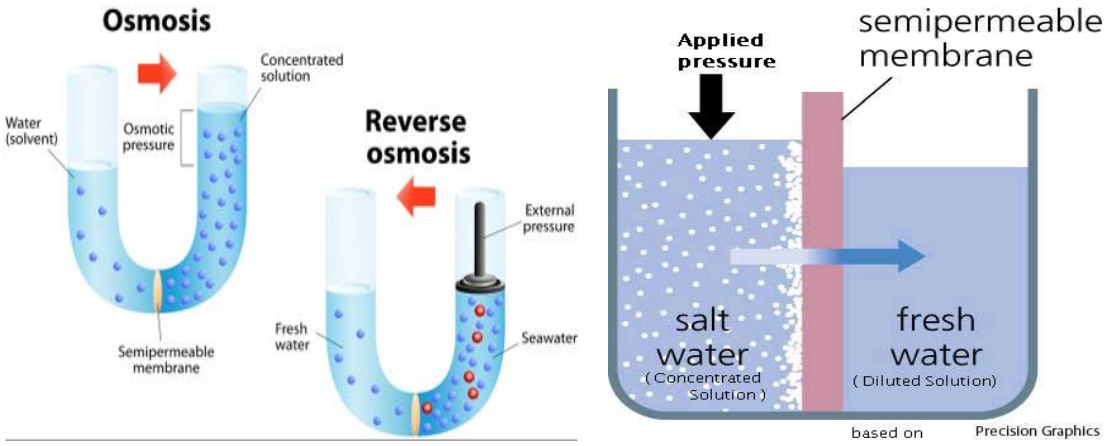

Figure: Reverse Osmosis

In industry, reverse osmosis is used to get very low hardened water.

Reverse osmosis generally works by reversing the principle of genuine osmosis. Suppose, a salt solution is taken and the solution is subjected to be pressurized and pressed against a semi-permeable membrane. When the applied pressure is greater than the osmotic pressure, then water molecule gets reversed from its high concentration to its low concentration.

During reverse osmosis, 99% of dissolved salt particles, colloids, micro-organisms etc. can be removed. Mentioned contaminants are separated by the RO-membrane on the basis of size and charge. Reverse osmosis cannot remove gases as they are not highly ionized [eg. CO2]

Reverse Osmosis Function:

In a reverse osmosis plant a high pressure pump is used. This high pressure pump force's the water across the semi permeable membrane of RO system. This forcing will leave all around 95% - 99% of dissolved salt into the rejected/concentrated water. the amount of pressure required depending on the

salt concentration of feed water. The fact is that; the more concentrated feed water will require the more pressure for RO system.

Permeate Water = The water that is demineralized or deionized in the process.
Reject/Concentrated Water = The water that contains concentrated contaminants & do not pass through the RO system.

Differences in between Osmosis & Reverse Osmosis:

Osmosis	Reverse Osmosis
Natural process	Artificial pressurized process
Works along the potential gradient	Works against the potential gradient
Works aligning with osmotic pressure	Works against osmotic pressure
Water movement from its high concentration to its low concentration	Water movement from its low concentration to tis high concentration

RO Types:

Different types of RO are illustrated here…

1. Single Pass
2. Partial Two Pass
3. Split Partial Single Pass [SSP]
4. Split Partial Second Pass [SPSP]
5. Forward Osmosis [FO-RO]
6. Pressure Related Osmosis [PRO-RO]

A] Single Pass

In a single pass RO system, the feed water is pumped into the system through a semi-permeable membrane. After the treatment the permeate water is passed into the production process where as the rejected water is flushed out from the entire process.

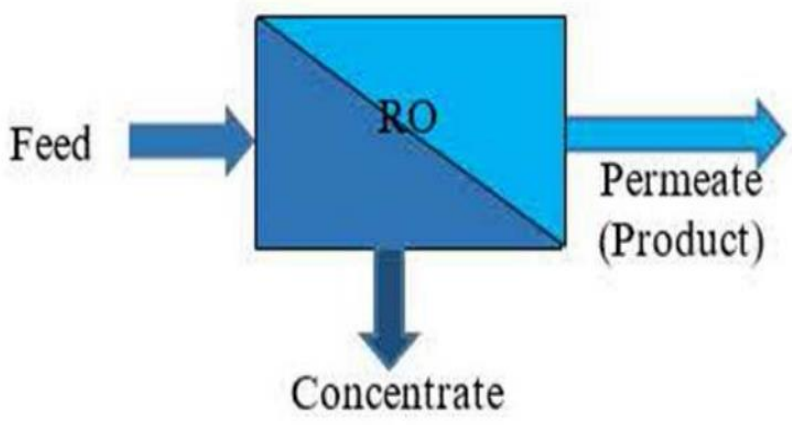

Figure: Single Pass RO System

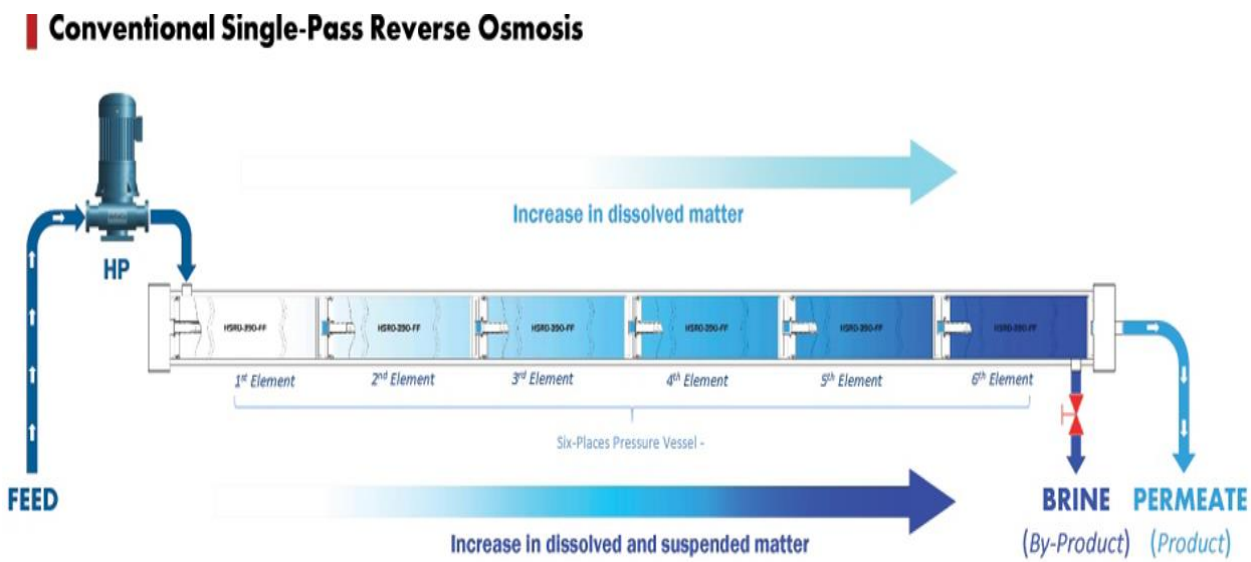

Figure: Single Pass RO System

Single Pass RO System can provide such kind of water quality which has a conductivity range under 15µS. It is a compact design which helps on space saving & storage. It helps to avoid the handling and storage of Caustic & Acid.

Figure: Single Pass RO System

The average level of water wastage in single pass RO system is 20-25%.

Double Pass RO System:

In a double pass RO system, the feed water is pumped into the system through a semi-permeable membrane. After the treatment the permeate water is passed into the production process where as the rejected water is re flushed out from the entire process.

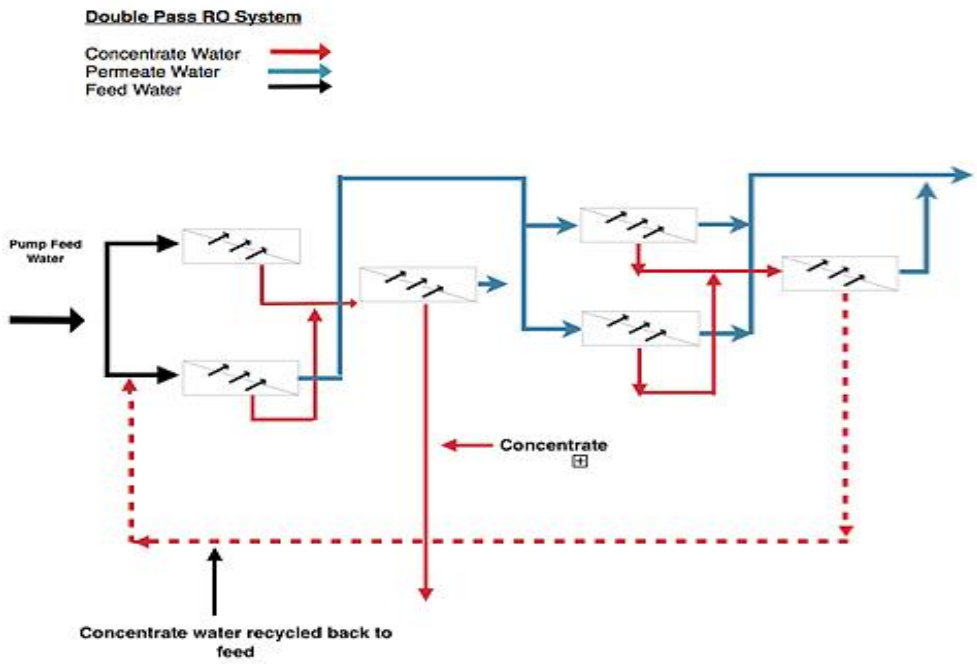

Figure: Double Pass RO System

To minimize water waste, double pass system is highly recommended. The rejected water from the primary cycle can be reused by the double pass system through the semi-permeable membrane.

The average level of water wastage in single pass RO system is 20-25%. But in double pass RO system, the water wastage level is 05%.

Double pass RO system is very much useful for any company where the company thinks about not only the permeate value but also the reject value.

B] Partial Two Pass

Partial Two Pass RO system is a process where the permeate water enters into a new RO membrane and finally produced permeate and rejected water as well.

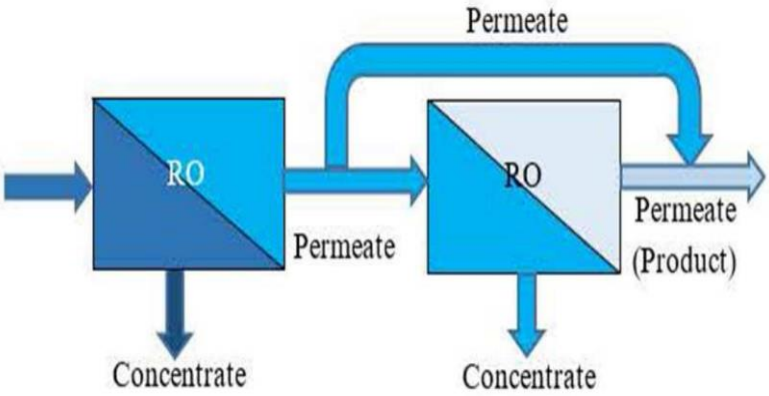

Figure: Partial Two Pass RO System

C] Split Partial Single Pass [SSP]

Split Single Pass RO System is a process where the rear permeate water enters into the feed water in the same RO membrane and finally produced permeate and rejected water as well.

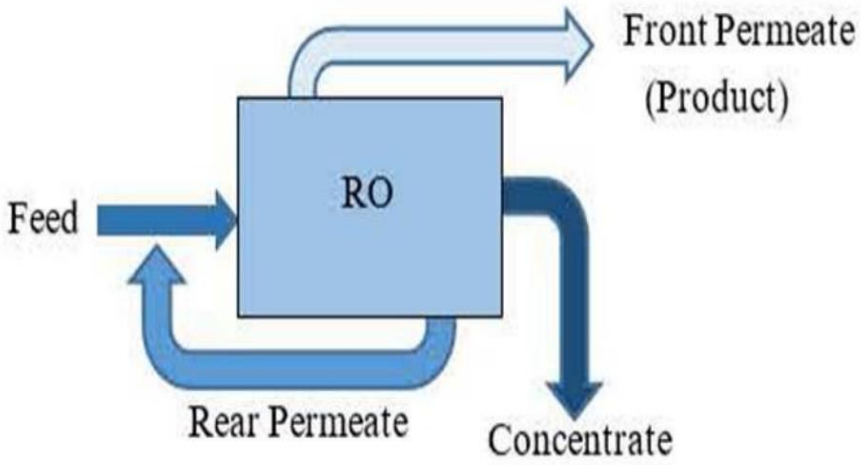

Figure: Split Single Pass RO System

D] Split Partial Second Pass [SPSP]

Split Partial Second Pass RO System is a process where the rear permeate water enters into a new RO membrane and finally produced permeate and rejected water as well. The permeate water of both membrane 01 and membrane 02 are combinedly used in production process.

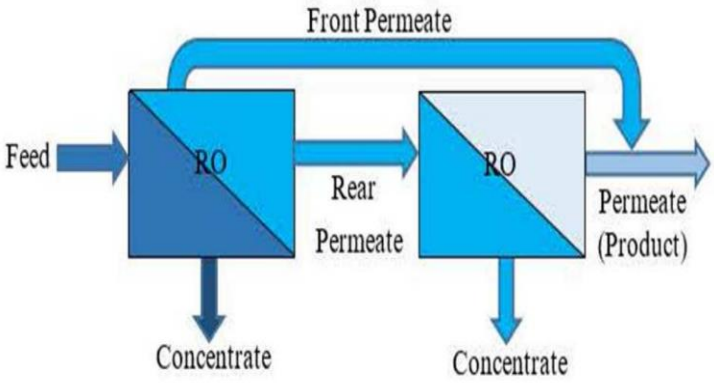

Figure: Split Partial Second Pass RO System [SPSP]

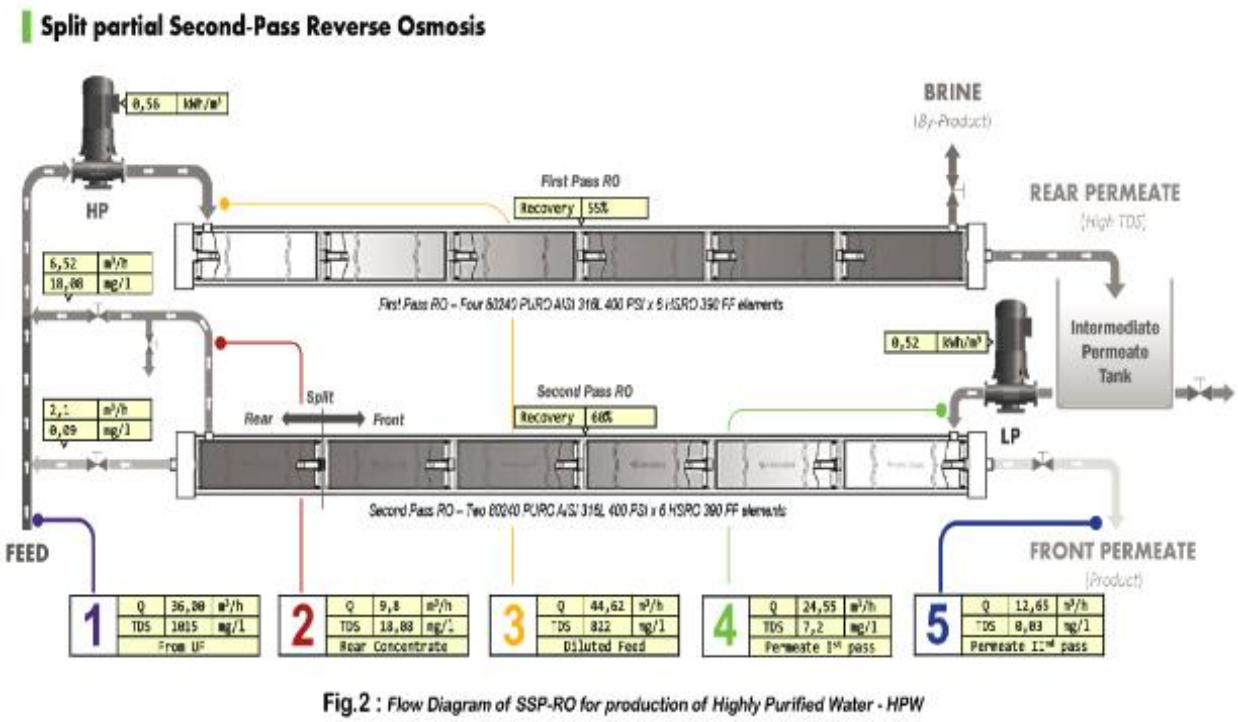

Fig.2 : *Flow Diagram of SSP-RO for production of Highly Purified Water - HPW*

Figure: Split Partial Second Pass RO System [SPSP]

E] Forward Osmosis [FO-RO]

Forwarded Osmosis [FO-RO] RO system is a process where a feed solution such as industrial waste water flows on one side of the water membrane, while a draw solution with a higher total dissolved salinity [TDS] flows on other side. The difference in TDS between the two solids creates osmotic pressure which induces water to flow form the feed solution through the membrane and into the draw solution while retaining all the contaminants in the feed stream.

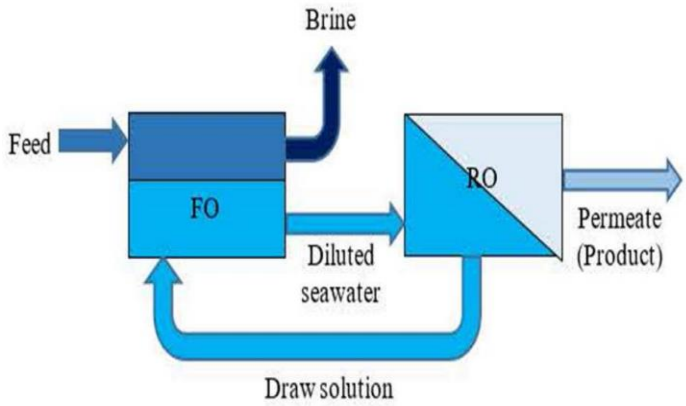

Figure: Forward Osmosis [FO-RO]

As the water moves through the membrane, the draw solution becomes diluted and the feed solution is concentrated. This generally produce the concentrated effluent. The charming thing is that, the entire process can be run without additional hydraulic pressure.

F] Pressure Related Osmosis [PRO-RO]

The energy released from the mixing of freshwater with saltwater is a source of renewable energy that can be harvested using pressure retarded osmosis. The water from a low salinity solution permeates through a membrane into a pressurized, high salty salinity solution; power is obtained by depressurizing the permeate through a hydro turbine.

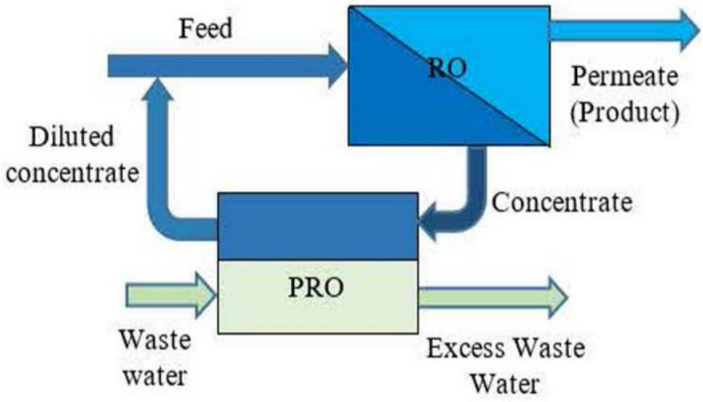

Figure: Pressure Related Osmosis [PRO-RO]

Pressure Related Osmosis [PRO] is such kind of technique where solvent is separated [e.g. fresh water] from a solution which is more concentrated [e.g. sea water] and pressurized at a same time.

A semi-permeable membrane allows the solvent to pass to the concentrated solution side by osmosis. The technology is used to generate power from the salinity gradient energy resulting form the differences in the salt concentration between river water and sea water.

Types of Reverse Osmosis Filters:

A] Desalination System: Used to desalinate sea water for consumption, field irrigation etc.
B] Brackish Water System: Used to clean high salinity water [dirtier than tap water]
C] Water Treatment Plant: Used to clean a large area of surface, brackish and seawater

Types of Semi-permeable Membrane in Reverse Osmosis Filters:

RO water treatment contains semi-permeable membrane. The two common types of membranes are…

- Cellulose Acetate [CA]
- Thin Film Composite [TFC]