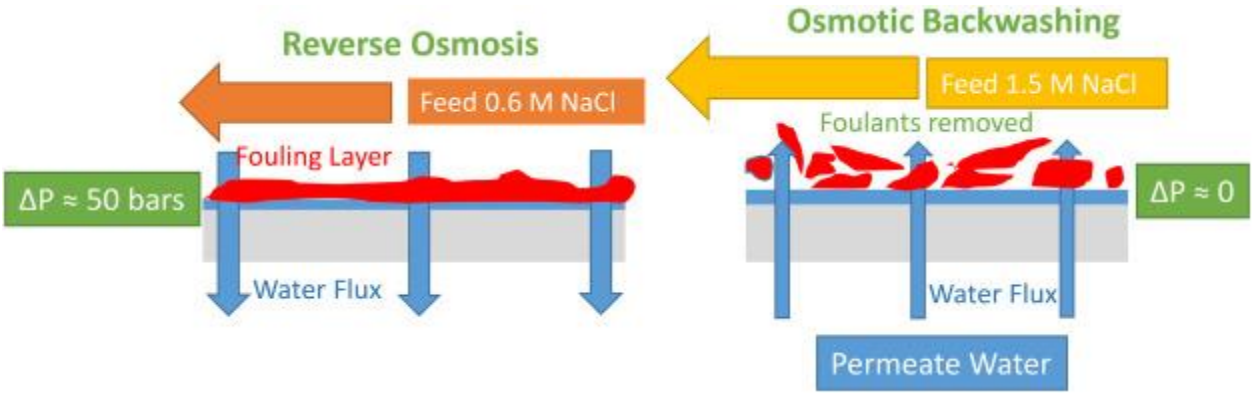
RO – Fouling Pretreatment Solution

RO - Fouling:

When contaminants get accumulated on the membrane surface & plugging occurs the Fouling. If we go for municipal feed water, then we can get usually many contaminants. These contaminants pose the ability to perform a quick plugging or fouling in RO membrane.

Membrane fouling caused by deposition & precipitation of molecules or particulates on the membrane surface or membrane pores.



Generally, fouling starts in the front end of RO & results with a higher pressure drop. Same time, the permeate flow gets down. As a result, incurs the higher operating cost as well as chance to clean the RO membrane or to change the RO membrane.

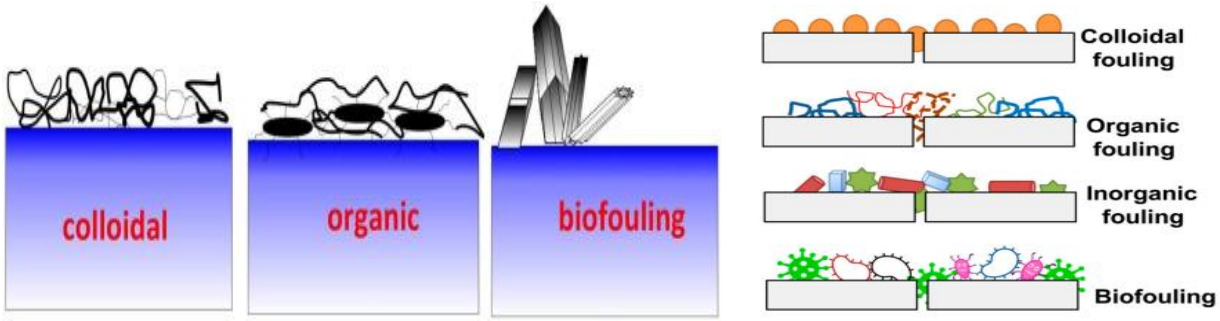


Figure: Fouling

Though you have an effective pretreatment, sometimes the RO system can gets fouling in its pore. If you have a proper pretreatment in your system, there is a minimal chance of RO fouling.

RO Fouling can be caused by the following.

- Colloidal or Particulate Matter [with dirt, slit, clay etc.]
- Organic Matter
- Biofilms/Micro-organisms [bacteria can produce biofilms which can cover the membrane surface]
- Breakthrough of Filter Media Upstream [softener bed leak can lead to a RO fouling]

RO – Pretreatment:

RO pretreatment takes place to prevent RO Failure & RO Frequent Cleaning. The pretreatment of RO can be illustrated in two parts…

- Mechanical pretreatment
- Chemical pretreatment

Laboratory analytical test can help to find out the problem. A mechanical filtration will help to prevent RO fouling in most cases. The most popular methods against RO Fouling are…

A) MGF [Multi Grade Filter] using
B) Cartridge Filter using
C) Microfiltration Unit using
D) Antiscalant and Scale Inhibitors using
E) Softener [with Ion-Exchange]
F) Sodium Bi Sulfite or Sodium Meta Bi Sulfide Injection
G) Granular Activated Carbon Using [GAC]

A] MGF [Multi Grade Filter] using

Multi Grade Filter is used to prevent the RO fouling. Multi Grade Filter Contains 03-layers of Anthracite Coal, Sand, Garnet. There is a gravel layer for supporting the system. The media are chosen based on size and density.

Larger Anthracite [Larger but Lighter] = On top
Havier Anthracite [Havier but smaller] = On bottom

The filter media is arranged in such a way that; the largest dirt particle gets remove near the top of media. The smaller dirt particle gets removed in deep side of media. This will allow the long time activity of the Multi Grade Filter before backwash.

A well operated MGF can remove the particles down to 15 – 20 microns. If any coagulant can be used in MGF then the particles down to 05 – 10 microns.

If the SDI > 03, then MGF is recommended.
If the Turbidity > 0.2 NTU, then MGF is recommended.

Multigrade Filter [MGF] consist of vertical or horrizontal pressure sand filters. It contains mutiple layer of Coarse & Fine Sand namely pebbles and gravels which has a fixed proporiton while constituting. The filter has an adequate pore dimension for entrapping suspended solids and some un-dissolved impurities.

MGF – Function:

Generally water use to pass throught the layers of filter media which contains graded sand, pebbles and grabels layers simulteniously. By this method the contaminanting elements gets entrapped and the filtered water passes into the production process. After a certain period the MGF has got lots of contaminants on to it & a general back wash system takes place to remove the entrapped contaminants.

MGF is a cost effective system & it can work under high pressure or higher specific flow rates.

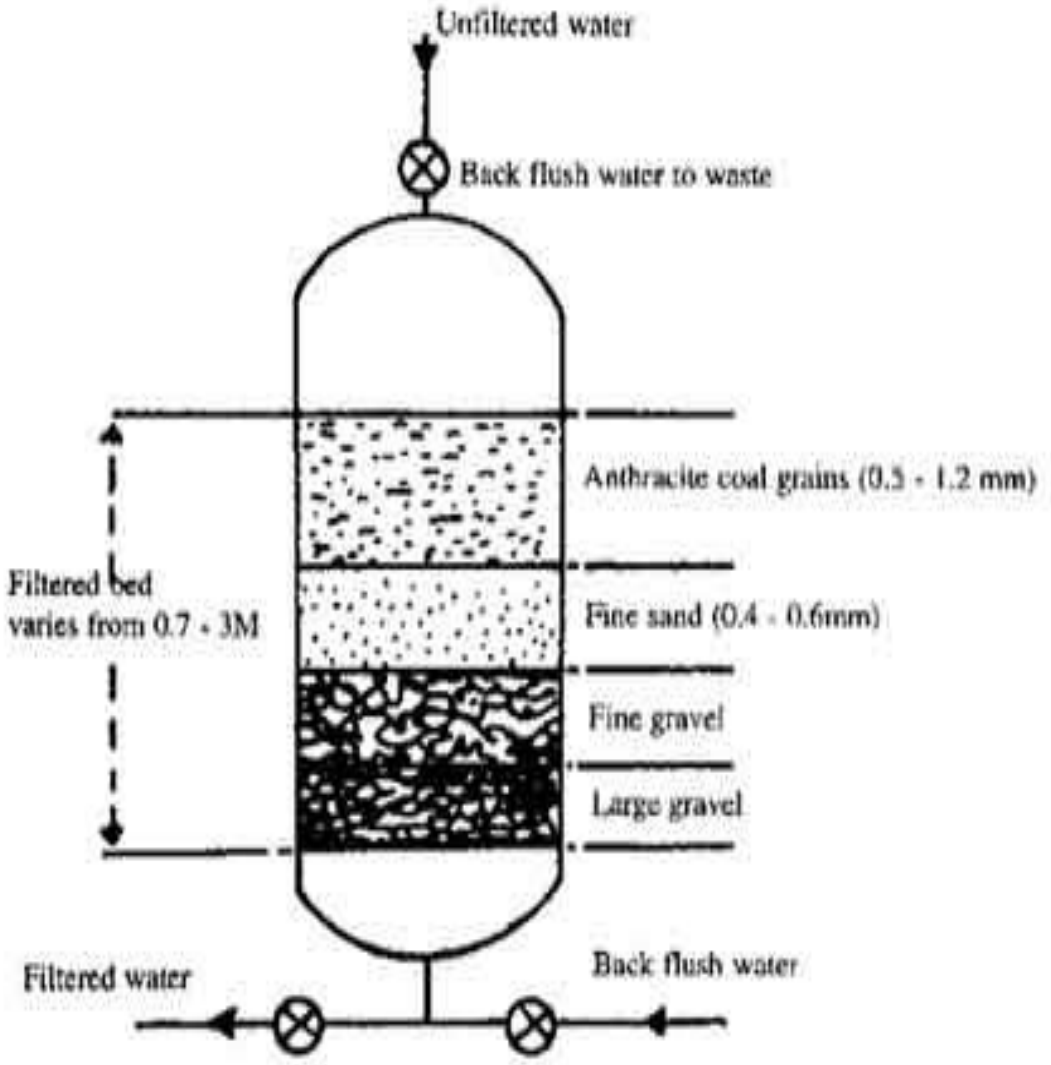


Figure: MGF [Multi Grade Filter]

B] Cartridge Filter Using

A cartridge filter is very much useful if the cartridge filter is placed right after the Multi Grade Filter. The cartridge filter size should be 05 microns. The cartridge filter will ensure the RO system stability as the output after cartridge filter will be below 05 microns.

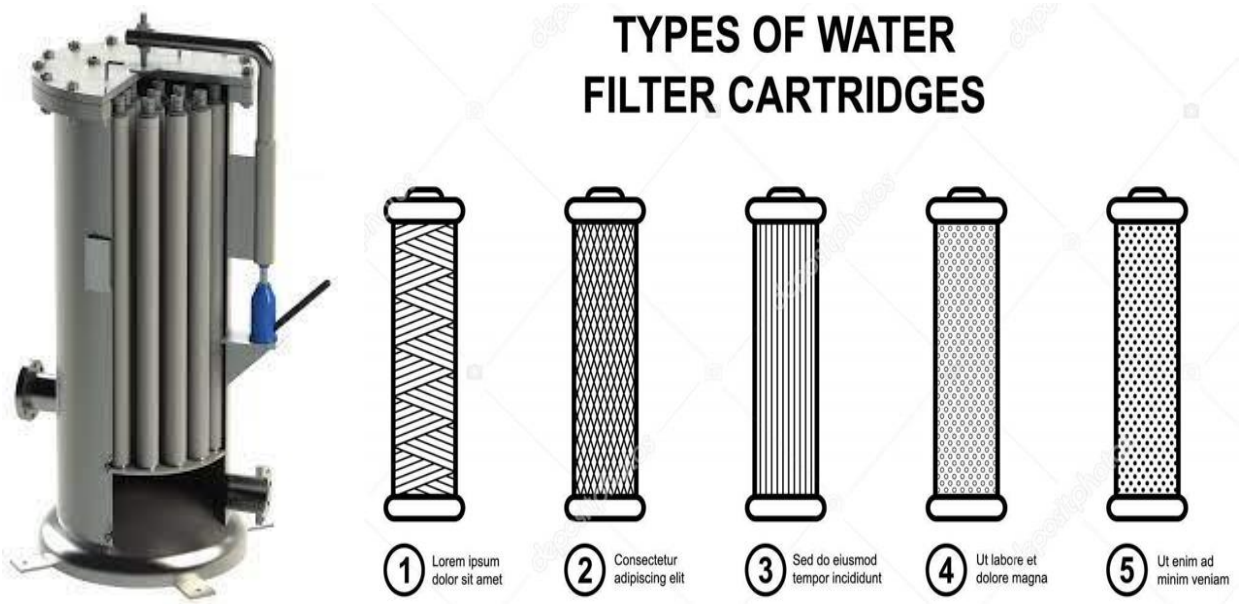


Figure: Cartridge Filter

Thus a cartridge filter will prevent from damaging the downstream pumps as well as fouling the RO system.

C] Microfiltration Unit using

Micro-filtration system has a pore size ranging from 0.1 – 10 microns. Hence, micro-filtration is effective to remove the colloid and bacterial particle as well.

Figure: Micro-filtration Unit

For micro-filtration the “hollow fiber” type is most commonly used. After operating micro-filtration unit, a general “filter cake” can be generated, which will be removed by backwashing. The recovery rates are, Recovery Rate > 90%.

D] Antiscalant and Scale Inhibitors Using

Antiscalant are chemical means of support. The Antiscalant are used in feed water in a steady rate. The main purpose of Antiscalant is to reduce the “Scaling Potentiality” of feed water.

Figure: Antiscalant

The function of Antiscalant is to increase the solubility limits of troublesome inorganic compounds.

E] Softener [with Ion-Exchange]

Softener is a water filter that removes the hardness from water [hardness = presence of Calcium, Magnesium]. In industry, hard water tends to degrade the finished goods quality. Generally, the softener is an Ion-Exchange process. The resin-beads which are placed inside the softener use to trap the calcium, magnesium, certain other metal ions and other minerals from the water. It is also to be added that, hard water affects regular Process Operation, Boiler Operation, Chiller Operation, Cooling Tower Operation by generating visible scales.

Ion Exchange Resins are Organic Polymer which contains Anionic Functional Groups.

The back wash process is applied with fresh water through the resin in an opposite direction with a normal flow. This will take 10 – 20 minutes. By this back wash the entrapped solids get out from the system. This back wash also expands the resin bed for the next softening cycle.

Softener – Function:

Inside the softener, the ion – exchange resin is placed. Ion Exchange Resins are Organic Polymer which contains Anionic Functional Groups. These plastic beads are made from polystyrene. Same time they are charge with a sodium ion. Generally, the softener resin beads are anionic [having the negative charge]. Negative charge attracts and hold the positive charge.

As the calcium, magnesium ions are positively charged and the they get attracted by the negative charge of the resin beads; hence the calcium, magnesium ion gets stuck on the resin beads. As the hard water passes through the resin beads, so finally sodium ion is released.

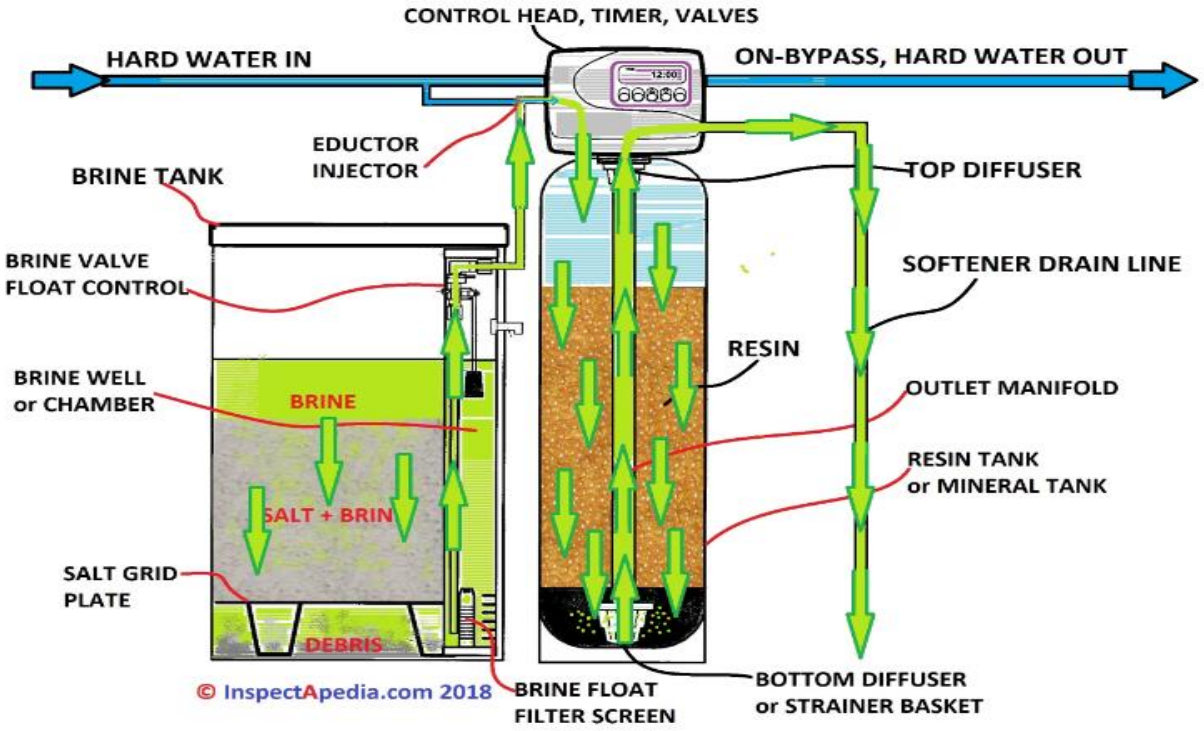


Figure: Softener

It is very much important to set a cartridge filter right after the softener. The cartridge filter size should be 05 microns. The cartridge filter will ensure the RO system stability as the output after cartridge filter will be below 05 microns.

Thus a cartridge filter will prevent from damaging the downstream pumps as well as fouling the RO system.

F] Sodium Bi Sulfite or Sodium Meta Bi Sulfide Using

Chlorine or Chloramines are used in water stream to prevent or control the microbial growth in water treatment plant. So, there is a chance of having the residual Chlorine or Chloramine in the treated water. This residual Chlorine or Chloramines have a major impact to destroy the membrane and to make pore on it.

- Sodium Bi Sulfite is a reducer. It can remove the residual Chlorine or Chloramines from the water stream.
- Sodium Meta Bi Sulfite is a reducer. It can remove the residual Chlorine or Chloramines from the water stream.

G] Granular Activated Carbon Using [GAC]

Chlorine or Chloramines are used in water stream to prevent or control the microbial growth in water treatment plant.

Figure: Granular Activated Carbon [GAC]

Granular Activated Carbon is used to remove the residual Chlorine or Chloramine from the treated water. The appropriate source of GAC is Coal, Coconut Shell, Wood. The Chlorine or Chloramines finally transform into Chloride Ion, which will be no longer an oxidizer.