Reverse Osmosis

an easy and safe technology

AquaCare GmbH & Co. KG
Am Wiesenbusch 11 • D-45966 Gladbeck • Germany
☏ 0 20 43 - 37 57 58-0 • 🖷 0 20 43 – 37 57 58-90
www.aquacare.de • info@aquacare.de

if small or large R.O. units the principle is the same

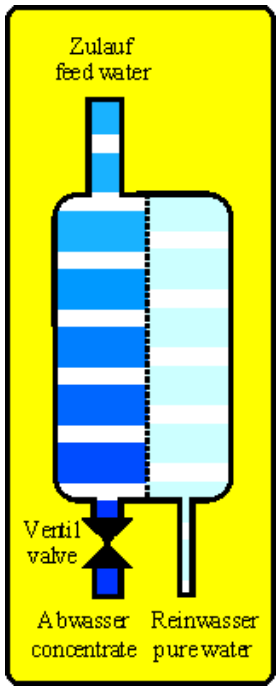
The principle of reverse osmosis technique

The reverse osmosis (R.O.) technique is an extreme fine filtration and is therefore called hyper-filtration, too. The well known filtration techniques do not need water pressure in contrast to R.O. technique. The R.O. membrane has a very fine structure with semi-permeable properties. This special characteristic allows to invert the natural phenomenon osmosis.

Osmosis is an autonomous material migration through semi-permeable membranes. If two aqueous solutions with different ion or substance concentrations are separated with a membrane both solutions try to equalize the different concentrations. The ions or substances are not able to pass the membrane, so the water must flow from the low concentrated side to high concentrated side. This phenomenon runs so long if the concentrations on both sides are equal or the pressure on the low concentrated side is as high as the osmotic pressure of the high concentrated side.

In nature this principle is very important for all plants and animals. The cell pressure (turgor, osmotic pressure) is regulated by transporting only ions or molecules – the water will flow by itself.

The reverse osmosis technique inverted this process. On the side with the high concentration (concentrate side) a high pressure is established. The only way to get the system in equilibrium is that the water passes the membrane to the low concentrated side (permeate side or pure water side). The ions and molecules are not able to pass the membrane in considerable extent. To prevent that the concentration on the concentrate side is rising and rising a part of the concentrate must be drained – this brine passes the concentrate valve.



The rejection of the different ions and molecules is varying depending on the size (molecular weight), the charge (uncharged, dipoles, mono-valent or multi-valent ions) and the structure of the substance. The used pressure in the system depends on the feed (fresh water, brackish or sea water), the used membranes and the recovery of the system. For example: a fresh water systems works with 4 to 16 bar, a sea water system needs minimum 40 bar to negotiate the osmotic pressure of the concentrate.

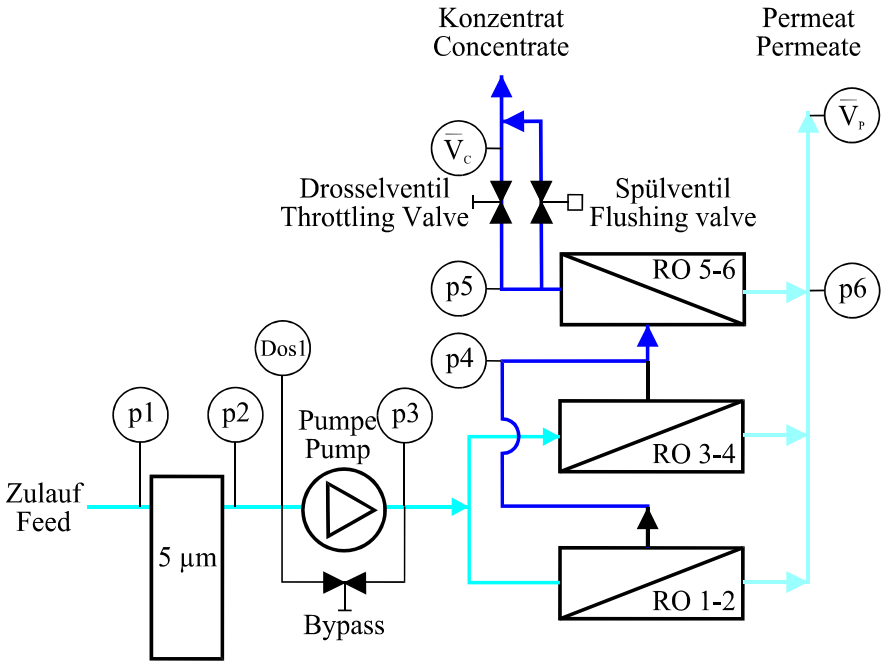
To guarantee a long life a reverse osmosis system some important terms must be redeemed:

- the water must be particle-free → a sediment filter with 5 µm must be installed
- the water must be free of oxidizing agents, e.g. chlorine → activated carbon

filtration is necessary
- the dissolved salts should not precipitate while concentration at the membrane → the right recovery must be calculated exactly and anti-scaling substances must be dosed or the water must be softened with a ion exchange unit
- all materials must be suitable for the concentrate → plastics, stainless steel at low chloride concentrations (fresh water), duplex steel at high chloride concentrations (brackish and sea water)
- the main components and parameters must be controlled to ensure a proper running of the system.

Process with AquaCare units (type HP)

If the unit is starting an automatic feed valve opens and the incoming water will be cleaned by a 5 µm sediment filter. A dosing station pumps antiscaling substances into the feed water tube. For best intermixing a static mixer is installed. Only if the antiscalants are mixed very well a proper running of the unit is guaranteed. Alternative softened water can be used with small units. After pre-pressure control the water flows into the main pump. AquaCare is working only with high pressure circulation pumps made of stainless steel. Noise and vibrations are very low to ensure a long life time of the components. The high pressure tube made of austenitic stainless steel 1.4571 (316 Ti) guarantees a long life time without pitting corrosion. After passing the membranes the permeate flow is monitored; a counter pressure is inhibited by a check valve. The concentrate flow is adjusted by a gate valve or needle valve and monitored by a flow meter. Before and after operation the unit flushes the membrane with feed water. All components are controlled by a micro-processor unit or optional by a PLC. The conductivity is shown in the display. If the adjustable maximum limit is reached the unit shuts down automatically.



p = pressure gauges; RO = reverse osmosis module; V = flow meter; Dos = dosing pump

CIP-units (clean in place)

During operation of a R.O. system the membranes will foul although antiscalants are dosed or softened water is fed. With the time inorganic substances and bio films will be taken up by the membranes. Therefore once to three times a year – depending on quality of antiscalants, maintenance of the unit, and of course of the feed water quality – the membranes must be cleaned with chemicals. After the cleaning process permeate flow and rejection of the membranes are quiet better than before cleaning.
For cleaning the tubes of the R.O. system are dismantled and the flushing adapters of the CIP (**C**lean **I**n **P**lace) connected. The CIP consists of a tank, a chemical resistant pump, a sediment filter and a flow meter.
The pump pushes the cleaning solution through the connected R.O. vessels. The detached dirt will be caught by the sediment filter. The inorganic crusts will be dissolved. After cleaning the R.O. membranes the chemical should be neutralized. After flushing the membranes with permeate and re-connecting to the R.O. main system the R.O. unit can be started again.
CIP-units are only profitable with large R.O. systems.