

97 C Desalination Plant

1 Water desalination by reverse osmosis

Reverse osmosis has been used to remove salt from seawater for many years. It is a simple process which uses a semi permeable membrane to separate the salt from the seawater. The water passes through the membrane while the salt and any other contaminants remain on the other side.

2 Two stage process

A reverse osmosis plant can be divided into two stages:

- pre-treatment, which may vary depending on the quality of the raw water (see 4 below); and
- desalination (reverse osmosis).

3 Desalination

In the desalination section of the plant, the seawater is pumped at high-pressure (40-70 bar) into a pressure vessel containing the membranes. Some of the water is forced through the membranes, removing the salt. This desalinated water (referred to as the permeate) is then discharged into a tank where it is disinfected using sodium hypochlorite. After approximately 30 minutes disinfection it is ready to be introduced into the water supply.

The remainder of the seawater (known as the concentrate) continues to flow over the membranes, helping to prevent biological and other build-up on their surface. The concentrate can then be discharged into an evaporation pond or returned to the sea.

Spiral wound membranes

Spiral wound membranes are generally used for seawater desalination. The membrane element consists of a flat membrane wound around a central tube. One or more of these elements are then connected in a pressure vessel. Spiral wound membranes are cost efficient because they allow a large membrane surface area in a comparatively small space.

4 Pre-treatment options

There are two options for treating the seawater before it is desalinated using conventional filtration or ultra filtration.



Multimedia and Cartridge filters

Conventional filtration

Conventional filtration is through a multimedia filter followed by a fine filtration cartridge (5-20 μ). This method has the advantage of a comparatively low capital cost but experience has shown that unless the water is of very high quality, this treatment alone is insufficient to protect the membrane against fouling. It can be improved by adding chlorination, activated carbon filtration and de-chlorination stages between the multimedia and cartridge filtration.

Ultrafiltration

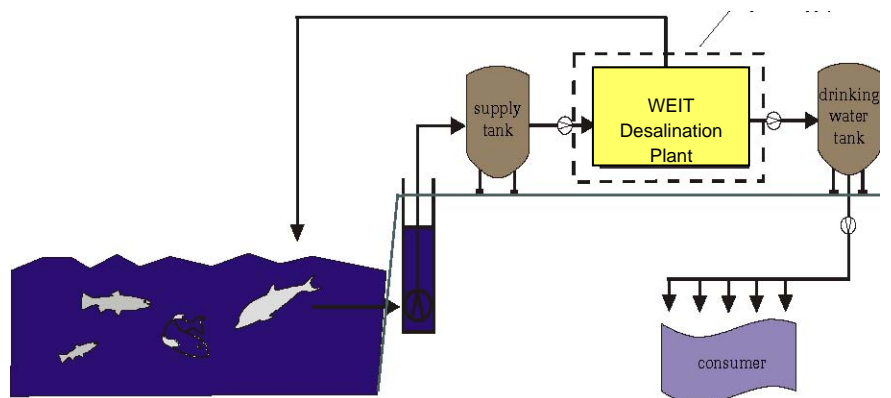
The ultrafiltration option also uses membranes in the pretreatment stage. The seawater is pumped through the ultrafiltration membranes at 0,5-2 bar. The permeate, from which all suspended solids, colour and bacteria have been removed, flows through the membrane and into the high pressure pump for the desalination stage. The concentrate flows into the evaporation pond or back to the sea.

When this form of pre-treatment is used, it inhibits biological fouling and build up of sediment on the reverse osmosis membranes. This results in better performance, increased membrane life and longer intervals between cleaning. Operating costs will be lower following this form of pretreatment (but the initial capital cost will be higher)

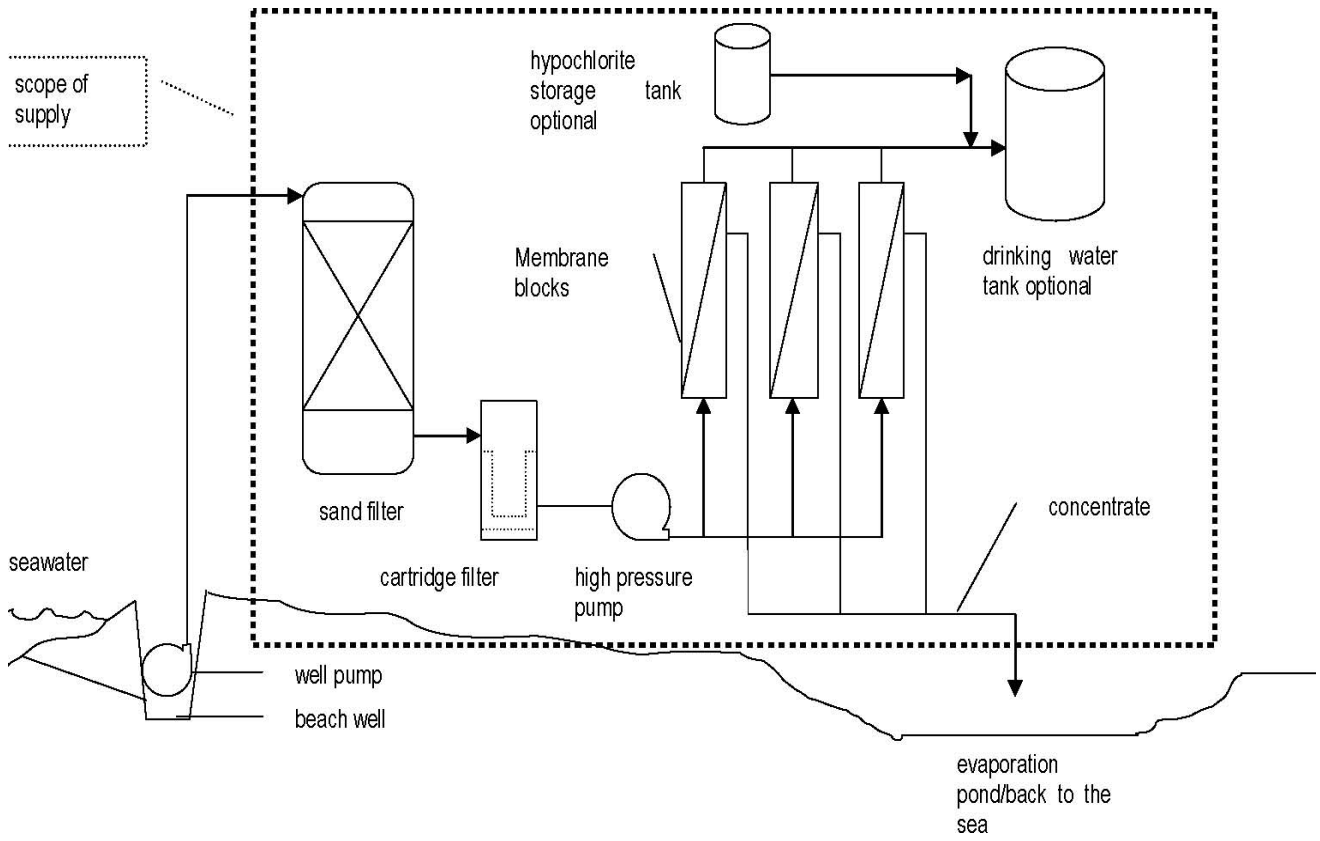


Reverse Osmosis Plant with Ultra Filtration Pre-Treatment

Seawater desalination



Process Flow Diagram



Questionnaire Desalination Plants

Company: _____
Name: _____ **Phone:** _____
Street: _____ **Fax:** _____
Town: _____
Country: _____

Sample identification: _____

Feed source: _____

Conductivity: _____ pH: _____ Temperature (°C): _____ air temperature (°C): _____

Feed water analysis: Ammonium NH_4^+ : _____ Carbon dioxide CO_2 : _____

Potassium K^+ : _____ Carbonate CO_3 : _____

Please give units: Sodium Na^+ : _____ Hydrogen Carbonate HCO_3 : _____

(mg/l as ion) Magnesium Mg^{++} : _____ Nitrate NO_3 : _____

or Calcium Ca^{++} : _____ Chloride Cl : _____

ppm as CaCO_3 Barium Ba^{++} : _____ Fluoride F^- : _____

or Strontium Sr^{++} : _____ Sulphate SO_4^{--} : _____

meq/l) Iron Fe^{++} : _____ Phosphate PO_4^{--} : _____

Iron Fe (tot) : _____ Sulfide S^{--} : _____

Manganese Mn^{++} : _____ Silica $\text{SiO}_2(\text{colloidal})$: _____

Aluminium Al : _____ Silica $\text{SiO}_2(\text{soluble})$: _____

Lithium Li : _____ Nitrogen N_2 : _____

Rubidium Rb : _____ Oxygen O_2 : _____

Argon Ar : _____

Other ions: _____

TDS (by method): _____

TOC: _____

BOD₅: _____ COD: _____

Total alkalinity (m-value): _____ Carbonate alkalinity (p-value): _____

Total hardness: _____ Turbidity (NTU): _____

Silt density index (SDI): _____

Bacteria (count/ml): _____ Free chlorine: _____

Remarks: _____

(Odor, smell, color, biological activity, etc. :) _____

Analysis by: _____

Date: _____

desired permeate quantity: _____ m_3/h _____ m_3/h _____ m_3/h

desired permeate quality: TDS _____ mg/l WHO-standard? **yes** **no** **special**

remarks:
