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WATER POTABILIZATION PLANTS BY REVERSE OSMOSIS, ECODEPUR ®, MODEL RO

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PRESENTATION

Water potabilizations plants ECODEPUR ®, MODEL RO, are intended for water purification, through the process of reverse osmosis.

This process consists of forcing water through a semi permeable membrane, in order to retain an extremely high percentage of salts, undesirable substances, bacteria or viruses, using a pressure higher than the osmotic pressure of the water to be treated, in the opposite direction to that of osmosis.

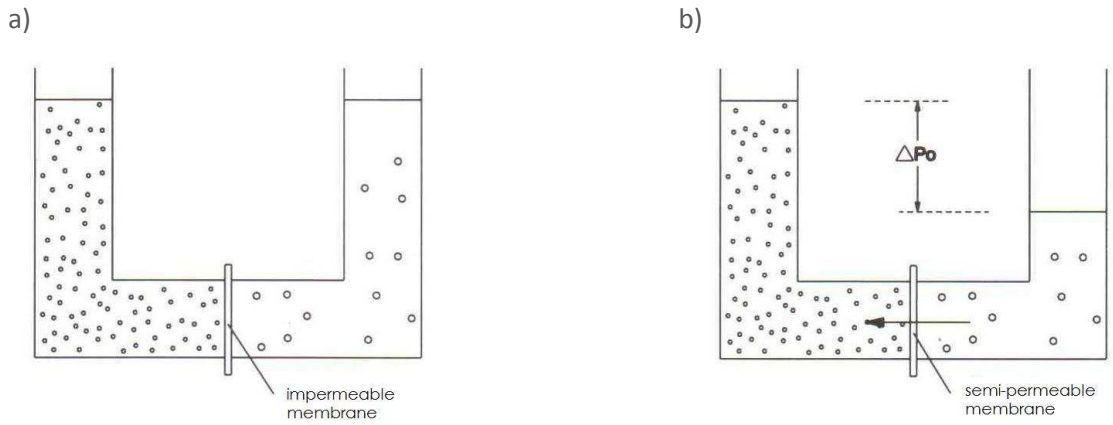
Today, this technology is considered the most energy efficient for removal of water salinity.

FUNCTIONING

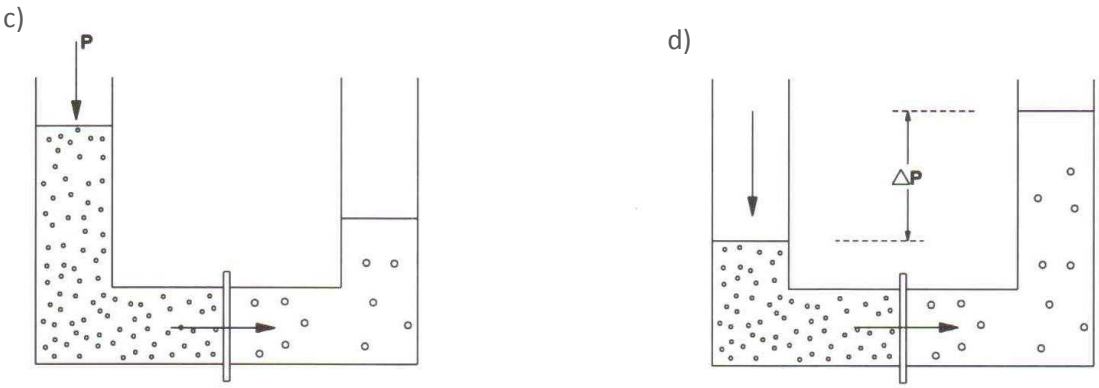
Reverse osmosis technology is based on the process of osmosis, which is a natural phenomenon that occurs in the cells of living beings, through which two solutions of different salt concentrations put in contact by means of a semi-permeable membrane tend to achieve equal concentrations at an intermediate value.

To do so, it produces a flow from the diluted solution to the more concentrated which only stops when it reaches the equilibrium between the two concentrations. The force that causes this movement is defined as osmotic pressure and is proportional to the difference in concentration of salts inside of both solutions.

This process is outlined in the following figures:



Simple Osmosis Process Principles



Reverse Osmosis Process Principles

When two solutions of different concentration or salinity are placed in two deposits separated for a waterproof wall, each one of them reaches the respective deposit height wich is a function solely of the volume of the solution and the diameter of the tank. If we equal the height of both solutions will have figure a).

If we replace the waterproof wall by a semi-permeable membrane (permeable only to water and not to the dissolved salts) it produces flow from the more diluted solution moving through to the more concentrated, as exemplified in Figure b), which only stops when it reaches a particular gap which corresponds to the difference between the osmotic pressure of the two solutions, ΔP0.

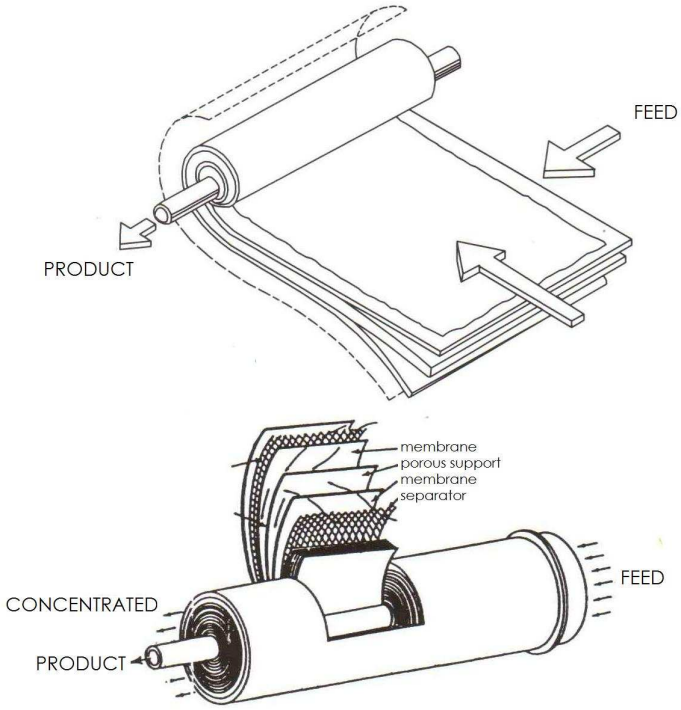
This value is the pressure differential that causes the flow of water through the membrane.

If we reverse the process by applying a pressure in the reservoir of the stronger solution, fig. c), produces this movement to the diluted solution, increasing its concentration to achieve a situation of balance as shown in Fig. (d)), in which the height ΔP is a function of the pressure applied, the characteristics of the membrane and concentrations of both solutions.

This process is what constitutes the reverse osmosis, named so because to achieve a solvent flow through a semi-permeable membrane, it is necessary to apply sufficient pressure to win, at least, the osmotic pressure of the solution.

In practice, it is not necessary to overcome the osmotic pressure of the feed solution but only the difference of the osmotic pressure between the feed and product solutions. This pressure depends on the water flow through the membrane.

When we look at the different phases of this process, we can easily realize that the main elements in order to reproduce this process at industrial scale process are a pump required to apply the pressure and a membrane capable of performing the separation of salts.



Detail of a spiral winding membrane

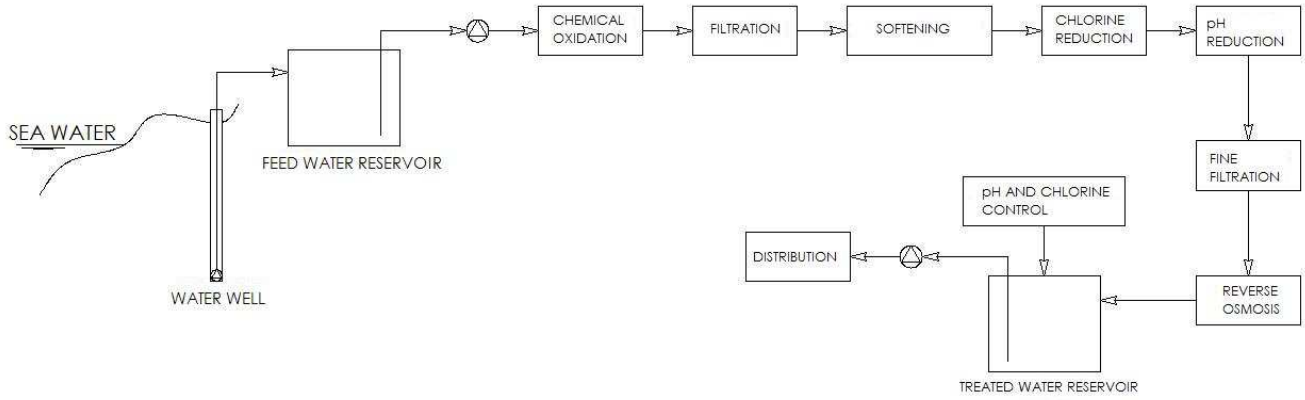
Giving as an example a case from a brackish water with a concentration of dissolved salts in the order of 3000-4000 ppm, reverse osmosis pump must produce a pressure of around 12-20 Bar to ensure a 90-95%. Osmosis water is a water of very high quality, very low mineral content and completely free of microorganisms and organic matter dissolved.

Since the reverse osmosis technology is a process of concentration, in order to produce a given amount of osmosis water of very high quality we will need to reject a proportional amount of high saline water (concentrate). Typically, a reverse osmosis works with rejection rates in the order of 25 to 40%.

To ensure the life of osmosis membranes it will always be necessary to design a pre-treatment sequence to remove from feed water all the organic matter, suspended solids and sand that could cause irreversible damage in the

membranes. Also to extend the life of the membranes and prevent its rapid fouling by salty scale, it is appropriate to remove much of the metal and alkaline-earth ions , such as iron, manganese, calcium and magnesium, or minimize their influence with the addition of anti-fouling reagents.

Typical sequence of installation of a drinking water production line/Desalination



MAIN CHARACTERISTICS

Ecodepur® RO Reverse osmosis plants come completely assembled (except for INLET and OUTLET connections and the power supply) and include the following items:

-equipment support structure in stainless steel AISI 304;

-high-pressure pump for feeding to membranes;

-protection filter 5 µm upstream of membranes;

-set of flowmeters meter for permeate, concentrate and recirculation;

-set of pressure gauges for measurement of inlet pressures, filtration pressure and pump pressure;

-pressure switches for maximum and minimum pressure;

-stainless steel needle valves for flow/pressure adjustment;

- conductivity measurement;

-electronic controller;

-reverse osmosis membranes made of composite material for Very Low Pressure (for salts concentration of under 2000 ppm (1)) produced by spiral winding;

-set of pressure tubes made of glass reinforced plastic (membrane housing).

(1) Taking into account the specific characteristics of the feed water, it may be necessary to change the type for low pressure membranes, or even seawater membranes.

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TECHNICAL CHARACTERISTICS

Model	Production Flowrate [m^3/day]	Membranes	Power [Kw]	Dimensions (L x l x H) [mm]	Inlet Production Concentrated
ECODEPUR®-RO 500	10	3x 4040	1,5	1650 x 850 x 1600	32 x 32 x 25
ECODEPUR®-RO 1.000	20	5x 4040	2,2	1650 x 850 x 1600	32 x 32 x 25
ECODEPUR®-RO 2.000	40	10x 4040	2,2	2900 x 850 x 1600	32 x 32 x 25
ECODEPUR®-RO 3.000	60	14x 4040	3	2900 x 1200 x 1600	40 x 32 x 32
ECODEPUR®-RO 4.000	80	18x 4040	4	4000 x 850 x 1850	40 x 40 x 32
ECODEPUR®-RO 5.000	100	6x 8040	5,5	2500 x 1300 x 1600	50 x 40 x 32
ECODEPUR®-RO 6.000	120	6x 8040	5,5	2500 x 1300 x 1600	50 x 40 x 32
ECODEPUR®-RO 7.000	140	7x 8040	5,5	2500 x 1300 x 1850	50 x 40 x 32
ECODEPUR®-RO 8.000	160	8x8040	7,5	3500 x 1300 x 1850	50 x 50 x 40
ECODEPUR®-RO 9.000	180	10x 8040	7,5	3500 x 1300 x 1850	63 x 50 x 40
ECODEPUR®-RO 10.000	200	12x 8040	11	3500 x 1300 x 1850	63 x 50 x 40
ECODEPUR®-RO 12.500	250	14x 8040	11	3500 x 1300 x 1850	63 x 50 x 40
ECODEPUR®-RO 15.000	300	15x 8040	15	4600 x 1300 x 1850	63 x 50 x 40
ECODEPUR®-RO 17.500	350	18x 8040	15	4600 x 1300 x 1850	75 x 63 x 50
ECODEPUR®-RO 20.000	400	24x 8040	18,5	4600 x 1300 x 1850	90 x 75 x 63
ECODEPUR®-RO 25.000	500	32x 8040	18,5	5600 x 1300 x 1850	90 x 75 x 63
ECODEPUR®-RO 30.000	600	32x 8040	30	5600 x 1300 x 1850	90 x 75 x 63
ECODEPUR®-RO 35.000	700	40x 8040	30	6600 x 1300 x 1850	90 x 75 x 63
ECODEPUR®-RO 40.000	800	50x 8040	30	6600 x 2500 x 2000	DN100/DN80/DN65
ECODEPUR®-RO 45.000	900	55x 8040	37	6600 x 2500 x 2000	DN100/DN80/DN65
ECODEPUR®-RO 50.000	1000	66x 8040	37	8000 x 2500 x 2500	DN100/DN80/DN65

OPERATION/MAINTENANCE

All operation/maintenance routines are intended to extend the life of equipment and minimize extraordinary correction/repair operations that make more expensive the exploitation of the system and increase the cost/m^3 of water produced.

The normal exploitation of a line of potabilization/Desalination by reverse osmosis technology boils down to consumable replacement of pre and post-treatment operations (filters, reagents, seals, ...) and a set of more sensitive operations involving directly the ECODEPUR ® RO reverse osmosis plant.

These sets of operations include:

-Regular Registration of the Plant data (flow, pressure and conductivity of the product lines and concentrate);

- conductivity probe calibration every 2 month;

-Chemical cleaning of osmosis membranes at least every 4 months or when one of the following conditions occurs:

-Loss of 10 to 15% of normalized permeate flow

-Increase of 10 to 15% of the normalized differential pressure

-Reduction of 1 to 2% of the ion rejection

-Sanitization of osmosis membranes at least once a month or whenever there is bacterial contamination in product line;

-Replacement of osmosis membranes when the operational data of Osmosis Plant (pressure x flow) will not reset only with the chemical cleaning operation (typically every 2 years).

WARRANTY

Two (2) year warranty against any manufacturing defects.

ECODEPUR® – Tecnologias de Protecção Ambiental, Lda, does not assume any liability, if clear evidence observed poor installation and/or use.