

# Membrane Used In Seawater Desalination



**Good pre-treatment is of major importance for successful operation of seawater reverse osmosis plants. This article discusses an ultrafiltration membrane specifically developed for seawater pre-treatment.**

By Frans knops

## Ultrafiltration Technology

Seawater Reverse Osmosis (SWRO) is a very robust and widely practiced desalination technique. Through many years of experience it has been learned that the key to any successful reverse osmosis (RO) process is the pre-treatment. Ultrafiltration Technology has been generally accepted as a proper pre-treatment to spiral wound membranes for effluent polishing applications.

The alternative would require an extensive train of several treatment steps with associated high investment and operating costs while RO feed water quality cannot be guaranteed 100% of the time. Ultrafiltration (UF) guarantees constant water quality at low cost, virtually independent of the feed water quality. UF has also been accepted as an alternative to conventional pre-treatment for brackish surface water RO systems.

## Desalination With UF Pre-Treatment

Norit X-Flow technology provides the highest quality feed water to the RO by first filtering the raw seawater with Norit X-Flow Seaguard UF membrane modules. With its specialized membrane geometry and characteristics, Seaguard offers the highest quality SWRO feed water. This guarantees years of trouble-free desalination at the lowest cost possible.

Seaguard is the first membrane ever that is specially designed as pre-treatment system to seawater reverse osmosis

membranes. The cost of operating a Seaguard membrane system is comparable to the costs of operating a conventional pre-treatment system. The water quality will be substantially better.

Seaguard UF is being widely chosen for SWUF, because of its superior solids removal capability, low energy and chemical requirements, and small footprint, as space is a highly valued commodity on a ship. The pressurized Seaguard UF is also unique in that it is a flow through design, with the UF and RO directly coupled, without an intermediate break tank. This is also a space saving feature and eliminates the need for the energy wasting re-pressurization of the UF permeate.

This translates into:

- More robust operation, the desalination plant can be kept in operation longer and is less sensitive to upsets in process conditions.
- Lower chemical consumption.
- This provides cost savings as well as environmental benefits.
- Lower operating costs of the desalination plant.
- The cleaning frequency will be reduced which in turn reduces the downtime and the chemical consumption.
- Longer life time of the reverse osmosis membranes.



Figure 1: SEAGUARD Membrane

**The Key To Cost Savings**

Norit X-Flow has managed to achieve comprehensive cost savings with the Seaguard by keeping the following parameters in mind:

**Pressure Level:**

Less pressure is required and less energy. The Seaguard membrane must operate under a stable average pressure of 0.2 bar with a maximum of 0.5 bar in order to function optimally.

**Chemicals for Maintenance and Pre-treatment:**

It must be possible to clean the membrane with readily available chemicals, such as acids or sodium chloride.

**Quality of Seawater:**

The membrane must be able to process not only pure seawater, but also seawater that is used for cooling purposes, in the event that a purification plant is combined with a power station.

The membrane must be able to deal with all types of seawater as well as water with a different composition due to natural forces such as storms, floods or water discharges, whether or not of natural origin. This makes it possible to build a purification plant close to where people live, reducing the costs of transporting the fresh (drinking) water.

**Water Quality Follow-Up Treatment:**

In order to guarantee the life of membranes, the membrane manufacturers impose requirements for reverse osmosis on turbidity and the amount of sludge in the water. From a microbiological point of view, bacteria, algae and viruses should preferably be filtered as quickly as possible.

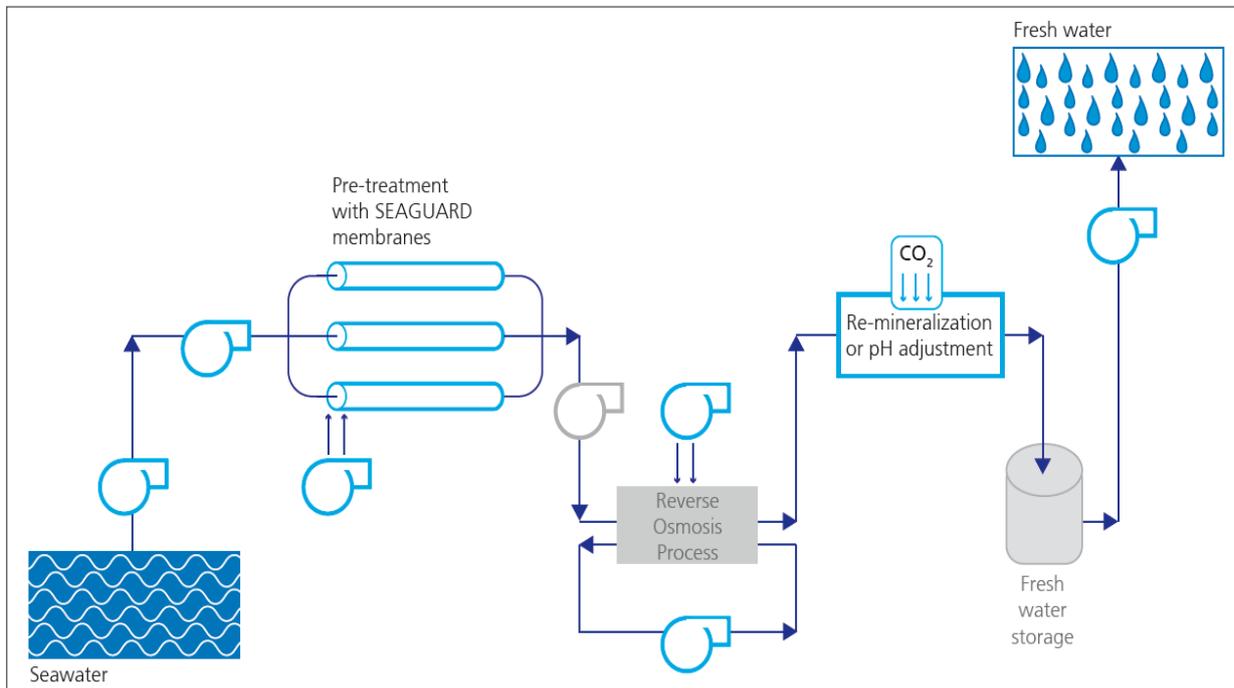


Figure 2: Schematic diagram of the process

Description	Unit	Ultra Filtration	Media Filter
<b>Quality Parameters</b>			
Turbidity	NTU	< 0.3	< 5.0
Total Suspended Solids	Mg/L	< 1	< 5.0
Total Organic Carbon	Mg/L	< 1	< 5.0
SDI15	-	< 3	>5
Bacteria	Log	Log 6 removal	No Removal
Virus	Log	Log 4 removal	No Removal
<b>Operational Parameters</b>			
Operating Mode	-	Pressurized	Pressurized
Material of Construction	-	PES	Sand
Pore Size	Microns	0.02	100
Flux – Gross	l/mh	70 to 90	-
Trans Membrane Pressure Range	Bar	0.1 – 0.8	1.0 – 2.5
Back Washing Frequency	Min	Once in 30 – 50	Once in 240
Chemical Cleaning Frequency	Day	Once	NIL
Waste Water Produced	%	1	20
Recovery	%	95	80
Membrane replacement produced	Day	Once in 3 Years	Once in Year
<b>Chemical Consumption – Process Chemicals / Cleaning Chemicals</b>			
Ferric Chloride as 100%	mg/l	5	0.25
Polymer as 100%	mg/l	0.5	-
Sodium Hypo Chlorite as 100%	mg/l	15	0.75
Sodium Hydroxide as 100%	mg/l	-	2.8
Sulphuric acid as 100%	mg/l	30	46.8

Table 1: SEAGUARD Ultrafiltration vs. Conventional media filters for SWRO Pre-treatment

The Seaguard membrane ensures that the water which passes through meets these parameters, which then has a positive effect on subsequent steps further along the chain.

## Summary

Using UF membranes as pre-treatment to SWRO desalination plants does not increase the cost associated with the pre-treatment. The additional cost of having to replace the UF membranes at the end of their useful life time is more than offset by the cost reduction in use of chemicals (mainly coagulant).

If the whole of life costs of a desalination plant are being calculated there is a number of additional cost savings that can be achieved: the main cost savings can be achieved by a decrease in RO cleaning frequency (less use of chemicals, shorter down time and longer RO life time). By taking all of these factors into account the whole of life costs of a dual membrane desalination plant (Norit X-Flow Seaguard UF +

SWRO) will be 2 to 7% lower than the whole of life costs of a SWRO plant based on conventional pre-treatment.

### About The Article

Frans Knops is the 'Product Manager – Water' at Norit X-Flow, responsible for the product line of Hollow Fiber Membranes. He has designed some of the largest UF plants in the world

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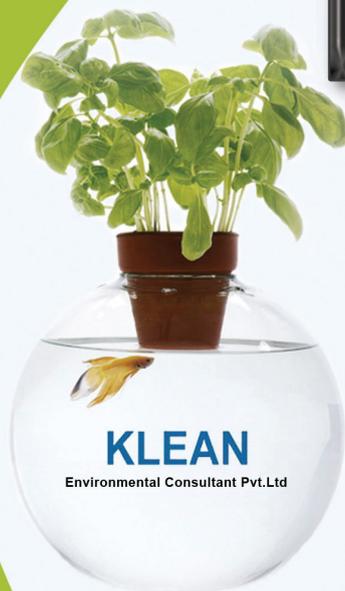
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