

GE Power & Water  
Water & Process Technologies

# Soluções GE Água do Mar



**Marcus Simionato**



imagination at work

# Skids de Osmose Reversa

**E2 - Series**

**E4 - Series**

**E4H – Series**

**E8 – Series**

**PRO – Series**

**SWRO - Series**

Desmineralização

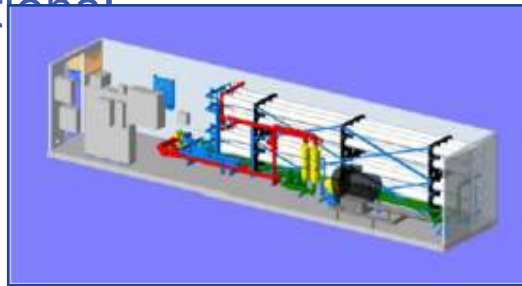
Dessalinização

# General Pre-Engineered Systems

Customers Trust GE Water

Over **100** SWRO systems installed in the past 10 years around the world.

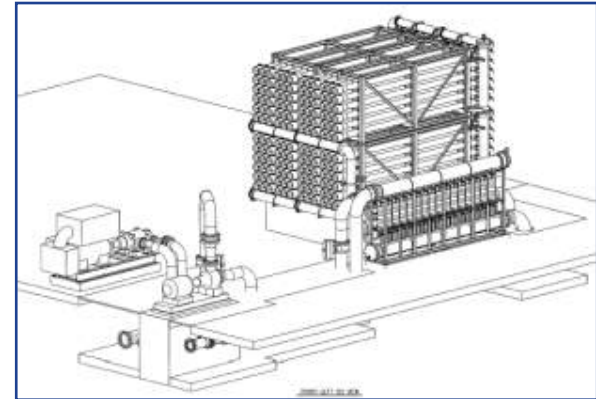
**3** basic design options:



Containerized solutions  
SeaTECH




Skid mounted solutions  
SeaPRO & SeaPRO-E



On-site assembled  
solutions  
SeaSMART

3

# GE's SeaPRO Features and Accessories:

- 
- Never more than 8 elements in series on any design
  - Integral Energy Recovery System
  - Welded skid & frame – painted for corrosion resistance
  - Pre-Engineered
  - Factory tested for fast commissioning
  - One source accountability with GE SWRO Elements
  - All use 40" RO. Save 5-micron nominal cartridge filters
  - High Quality & Efficient High Pressure Pump
  - VFD controlled permeate flow rate
  - RO Controls capable of running a system or a stand alone RO skid w/ 4-20 mA critical instruments for off-line trending
  - Reliable corrosion resistant high pressure piping

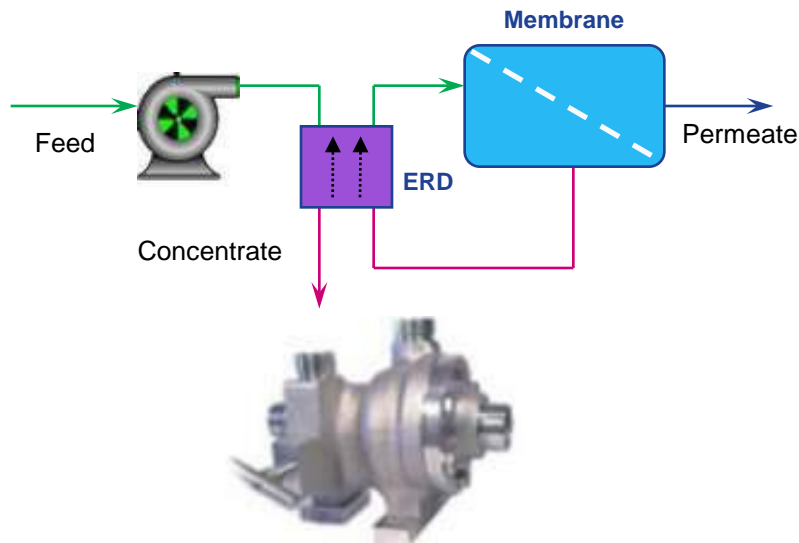
# SeaPRO Product Range

Model	Capacity	# Membranes	Flexible configuration
SeaPRO-8	20gpm (100 m <sup>3</sup> /day)	8	Feed water salinity: 35,000 or 45,000 mg/L
SeaPRO-16	40 gpm (200 m <sup>3</sup> /day)	16	
SeaPRO-28	60gpm (300 m <sup>3</sup> /day)	28	
SeaPRO-42	100gpm (500 m <sup>3</sup> /day)	42	Recoveries designs: 45% or 35% recovery
SeaPRO-63	150gpm (750 m <sup>3</sup> /day)	63	
SeaPRO-84	200gpm (1,000 m <sup>3</sup> /day)	84	Electrical Control Packages: Basic or Premium
SeaPRO-126	300gpm (1,500 m <sup>3</sup> /day)	126	
SeaPRO-210	500gpm (2,500 m <sup>3</sup> /day)	210	Power supply: 50 Hz or 60 Hz

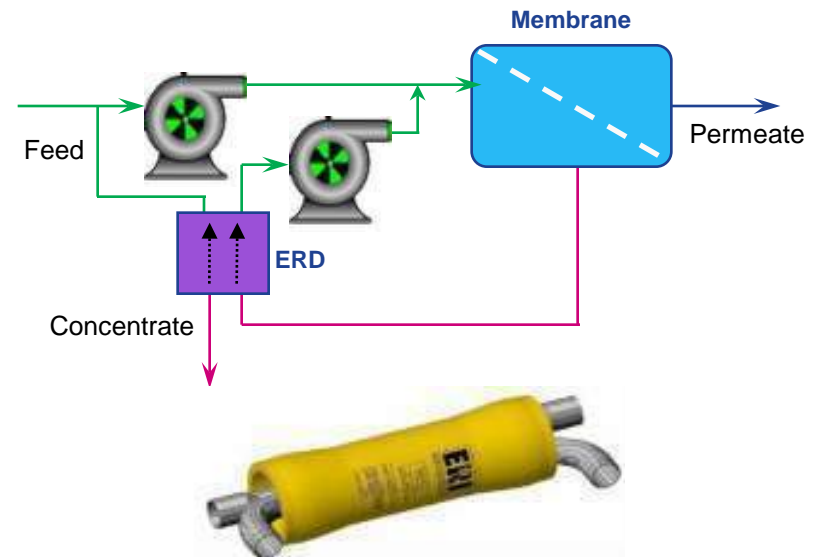




# Energy Recovery Device - Options



Fedco Turbine



ERI PX Rotor

- Custo de produção ~US\$ 1.00 /m<sup>3</sup>
- Consumo de energia: 3,5 a 5,0kwh/m<sup>3</sup> (ERD+LE membranes)

# Introducing: SeaTECH

## Containerized Desalination Plants

Model	Capacity	# Membranes	Pre/Post Treatment
SeaTECH-12	30gpm (163 m <sup>3</sup> /day)	12	Included in 1 module
SeaTECH-35	83 gpm (454 m <sup>3</sup> /day)	35	Included in 1 module
SeaTECH-84	200gpm (1,000 m <sup>3</sup> /day)	84	Separate modules
SeaTECH-252	550gpm (3,000 m <sup>3</sup> /day)	252	Separate modules

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Fact Sheet

### SeaTECH Series

SeaTECH-12: 163m<sup>3</sup>/day (30gpm) integrated SWRO Container

This specification defines the integrated design requirements for the SeaTECH line of containerized systems for the Industrial, Power and Municipal markets. All necessary equipment required for independent operation is provided given the necessary pretreatment precautions are taken. Design basis revolves around containerized system with high-pressure axial piston feed pump as well as a containerized media filter and cartridge filter system. Optional configuration available based on market needs.



Standard Components

Functional Description

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Fact Sheet

### SeaTECH Series

SeaTECH-84: 1000m<sup>3</sup>/day (200gpm) SWRO Container

This specification defines the integrated design requirements for the SeaTECH line of containerized systems for the Industrial, Power and Municipal markets. All necessary equipment required for independent operation is provided given the necessary pretreatment precautions are taken. Design basis includes containerized system with centrifugal feed pump as well as a containerized media filter and cartridge filter system (SeaTECH-MMF-84x3V). Optional configurations available based on market needs.



- Energy Recovery Device and Booster Pump
- VFD for Booster Pump & RO Feed Pump
- Valves: Permeate diversion valves, diaphragm valve for ERI reject out, isolation butterfly valves

#### Functional Description

Single pass, single stage, twelve pressure vessels total. Each pressure vessel contains 7 thin-film

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Fact Sheet

### SeaTECH Series

3000 m<sup>3</sup>/day (550 gpm) Containerized Seawater Desalination System

The following defines the integrated design requirements for the SeaTECH line of containerized systems for the Industrial, Power and Municipal markets. All necessary equipment required for independent operation is provided given the necessary pretreatment precautions are taken. Design basis includes 6 containerized systems:

- SWRO and power distribution/control system, coupled with pump and energy recovery system (2 container) SeaTECH-252
  - Cartridge filter, chemical feed system and CIP utilities container (SeaTECH-UTL-252)
  - Media filtration system (SeaTECH-MMF-80x3H)
- Optional configurations available based on market needs.



SWRO & Pump Operating Parameters	
TDSS	17,000-45,000 mg/l (as NaCl)
SDra	< 3.0
Temperature	10 to 55°C (77 to 95°F)
Recovery	45 to 95%
Normal Rejects	> 90%
Max/Min Supply Pressure	2-4 bar

Note: Low temperatures, recoveries, and high salinities will reduce system productivity.

SWRO & Pump Functional Description

# SeaTECH Installation:

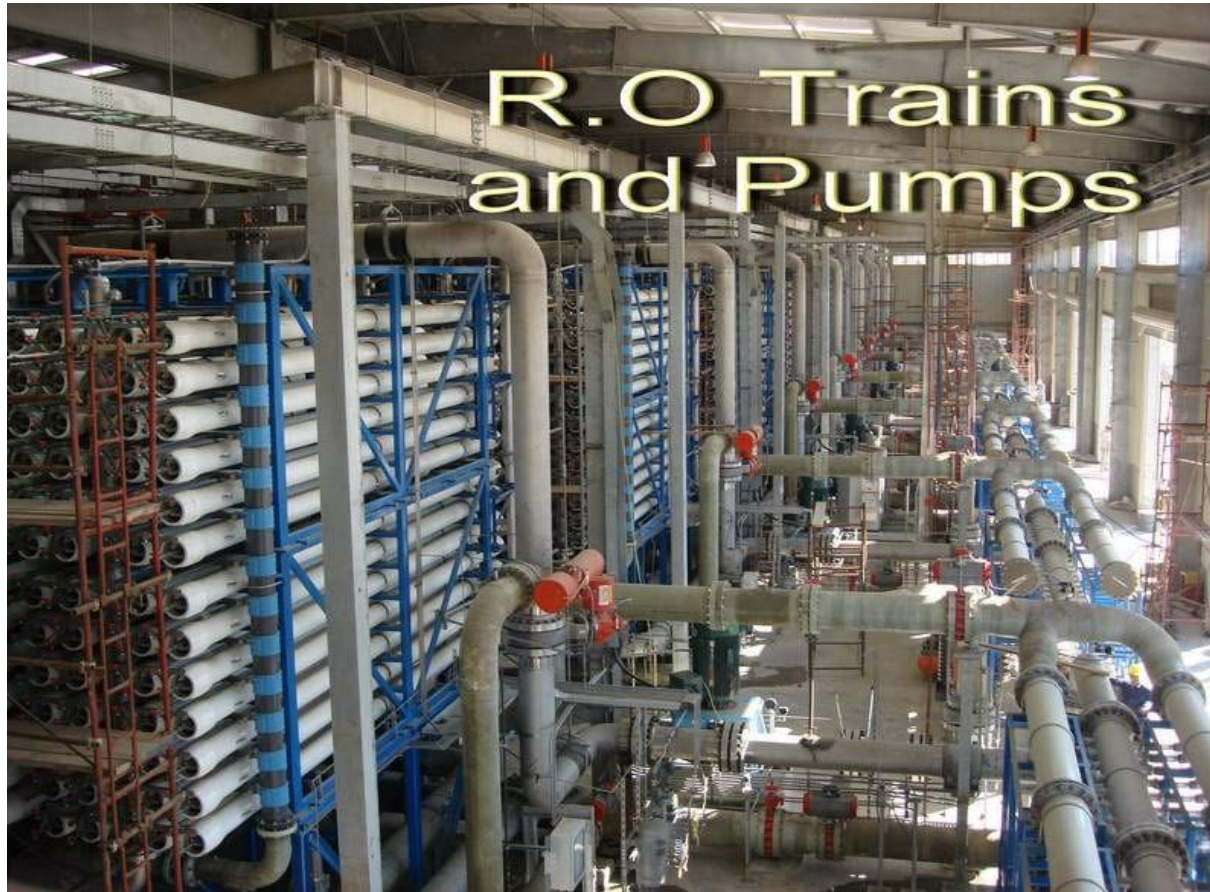
Fuertaventura, Spain  
Canary Islands

Installed: January 2008





# Hamma Seawater Desalination 200.000m<sup>3</sup>/dia - Algiers, Algeria



On-site assembled solution  
SeaSMART



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# Seawater RO Pretreatment

# SWRO Plant: Type of intake

Feed water is collected from either

a) open sea intake (ideally 6 m submerged)

closer to surface = higher risk

near ship traffic = higher risk

b) beach well

They have the advantage of delivering “pre-filtered” water that may greatly reduce additional pretreatment requirements.

closer to ocean = greater solids

farther from ocean = fresh water dilution

From the intake, feed pump transfers sea water to the pretreatment system.

# Pre-treatment Matters!

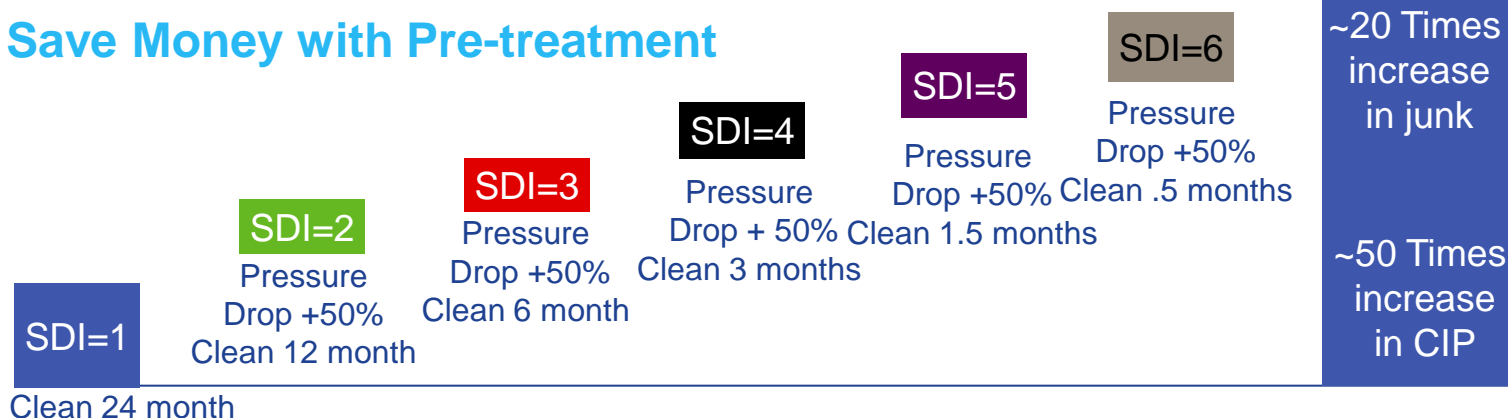
Did you know that qualitatively, SDI is proportional to particulates and junk going through your RO membrane elements. A less efficient system costs you money. In 15 Minutes:

SDI=6-----270 grams  
SDI=5-----90 grams  
SDI=4-----50 grams  
SDI=3-----30 grams  
SDI=2-----15 grams  
SDI=1-----7grams

ELSEVIER, 259-262  
(Kremen, Tanner etal)



## Save Money with Pre-treatment



Patented GE technology:



Depth Filters



UF Membranes

# Pretreatment Platforms

## Two Choices:

### Multimedia Filtration:

- Lowest Equipment Capital Cost
- Well known
- Good water quality produced
- Narrow TSS range
- Standard membrane life
- Larger footprint







### Ultrafiltration:

- New technology
- Best water quality produced
- Broad TSS range
- Longer RO membrane life
- Smaller footprint





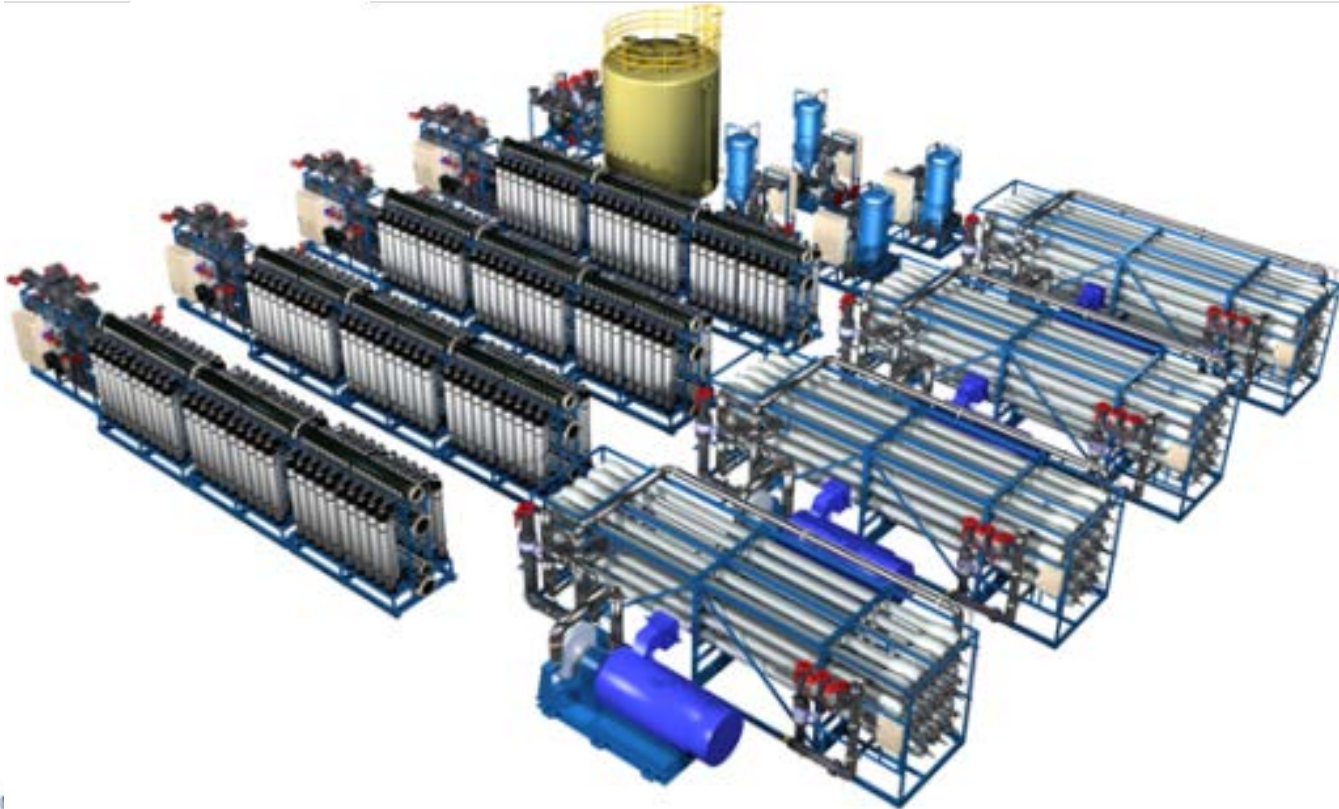
# Seawater Media Filtration Products

Model	Capacity		Capability
SeaTECH-MMF-84x3V	500gpm 2,700 m <sup>3</sup> /day		1 x MMF for Beach Well (<3ppm TSS) 3 x MMF for Open In-Take (<20ppm TSS)
SeaTECH-MMF-80x2H	1,100gpm 6,200 m <sup>3</sup> /day		Max feed turbidity TSS: 10ppm
SWRO MMF63	100gpm 550 m <sup>3</sup> /day		Max feed turbidity TSS: 10ppm
SWRO MMF96	250gpm 1,360 m <sup>3</sup> /day		Max feed turbidity TSS: 10ppm

# SeaPAK Series

## Integrated UF SWRO Platform:

- SeaPAK-1000: 1000 m<sup>3</sup>/day of permeate
- SeaPAK-2500: 2500 m<sup>3</sup>/day of permeate

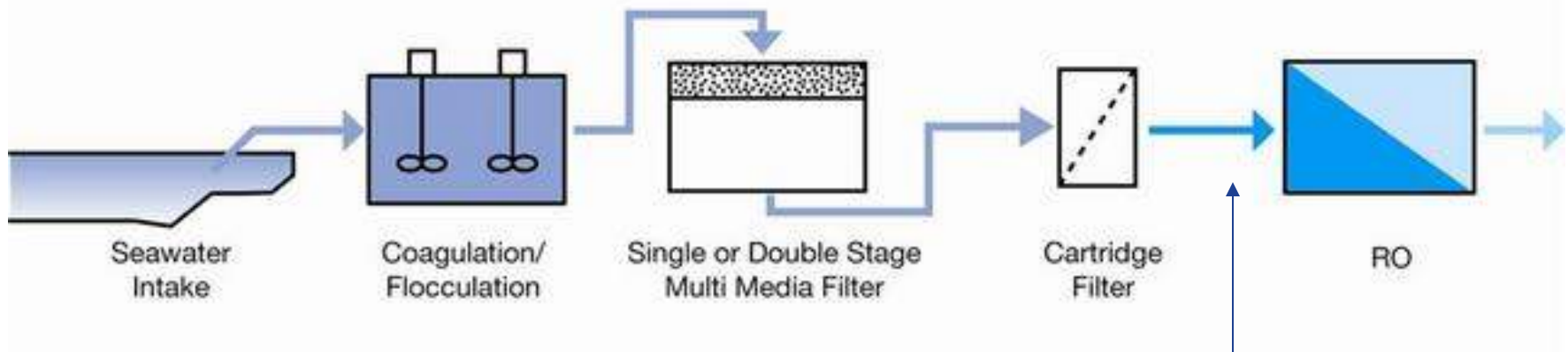


# Comparação Técnica UF vs. FMM

Pré-tratamento	UF ZeeWeed®	Convencional
Descrição	<ul style="list-style-type: none"><li>• Fibra oca imersa</li><li>• tamanho nominal do poro 0.02 µm</li></ul>	<ul style="list-style-type: none"><li>• Filtro multimedia (FMM)</li><li>• Filtro cartucho de 5 µm</li></ul>
Qualidade da água tratada	<ul style="list-style-type: none"><li>• Qualidade consistente e confiável</li><li>• SDI &lt; 2.5, 100% do tempo, tipicamente &lt; 1.5</li><li>• Turbidez: &lt; 0.1 NTU</li><li>• Barreira absoluta para partículas e microrganismos</li><li>• Bacteria: &gt; 5 log remoção</li><li>• <i>Giardia</i>Cyst: &gt; 4 log remoção</li><li>• Virus: &gt; 4 log remoção</li></ul>	<ul style="list-style-type: none"><li>• Qualidade flutua</li><li>• SDI &lt; 4 ~90% do tempo</li><li>• Turbidez: &lt; 1.0 NTU</li><li>• FMM não é uma barreira absoluta para partículas e microrganismos</li><li>• Qualidade da água flutua em relação a retenção das partículas e qualidade da água bruta.</li></ul>

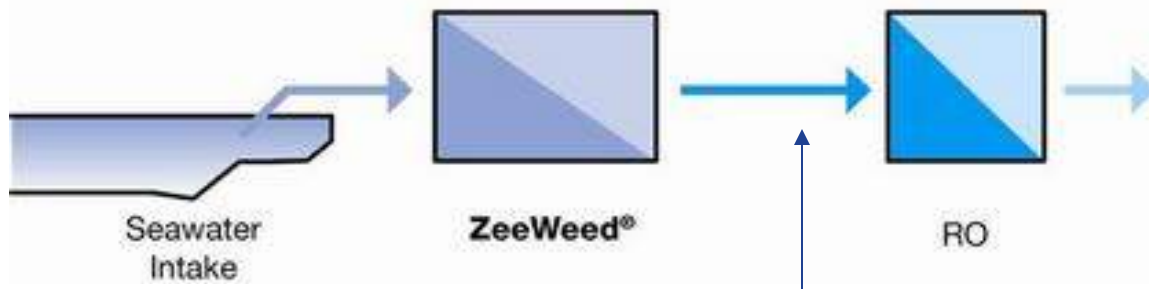
# Conventional SWRO Process Vs. GE's Optimized SWRO Process

## Conventional RO Pretreatment Process



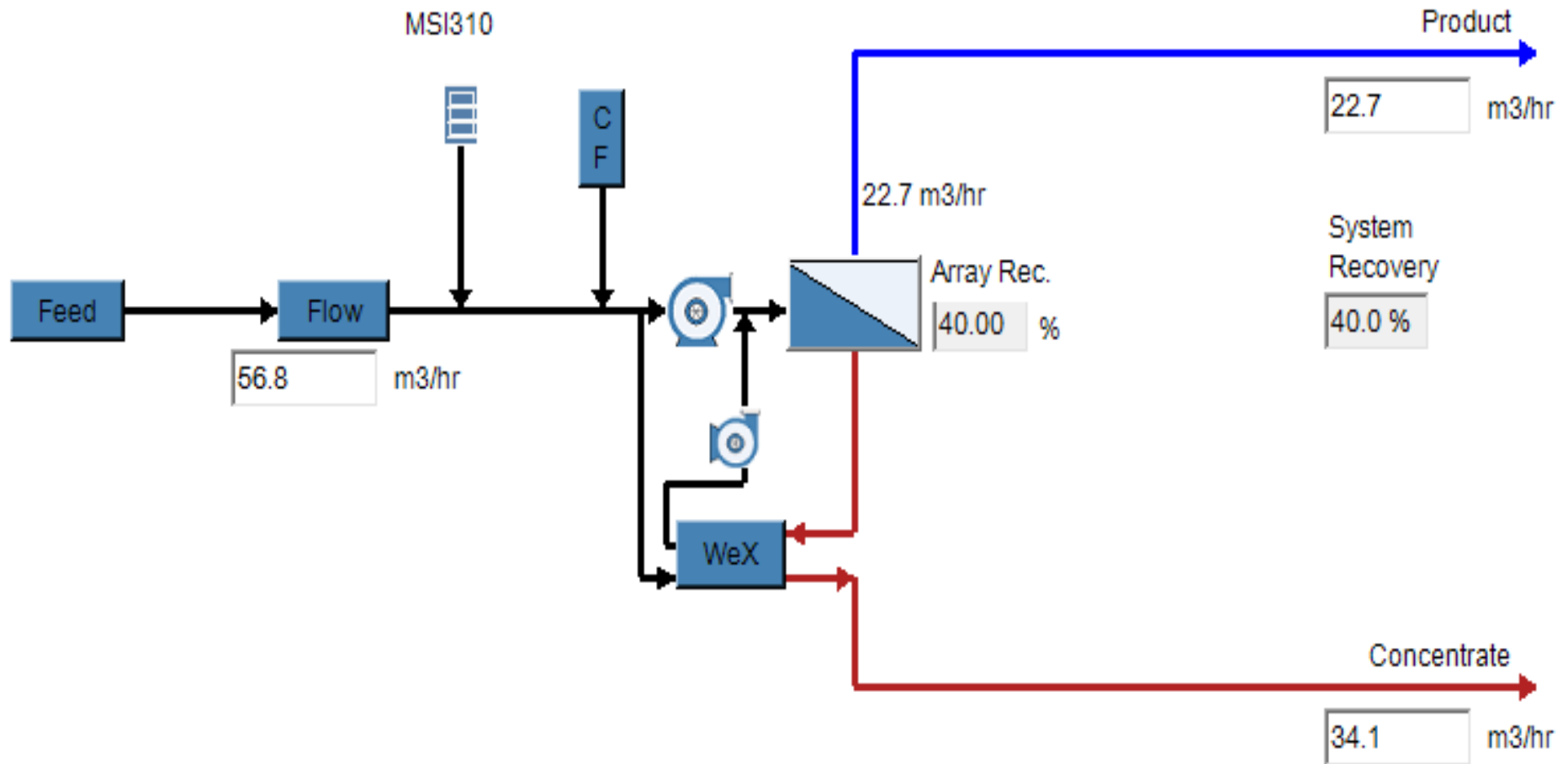
**SDI ~4-5  
(90% of time)**

## ZeeWeed® Simplified RO Pretreatment Process



**SDI =<2.5 (100% of time)**

# WinFlows





# WinFlows

Stage	Total		Element Type	Flow, m3/hr		Pressure, bar		Perm TDS
	Housing	Element		Feed	Perm	Feed	DP	mg/l
1	6	42	SW-RO-400-HR	56.78	22.70	51.79	0.98	209.81
Total	6	42						

## Analytical data

mg/l				mg/l			
Cation	Product	Feed	Conc	Anion	Product	Feed	Conc
Ca	0.62	413.08	679.05	SO4	2.40	2735.64	4498.15
Mg	1.54	1314.15	2160.59	Cl	122.89	19686.71	32302.31
Na	75.67	10955.10	17970.62	F	0.00	0.00	0.00
K	4.07	400.88	656.77	NO3	0.00	0.00	0.00
NH4	0.00	0.00	0.00	Br	0.65	67.83	111.14
Ba	0.00	0.00	0.00	PO4	0.00	0.00	0.00
Sr	0.00	0.00	0.00	B	0.00	0.00	0.00
Fe	0.00	0.00	0.00	SiO2	0.04	5.06	8.30
Mn	0.00	0.00	0.00	H2S	0.00	0.00	0.00
TDS mg/l	209.81	35726.29	58628.77	HCO3	1.94	147.60	241.23
pH	5.50	7.00	7.09	CO2	9.18	9.18	9.23
				CO3	0.00	0.25	0.61

# WinFlows

Flow Data	m3/hr	Analytical Data	mg/L
Raw Feed:	56.78	Raw Feed TDS	35289.23
Product:	22.70	Product TDS	209.81
Concentrate:	34.10	Concentrate TDS	58628.77

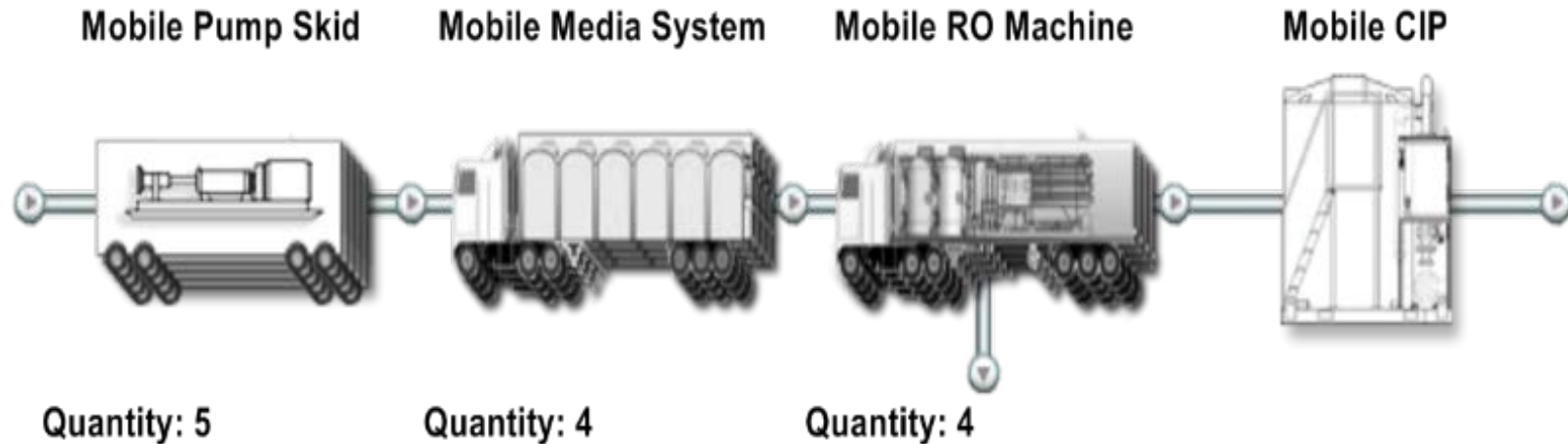
System Data	Single Pass Design		
Temperature: C	RO-1: 25.00		
		<b>Pass 1</b>	
Feed Flow to 1st Stage Housing	m3/hr		56.78
Feed Pressure	bar		51.79
Array Recovery	%		40.00
Permeate Flow	m3/hr		22.70
Split Permeate Flow	m3/hr		0.00

Pump Summary			
<b>Main Pump</b>		<b>Pass 1</b>	
Feed Flow	m3/hr		22.70
Inlet Pressure	bar		2.50
Discharge Pressure	bar		51.79
Total Efficiency	%		65.27
Power	kW		47.62
<b>ERD Booster Pump</b>			
Feed Flow	m3/hr		34.08
Pressure Increase	bar		1.53
Efficiency	%		54.38
Power	kW		2.66

<b>Total Power Consumption</b>	kW	50.28
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# Mobile Fleet (Sea Water System)

Example: System to produce 180 m<sup>3</sup>/h of permeate



Each train can produce up to 45 m<sup>3</sup> / h of permeate.

Emergency assistance and BOO contracts.

Estimated cost per m<sup>3</sup>:

- 12 months Contract: R\$ 4,00
- 10-years BOO contract: R\$ 2,80



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