Архангельск (8182)63-90-72
Астана (7172)727-132
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
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Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
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Красноярск (391)204-63-61
Курск (4712)77-13-04
Липецк (4742)52-20-81
Киргизия (996)312-96-26-47
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
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Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Казахстан (772)734-952-31
Пермь (342)205-81-47
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Рязань (4912)46-61-64
Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Таджикистан (992)427-82-92-69
Сургут (3462)77-98-35
Тверь (4822)63-31-35
Томск (3822)98-41-53
Тула (4872)74-02-29
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Ярославль (4852)69-52-93

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Multi-Effect Plate Distiller

MEP Series

Application

Conversion of seawater through Multi-Effect Distillation for production of high purity water for domestic and industrial use. Applicable on Cruise Liners, Oil & Gas Industry, Power Plants, Industries and domestic water production.

Features

- Simple design
- Enhanced performance by means of plate type evaporator/condenser
- Titanium heat transfer surfaces
- Non-coated materials resistant to seawater and brines
- Easy access for service
- Simple and reliable automation and control

Benefits

Lowest overall water production costs:
- Based on waste heat recovery
- Simple raw water pre-treatment
- 25 years economical life
- Lowest operation and maintenance costs

Highest availability:
- > 90% of yearly hours

Simple operation & maintenance:
- Full access to evaporator heat transfer surfaces for manual cleaning
- Low educational requirement for operators

High distillate purity:
- Conductivity < 10 μS/cm
- Lowest costs for technical water treatment

Capacity range

Our product range covers capacities from 200 up to 10,000 m^3/day per unit. Based on standard components and a modular concept, each unit is custom-designed for each particular installation.

The process

The Multiple Effect Distillation Process consists of a series of evaporation and condensation chambers called effects (1). Each effect is fitted with heat transfer surfaces based on plates - a patented proprietary design of Alfa Laval Desalt. In the plate channels, seawater is first evaporated and then condensed into pure distillate.

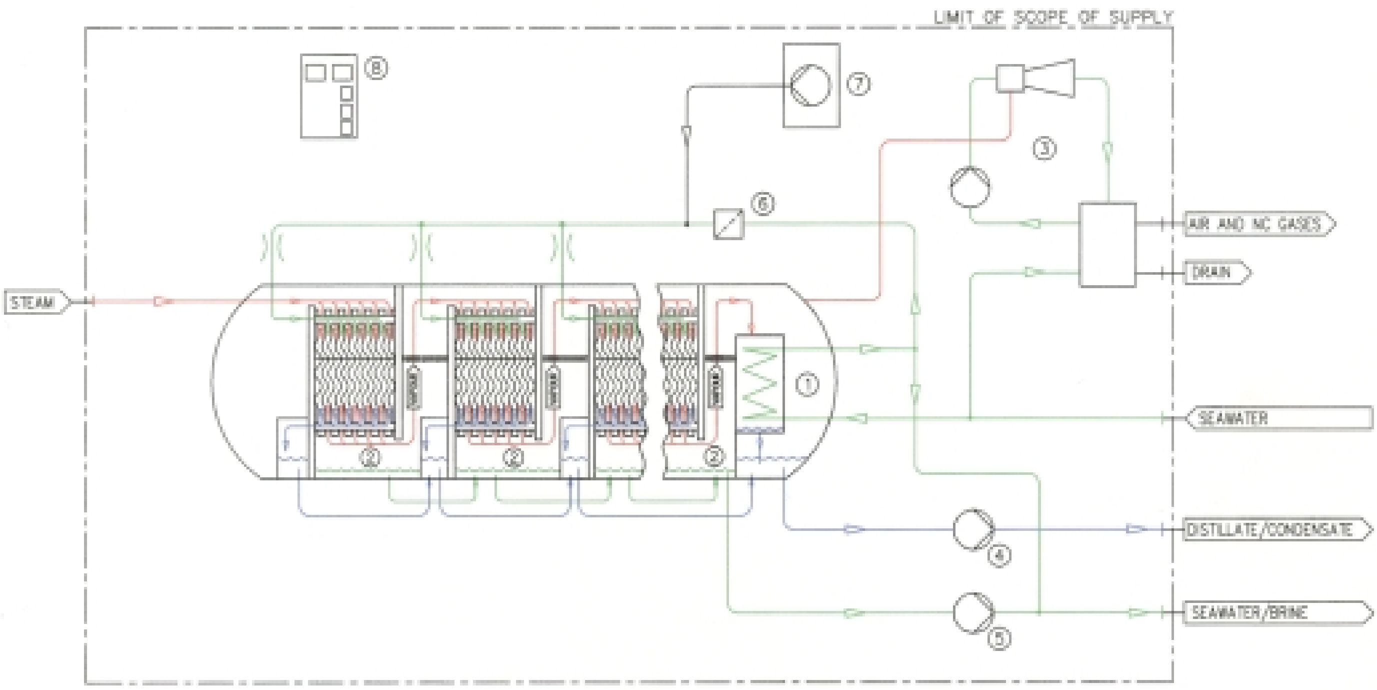
By maintaining a partial pressure difference across the effects, the process is able to yield maximum efficiency from available low-grade thermal energy sources. The economic performance and also the capital cost of the system is proportional to the number of effects contained in a unit.

Seawater is pumped into the system via an external pump to a condenser (2). Here, the seawater acts as a coolant removing the heat supplied to the system and thereby maintaining the proper energy balance. In the condenser the vapour produced in the last effect is condensed into pure distillate.

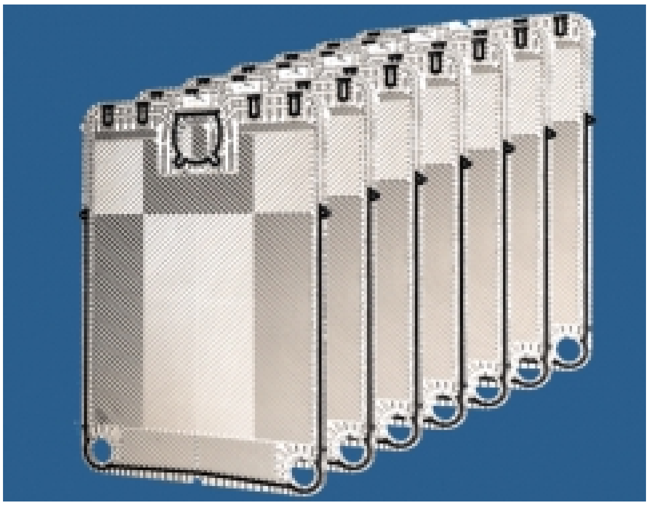
As vapour is condensed, heat is transferred to the seawater. The preheated seawater is then delivered by the feed-water pump (3) to the various effects in the unit for evaporation. The seawater flows towards the evaporation side of the plate stack in an even and controlled falling film. The special design of the plate surfaces ensures an even flow with no dry areas in order to reduce scaling to a minimum.

On the evaporation side of the plate stack, the seawater is partially evaporated by the latent heat from the condensation side of the plate. The vapour thus obtained is passed through a demister for separation of salt droplets prior to entering the condensation side of the heat exchanger plates. Here, the vapour condenses into distilled water while yielding its latent heat through the plate to the evaporation side.
The process is repeated in all effects. Finally, distillate and brine are extracted from the last effect.

The evaporation is done at subatmospheric conditions and vacuum is created and maintained by a venting system. The venting system can either be a water driven ejector (4), as shown on the flow diagram, or a steam driven ejector. The venting system evacuates the plant at start-up and extracts non-condensable gases during operation of the plant.



1	Condenser	4	Distillate discharge pump	7	Anti-scalant dosing unit
2	Evaporator effects	5	Brine discharge pump	8	MCC & Control Panel
3	Vacuum system	6	Make-up filter		



The Plate Technology

Alfa Laval's distillation equipment consists of a number of titanium plate heat exchangers, which have been specifically designed for this purpose. All plates are identical; with two gasket configurations being utilised in order to form both a condensing and an evaporating plate channel.

The plates are fitted into the evaporator vessel, forming a complete plate pack.

Compared to traditional shell and tube technology, the Plate Technology gives higher thermal efficiency. The material used for the plates is Titanium grade 1, which is considered the ultimate material concerning corrosion resistance in seawater enrironment (especially at elevated temperatures).

Full access to the Heating Surfaces

In the Alfa Laval plate concept, the plate pack can easily be disassembled for inspection and cleaning. In fact, the entire plate pack can easily be removed from the vessel through man-ways.

In comparison, traditional shell and tube plants have limited access for inspection. Mechanical cleaning is practically impossible. Should this be required in these systems, tubes will have to be removed and replaced, thereby incurring high costs.

Easy Removal of Scale

If calcium carbonate scaling occurs in an Alfa Laval desalination unit, it is easily removed by chemical cleaning with a mild acid solution.

However, should calcium sulphate scaling take place, most likely through mis-operation, disassembly of the plate pack can be carried out, allowing the scale to fall to the bottom of the desalination vessel.

This means that the desalination unit can be brought back on line and up to rated capacity with minimal downtime and virtually no expense.

Should this happen with traditional shell and tube units, the downtime would be extended, expensive cleaning chemicals used and virtually no guarantee that the unit will produce rated capacity. Added to this, if the scaling is significant, tubes will have to be scrapped and replaced.

The illustrations shown above are from a plant which was deliberately scaled up with calcium sulphate in order to successfully test and prove 100% cleanability.

Alfa Laval in Brief

Alfa Laval is a leading global provider of specialized products and engineered solutions.

Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again.

We help our customers to heat, cool, seperate and transport producсts such as oil, water, chemicals, beverages, foodstuff, starch and pharmaceuticals.

Our worldwide organization works closely with customers in almost 100 countries to help them stay ahead.

High Efficiency Evaporator

MEP: Multi-Effect Plate evaporator

The Alfa Laval Multi-Effect Plate (MEP) evaporator is used, among other places, on cruise vessels and at diesel power plants to produce the highest quality fresh water at the lowest possible overall production costs. The MEP system shown here has three effects and an integrated shell & tube condenser.

Application

Supplying high quality fresh water to meet the demands onboard the fleets of the world and at diesel power plants is a challenge that must be addressed in order to support sustainable development. To meet the growing demand for potable and technical water, it is important to be able to provide economical and efficient desalination technologies.

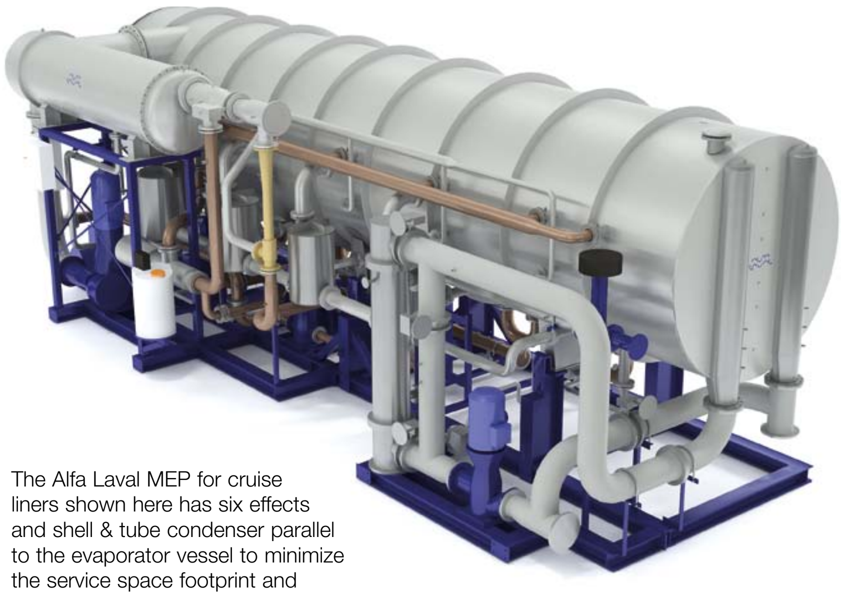
MEP system from Alfa Laval

The Alfa Laval MEP system is an easy-to-use fresh water distiller that uses seawater to produce the highest quality distillate with a conductivity of less than 20 µS/cm at the lowest possible overall production cost.

Economical and highly efficient, the MEP employs combined plate-type evaporator/condenser effects to produce fresh water using the available waste heat from hot water or low-pressure steam, or a combination of both. The self-contained automated MEP evaporator is designed with very high thermal efficiency for high production rates using very little waste heat. Furthermore, the electric energy consumption is kept to a minimum through the use of an optimized pump configuration and the application of frequency controlled motor on the sea water pump.

With its modular design, this highly reliable MEP evaporator is easy to configure to the requirements of any vessel, diesel power plant. Straightforward operation and automated control provides maximum uptime at less cost compared to technologies such as reverse osmosis (RO) and multi-stage flash (MSF). Its lightweight, space-saving design takes up less floor space while offering much higher thermal efficiency in relation to its volume and weight compared to other evaporators. This enables the production of much higher volumes of fresh water than other desalination technologies.

The MEP system offers the lowest possible consumption of both electric energy and chemicals. The electric energy consumption of the four-effect MEP-4-750 desalination unit, for example, is less than 2.5 kWh/m^3. Moreover, the MEP does not require brine circulation or any anti-foam injection, and its total anti-scale chemical consumption is less than traditional multi-stage flash units.



The Alfa Laval MEP for cruise liners shown here has six effects and shell & tube condenser parallel to the evaporator vessel to minimize the service space footprint and avoid a cross-tube design.

Alfa Laval MEP in brief

- Low water production cost
- State-of-the-art and user-friendly control technology
- Fast start-up and quick response to load changes
- Corrosion-resistant titanium plates
- Patented plate design and thin film process for high thermal efficiency
- Unique construction that allows direct access to heating surfaces
- Evaporator vessel of AISI 316L steel
- High distillate purity and salinity of 5–10 ppm (10–20 µS/cm)
- Capacity range: 180–1000 m^3/24 h per unit

Features and benefits

Lowest overall water production costs
The MEP is the most economical and cost-effective technology available today to produce fresh water from seawater when waste heat is available. A simple, straightforward design and PLC-based control system make the MEP easy-to-use without requiring extensive operator training.

Energy efficiency
The MEP uses between 30% and 70% less electric power than comparable reverse osmosis systems, and between 50% and 80% less compared to multi-stage flash desalination systems. Actual cost savings will vary according to the unit type, operating conditions and electricity prices. In addition, unlike reverse osmosis systems, the MEP does not require pre-heating of the seawater when seawater temperature drops below 25°C.

High reliability
The MEP provides more than 95% availability and more uptime than comparable shell & tube evaporators. All available diesel engine waste heat is used independently of the load of the diesel engines. Distillate production can automatically be maintained down to 30% of the design rate.

High efficiency
The MEP evaporator effects consist of corrosion-resistant titanium plates with a patented corrugated design that promotes high turbulence and thereby extremely high thermal efficiency. All plates of an effect are identical but have two different gasket configurations in order to form both condensing and evaporating plate channels on each effect. The effects are fitted into the evaporator vessel, forming a multi-effect plate evaporator.

Minimal environmental impact
Reduced chemicals consumption combined with reduced pumping requirements results in reduced overall CO_2 emissions and compliance with the Kyoto Protocol, which provides subsidies in the EU region.

Reduced chemicals storage and consumption
The MEP only requires cleaning using specially developed non-toxic cleaning agents about once a year, or approximately 10 times less than reverse osmosis systems. This means less floor space is required for storage of full and empty plastic barrels and lower waste disposal costs.

Minimal maintenance and downtime
A continuous thin film of water over the entire plate surface minimizes the risk of deposit build-up (scale) and thereby downtime. Corrosion-resistant titanium heat transfer surfaces and non-coated materials withstand seawater and brines.

The Alfa Laval MEP system for diesel power plants.

Should calcium carbonate scaling occur, it is easily removed by chemical cleaning with a non-toxic solution using Cleaning-in-Place (CIP) equipment.

In the unlikely event of calcium sulphate scaling, which usually results from incorrect operation of the unit, disassembly of the plate pack can be carried out, allowing the scale to fall to the bottom of the desalination vessel. This enables the unit to be brought back online at rated capacity with minimal downtime. This is not possible with a tubular system.

Full access to heating surfaces
Simply open the MEP access doors to inspect and/or clean the MEP vessel's internal compartments, including the entire plate pack as well as individual plates. The plate packs can also be completely removed from the vessel for maintenance, if required.

Easy, automated operation
The MEP is a fully automated PLC-controlled solution that provides reliable operation.

Operating principle

The Alfa Laval MEP desalination process consists of a series of evaporation and condensation chambers known as effects (2). Each effect is fitted with heat transfer surfaces based on patented Alfa Laval plates. In the plate channels of an effect, seawater on one side is heated up and partially evaporated to distillate vapour, which is used in the next effect; on the other side, the distillate vapour from the previous effect is condensed, giving up its latent heat, into pure distillate.

By maintaining a partial pressure difference across the effects, the process is able to yield maximum efficiency from available low-grade thermal energy sources. The performance and the capital cost of the system are proportional to the number of effects contained in a unit.

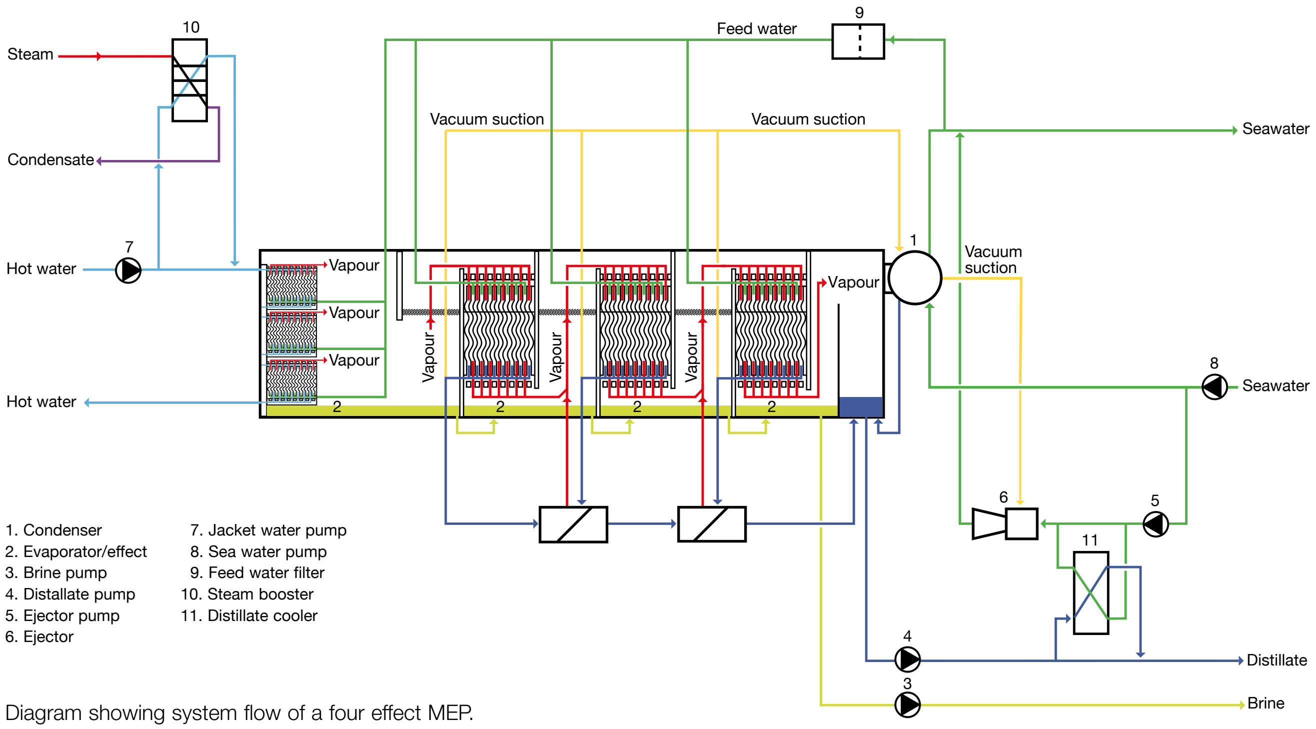
Seawater is pumped into the system via a seawater pump (8) to a condenser (1). Here, the seawater acts as a coolant, removing the heat supplied to the system and thereby maintaining the proper energy balance. In the condenser, the vapour produced in the last effect is condensed into pure distillate.

As distillate vapour is condensed, heat is transferred to the seawater. The seawater pump (8) also transports preheated seawater downstream of the condenser to the various effects (2) of the unit for evaporation. The seawater is led towards the evaporation side of the plate stack, creating a uniform and controlled thin film on the plate. To minimize scaling, the special design of the plate surfaces ensures a uniform flow without any dry areas.

On the evaporation side of the plate stack, the seawater is partially evaporated by the heat from the condensation side of the plate stack. The vapour thus produced is passed through a demister to separate salt from the water droplets before the vapour enters the condensation side of the subsequent heat exchanger plates. Here, the vapour condenses into distilled water while transferring its latent heat through the plates to the evaporation side.

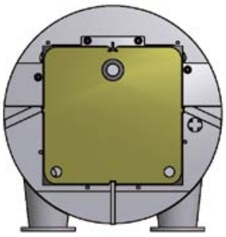
The process is repeated in all effects. Finally, distillate and brine are extracted from the last effect.

The evaporation takes place at sub-atmospheric conditions, and vacuum conditions are created and maintained by a venting system. The venting system is a water-driven ejector (5 and 6), as shown on the flow diagram. The venting system removes air from the plant at start-up and extracts non-condensable gases during operation of the plant.

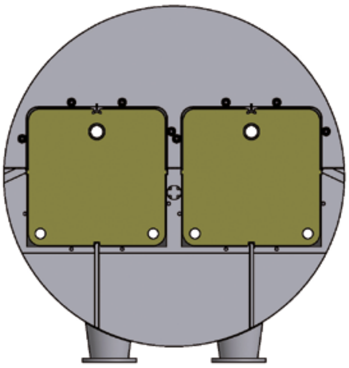


1. Condenser
2. Evaporator/effect
3. Brine pump
4. Distallate pump
5. Ejector pump
6. Ejector
7. Jacket water pump
8. Sea water pump
9. Feed water filter
10. Steam booster
11. Distillate cooler

Diagram showing system flow of a four effect MEP.



MEP 1.6 m vessel.



MEP 2.5 m vessel.

Capacity range

Vessel diameter	Capacity range*
1.6 m	180–500 m^3/24h
2.5 m	500–1000 m^3/24h

* Upon request, Alfa Laval can also supply MEP systems with capacities up to 7000 m^3/24h based on larger plates and vessels.

The MEP system can supply between 180 and 1000 cubic meters of fresh water a day, depending on the unit employed. This means that ship owners and operators need to bunker less fresh water when at port. Based on standard components and a modular concept, each unit is custom-designed.

Ship installations

	Vessel diameter (mm)	Length (mm)	Width (mm)	Height (mm)
MEP-2-180	1600	4500	3000	2700
MEP-3-250	1600	5500	3000	3000
MEP-4-500	1600	9000	3500	3300
MEP-4-750	2500	9000	5000	4100
MEP-5-750	2500	9700	5000	4100
MEP-4-900	2500	9700	5000	4100
MEP-5-900	2500	10400	5000	4100
MEP-6-1000	2500	11800	5000	4100

Service space should be decided depending on machine room layout.

Diesel plant installations, including gangway and stairs

	Vessel diameter (mm)	Length (mm)	Width (mm)	Height (mm)
MEP-2-180	1600	6000	3500	2700
MEP-3-250	1600	7000	3500	3000
MEP-4-500	1600	10500	4000	3300
MEP-4-750	2500	11000	5600	4100
MEP-5-750	2500	11700	5600	4100
MEP-4-900	2500	11700	5600	4100
MEP-5-900	2500	12400	5600	4100
MEP-6-1000	2500	14200	5600	4100

Service space should be designed based on site layout.

Specific energy consumption (in kWh/m^3)

Electrical consumption range*	1.3–3.9
Heat consumption range	128–385

* Note: Electrical consumption will depend on the unit type and actual installation.

Thermo Vapour Compression Distiller

TVC Series

Application

Conversion of seawater through Multi-Effect Distillation for production of high purity water for domestic and industrial use. Applicable on Cruise Liners, Oil & Gas Industry, Power Plants, Industries and domestic water production.

Features

- Simple design
- Plate type evaporator/condenser
- Titanium heat transfer surfaces
- Non-coated materials resistant to seawater and brines
- Easy access for service
- Simple and reliable automation and control
- Enhanced performance by means of thermo vapour compression

Benefits

Lowest overall water production costs:

- Simple raw water pre-treatment
- 25 years economical life
- Lowest operation and maintenance costs

Highest availability:

- > 90% of yearly hours

Simple operation & maintenance:

- Full access to evaporator heat transfer surfaces for manual cleaning
- Low educational requirement for operating crew

High distillate purity:

- Conductivity < 10 uS/cm
- Lowest cost for technical water treatment

Capacity range

Our product range covers capacities from 200 up to 25,000 m^3/day per unit. Based on standard components and a modular concept, each unit is custom-designed for each particular installation.

The process

Thermo vapour compression is a distillation process, where evaporation of seawater is obtained by the application of heat delivered by motive steam and recompressed low pressure vapour.

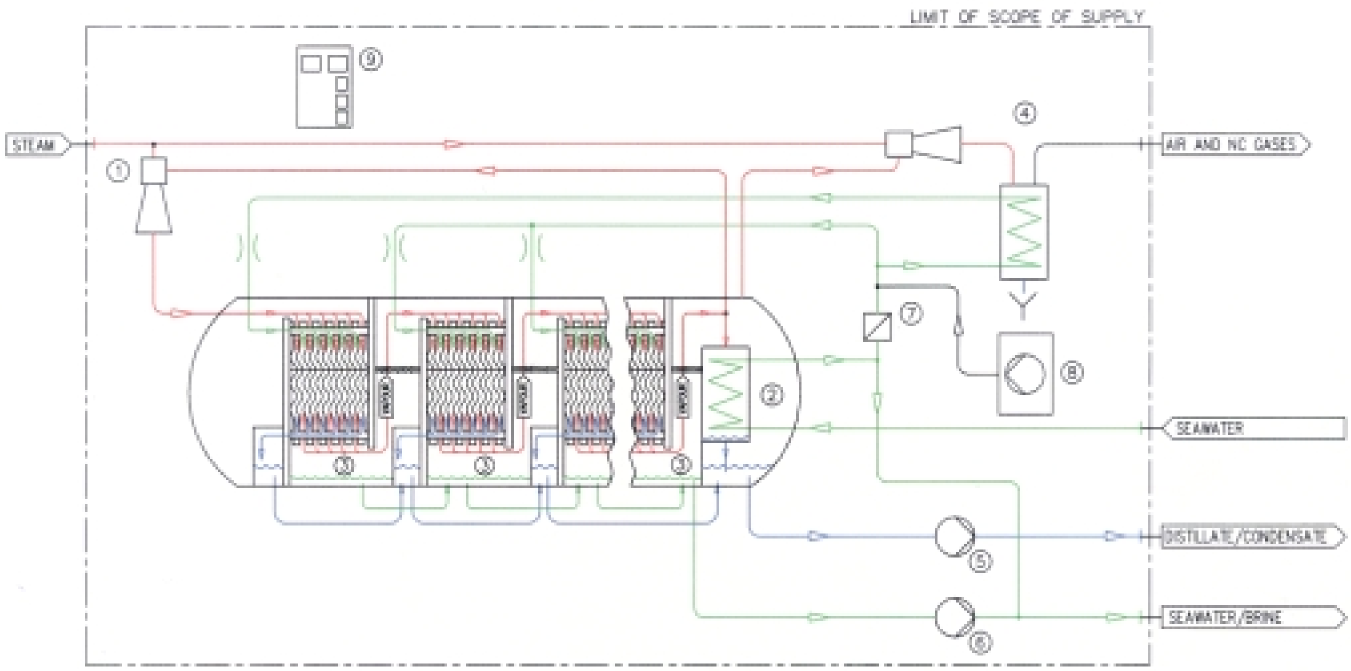
The effect of compressing water vapour is obtained by means of an ejector system (1) motivated by live steam supplied at a pressure of typically 3-10 bar. The ejector system recycles vapour produced in the last (cold) effect of the desalination process, and increases its pressure and temperature. Then the mixture of live steam and recompressed vapour is injected as heating media at the first (hot) effect of the desalination plant.

The sea cooling water is pumped into a condenser (2) and is heated by the condensation of vapour produced in the last (cold) effect of the unit. The feed-water, the water to be evaporated, is taken from the outlet of the condenser, thus utilizing the pre-heating provided by the condenser. The remaining part of the sea cooling water is rejected back to the sea.

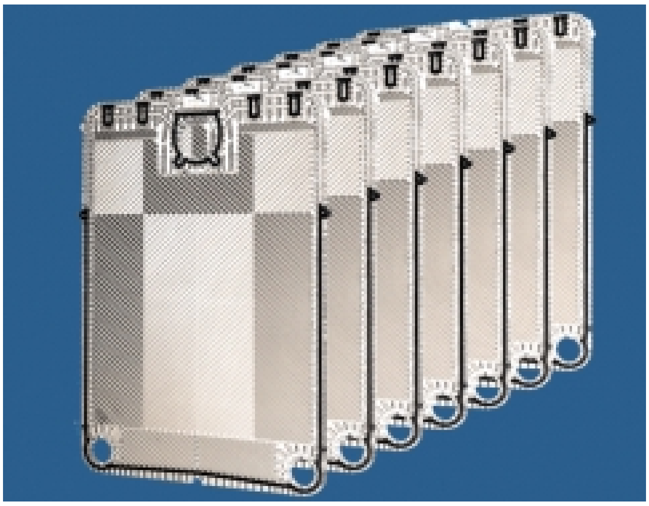
The preheated seawater is then delivered into the Titanium plate heat exchangers' evaporator section. The seawater flows on the plates in an even and controlled falling film. While flowing down, the seawater film is heated up and partially evaporated by the heat obtained from the condensation of vapour on the other side of the plate. The released vapour then flows through a demister to the Titanium plate heat exchangers' condensing side of the subsequent effect. Here the vapour condenses into pure distillate water while transferring its latent heat, and thereby evaporating the seawater which flows on a falling film on the other side of the plates. The process is repeated in all effects of the desalination unit.

The transport of fluids inside the evaporator such as vapour, distillate water and brine is done by the pressure differential created between effects. The effect number one, which operates at the highest temperature, has the highest pressure, - the subsequent effect has a lower temperature and pressure. This pressure differential is maintained throughout all the effects of the unit.

The evaporation is done at subatmospheric conditions and vacuum is created and maintained by a venting system. The venting system can either be a water driven ejector (4), as shown on the flow diagram, or a steam driven ejector. The venting system evacuates the plant at start-up and extracts non-condensable gases during operation of the plant.



1	Thermo-compressor	4	Vacuum system	7	Make-up filter
2	Condenser	5	Distillate discharge pump	8	Anti-scalant dosing unit
3	Evaporator effects	6	Brine discharge pump	9	MCC & Control Panel



The Plate Technology

Alfa Laval's distillation equipment consists of a number of titanium plate heat exchangers, which have been specifically designed for this purpose. All plates are identical; with two gasket configurations being utilised in order to form both a condensing and an evaporating plate channel.

The plates are fitted into the evaporator vessel, forming a complete plate pack.

Compared to traditional shell and tube technology, the Plate Technology gives higher thermal efficiency. The material used for the plates is Titanium grade 1, which is considered the ultimate material concerning corrosion resistance in seawater enrironment (especially at elevated temperatures).

Full access to the Heating Surfaces

In the Alfa Laval plate concept, the plate pack can easily be disassembled for inspection and cleaning. In fact, the entire plate pack can easily be removed from the vessel through man-ways.

In comparison, traditional shell and tube plants have limited access for inspection. Mechanical cleaning is practically impossible. Should this be required in these systems, tubes will have to be removed and replaced, thereby incurring high costs.

Easy Removal of Scale

If calcium carbonate scaling occurs in an Alfa Laval desalination unit, it is easily removed by chemical cleaning with a mild acid solution.

However, should calcium sulphate scaling take place, most likely through mis-operation, disassembly of the plate pack can be carried out, allowing the scale to fall to the bottom of the desalination vessel.

This means that the desalination unit can be brought back on line and up to rated capacity with minimal downtime and virtually no expense.

Should this happen with traditional shell and tube units, the downtime would be extended, expensive cleaning chemicals used and virtually no guarantee that the unit will produce rated capacity. Added to this, if the scaling is significant, tubes will have to be scrapped and replaced.

The illustrations shown above are from a plant which was deliberately scaled up with calcium sulphate in order to successfully test and prove 100% cleanability.

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