



Mechanical Vapour Compression (MVC) Evaporators

for sea water desalination



Advantages of MVC-HTE Evaporators:

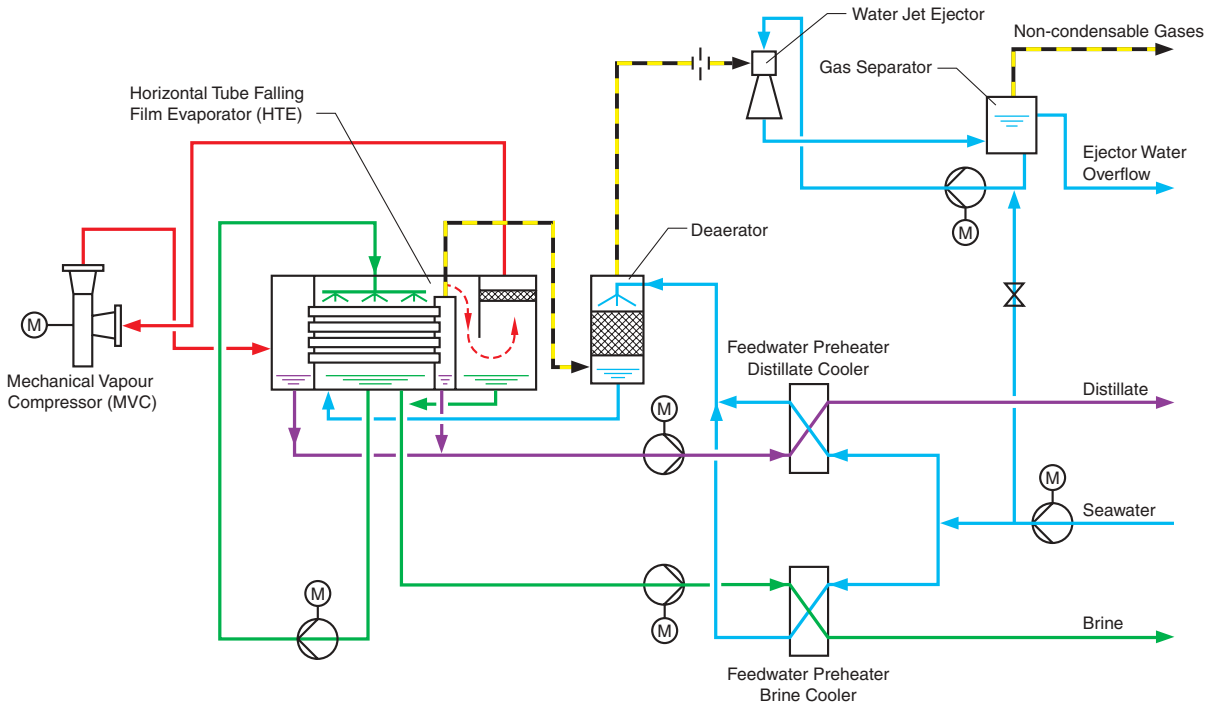
- ▶ Use of a reliable industrial vapour fan as Mechanical Vapour Compressor (MVC) with speed control for driving the process.
- ▶ Horizontal Tube (falling film) Evaporator (HTE) with a narrow tube bundle design for good wetting of tubes with sea water.
- ▶ Highly-efficient mist eliminators (demisters) guarantee optimum distillate quality.
- ▶ Efficient pre-separation of sea water droplets from vapour before entering mist eliminator.
- ▶ Fully automatic operation (start-up, shut-down and partial load).
- ▶ Non-blocking, full conical spray nozzles for a uniform distribution of the feed water.
- ▶ All parts in contact with sea water, brine, vapour or distillate are made from corrosion resistant stainless steel or copper nickel. Tubes - if requested - are made of titanium.
- ▶ Efficient plate type heat exchangers ensure optimum heat recovery so that no additional heat supply is required for start-up or continuous operation.
- ▶ Evaporators can be delivered as packaged units with all integral piping, pumps, valves, switchboard etc.
- ▶ It is recommended that the compressor is installed on a concrete foundation at the appropriate level.

Characteristics of MVC-HTE Evaporators:

- ▶ The capacity of our standard or individually designed plants ranges between 50 and 1200 t/d.
- ▶ Design sea water temperature ranges between 2 and 35°C. This only effects the size of the feed water heaters.
- ▶ Distillate salinity is $\leq 10\mu\text{S/cm}$ (4 ppm) or even less if requested.
- ▶ According to the heat transfer surface installed, the specific electric power consumption including compressor and all process pumps ranges between 10 and 17 kWh/m³ of distillate.
- ▶ The concentration factor is 1.66 and the required sea water is correspondingly only 2.5 times the distillate production. Cooling water is not required.
- ▶ Low evaporation temperature ($\leq 65^\circ\text{C}$) and a limited sea water concentration factor reduces the risk of scale formation on the tubes.
- ▶ The low temperature difference between the process fluids and the large evaporation surfaces result in a low heat influx which further contributes to avoiding scaling.
- ▶ Due to the electronic speed control of the compressor, energy consumption at partial load operation is minimised.
- ▶ On request, a water treatment unit according to WHO - Standards can be supplied.



**Process flow diagram of MVC-HTE Evaporator
(Horizontal Tube Evaporator with Mechanical Vapour Compression)
for sea water desalination**



Description of process

The sea water flows in two parallel streams through two plate type heat exchangers. Before passing through the vacuum deaerator the feed water is heated up by recovering the latent heat available from the distillate and the brine. The pre-heated and deaerated feed water is then mixed into the brine recirculating flow. The recirculation brine is pumped to the top of the evaporator and distributed uniformly over special spray nozzles on a horizontal tube bundle inside the evaporator shell. While the brine flows downwards from tube row to tube row, it is heated by the vapour flowing through the tubes and partial evaporation takes place. The vapour produced passes an internal mist eliminator (demister) and flows to a suction nozzle of a radial vapour fan. Due to mechanical vapour compression, the saturation temperature is raised by approximately 5 K, which causes condensation of the vapour inside the tubes. This process is called 'Open Heat Pump Cycle'.

While the heat of condensation is approximately 660kWh/t of steam, the total electric power consumption of the process is only 10 -17kWh/t (depending on the heat transfer surface installed in the evaporator).

Due to the low heat flux on a large heat transfer surface, the low evaporation temperature ($\leq 65^{\circ}\text{C}$) and the limited concentration of the brine in the evaporator (maximum 7% TDS), the risk of scale formation on the tubes is reduced to a minimum so that it can easily be handled by dosing a small quantity of non-corrosive antiscaling agent.

The vacuum is maintained by a water jet ejector. The non-condensable gases are released in an atmospheric separation tank.



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