Körting
Steam jet chilling plants

The environment-friendly alternative amongst chilling plants

Steam jet chilling plants

Körting steam jet chilling plants
can be ideally utilised whenever large chilling capacities have to be easily realised. Preferably, unused exhaust, residual or excess steam is available.

Körting steam jet chilling plants provide:

- an environment-friendly operation by means of water as refrigerant
- high operational safety
- minimum maintenance
- an easy assembly, as well as a good handling since the plants basically do not require rotating and moving components

Applications

Usually, conventional steam jet chilling plants are equipped with electrically driven mechanical compressors. Such plants show obvious disadvantages as they generate additional energy costs, increased maintenance of rotating components and therefore higher investments for safe operation.

Steam jet chilling plants by Körting provide an environment-friendly alternative at reasonable costs compared with traditional chilling plants. If sufficient motive steam is available, the advantages of the Körting plants are convincing. Körting chilling plants are particularly efficient when processes provide excess or residual steam. This means high efficiency for the entire process, and, at the same time, good chilling performance at high availability and low need of maintenance.

The required cooling water volume is larger than with mechanical compression chilling circuits, but it is comparable to absorption plants.

28 MW steam jet chilling plant in Egypt, cooling of 1 600 m³/h from 35 °C to 20 °C

About 1.4 MW steam jet chilling plant in Stendal, cooling of about 72 m³/h from 25 °C to 8 °C

24 MW steam jet chilling plant Petro China/Sichuan refinery, cooling of 2 300 m³/h from 29 °C to 20 °C

Function

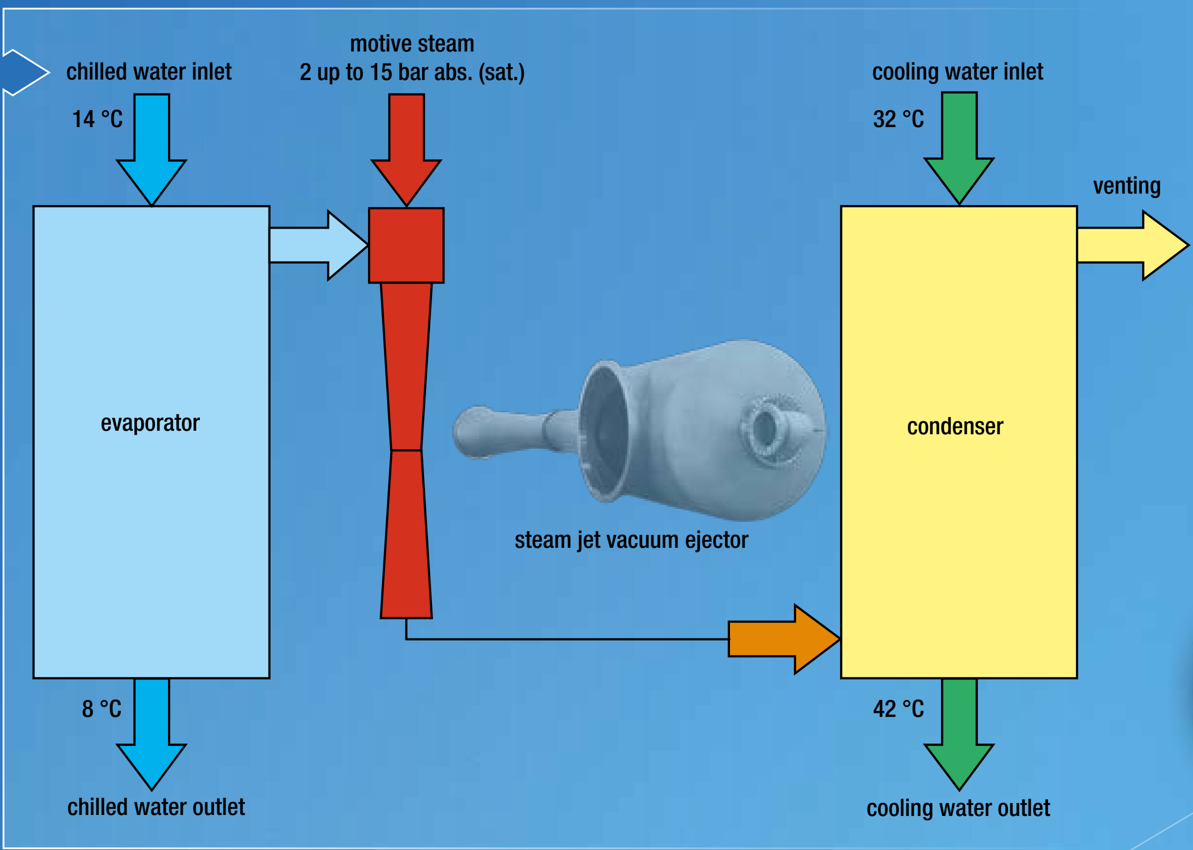
Körting steam jet chilling plants take advantage of the principle of flash evaporation. The liquid to be chilled is being passed through a flash evaporator. The pressure in the evaporator is below the steam pressure of the liquid.

As a result of the flash evaporation process, part of the liquid evaporates (flash steam); evaporation heat is deducted from the heat capacity of the liquid. This causes the liquid to cool down to the boiling point of the respective evaporation pressure (vacuum).

The application is only limited by the freezing point of the liquid to be cooled.

The resulting flash steam will be sucked off by a Körting steam jet vacuum ejector, then compressed and finally condensed in a down-stream condenser. The respective pressure level is defined by the temperature of the used cooling medium.

This condenser has to be vented until atmospheric pressure is reached. For this process Körting steam jet vacuum ejectors or liquid ring pumps have proven to be ideal.



Schematic diagram: steam jet chilling plant

Advantages

- basically no rotating and moving components
- simple and good handling, even with large volume flows and chilling performances
- environment-friendly as no special refrigerants are required (water serves as refrigerant)
- summertime peak load can be covered by the difference in demand of heating steam between summer and winter
- high operational safety
- low maintenance
- simple set-up and easy handling
- long service life
- corrosive media can be dealt with flexibility (use of various successfully tested materials from plant building)
- electrical energy feed is not necessary (except for transporting chilled water and cooling water)
- Körting has many years of experience in the development, design, manufacturing, commissioning and maintenance of steam jet chilling plants

Options

Direct contact condensers are common in use (mixing condensers). Evaporated cooling liquids, cooling water and motive steam are mixed during operation (see figure on the left). By means of surface condensers this kind of mixing can be avoided. Multi-stage evaporators and condensers reduce the steam and cooling water consumption.

Körting steam jet vacuum ejector

Requirements

Increased requirements demand high performance. As with all technical processes the following applies:

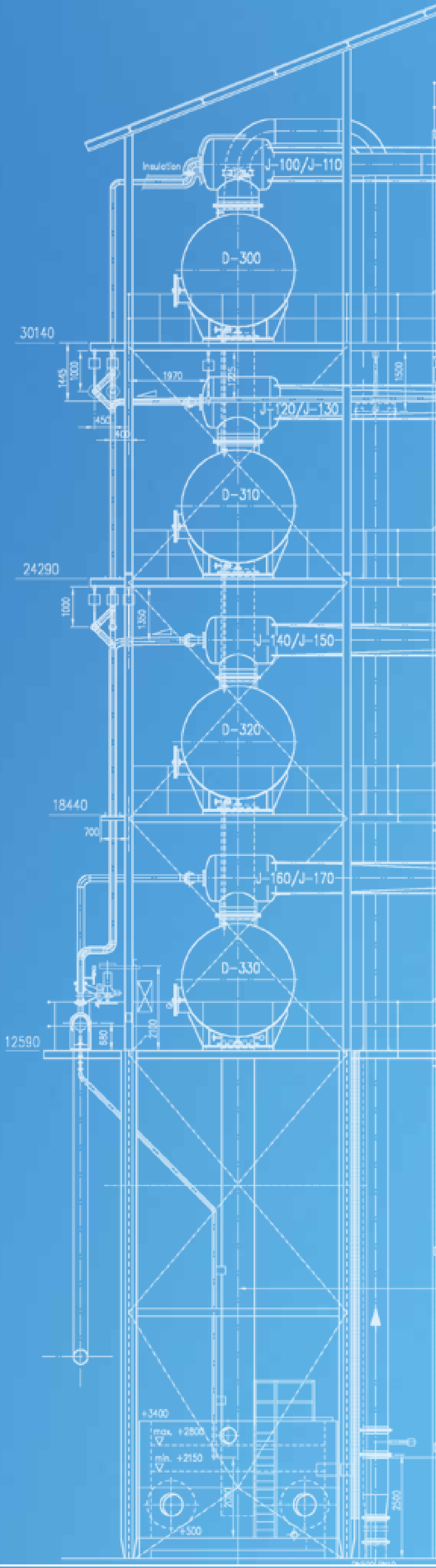
Sometimes less is more – the optimum design saves costs!

Alongside the plant size and the actual cooling performance Körting considers the following for individual design in order to reach high energy efficiency:

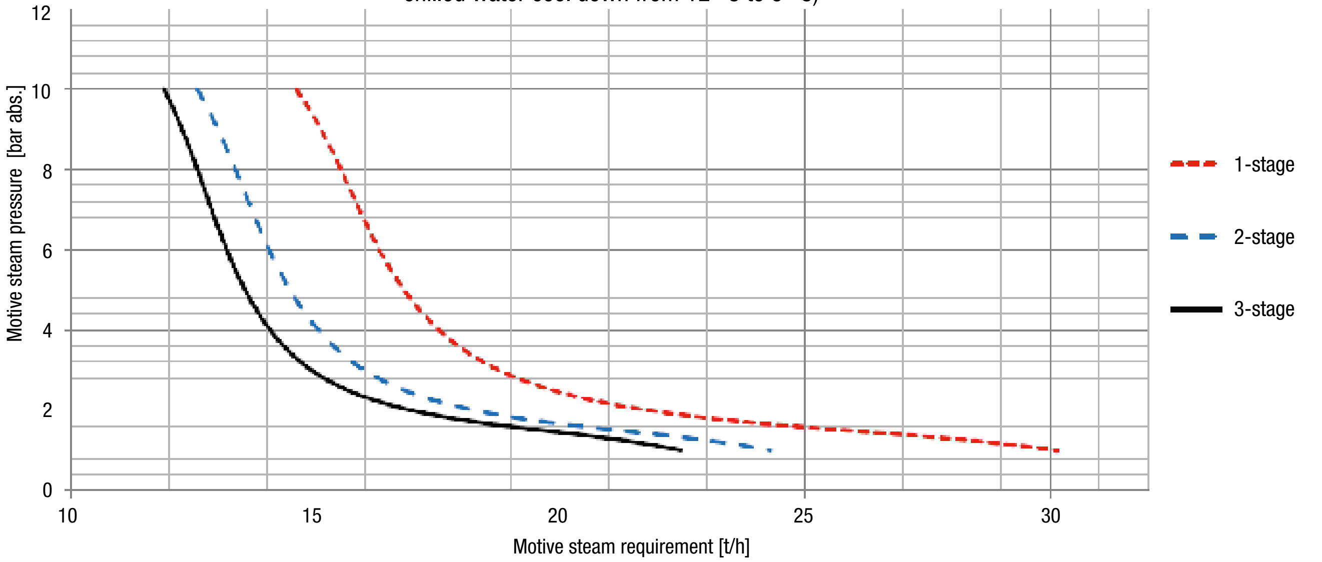
- The lower the required chilled water temperature has to be, the more motive steam is needed.
- The required motive steam flow decreases with an increasing motive steam pressure.
- Multi-stage steam jet chilling plants reduce operational costs and the demand for steam/cooling water considerably. This means that higher investment costs pay off quickly.
- The higher the cooling water temperature at the condenser inlet, the more motive steam is required.
- The more cooling water is available, which means, the less the cooling water heats up, the lower the required motive steam flow.
- In contrast to the countercurrent operation a cocurrent operation requires slightly more motive steam at a similar cooling water flow. However, it permits the space-saving 1-tower design.

What else has to be taken into account:

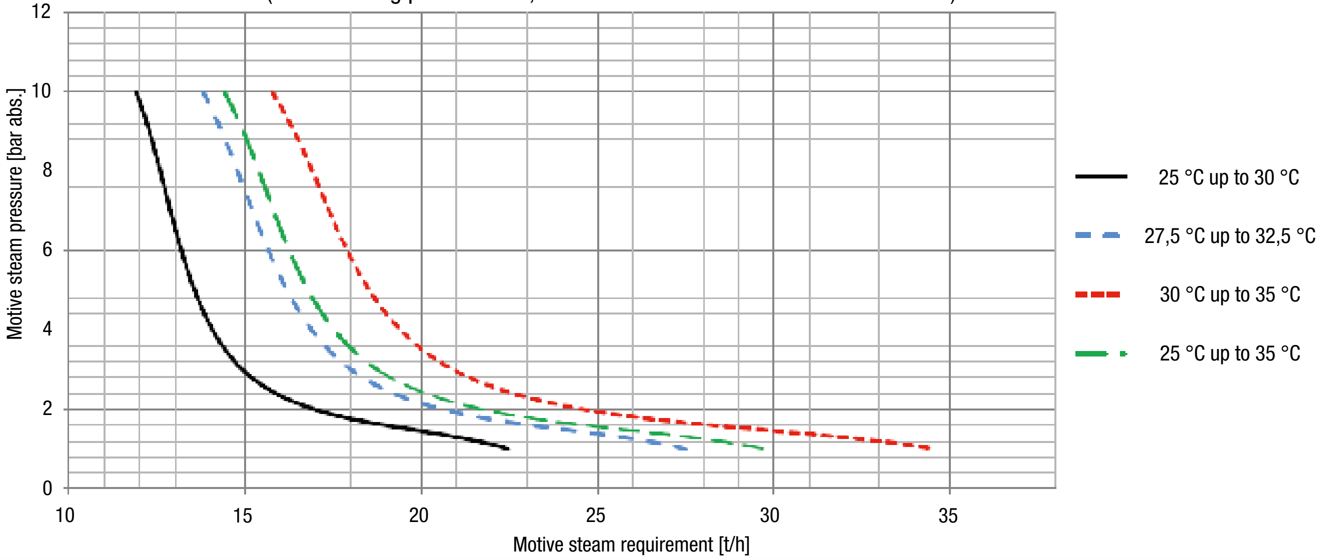
- How long runs the plant? During the whole year or during a certain season only?
- Are there any variations regarding the cooling water inlet temperature (why, when and how strong)?
- Are refrigerants and cooling fluids allowed to mix?
- Are there any requirements regarding corrosion?
- Which build up concept is the most favourable one?
- Shall the build up be horizontal or vertical?
- Does a steel construction already exist? Which load can it bear? Is a steel construction required at all?



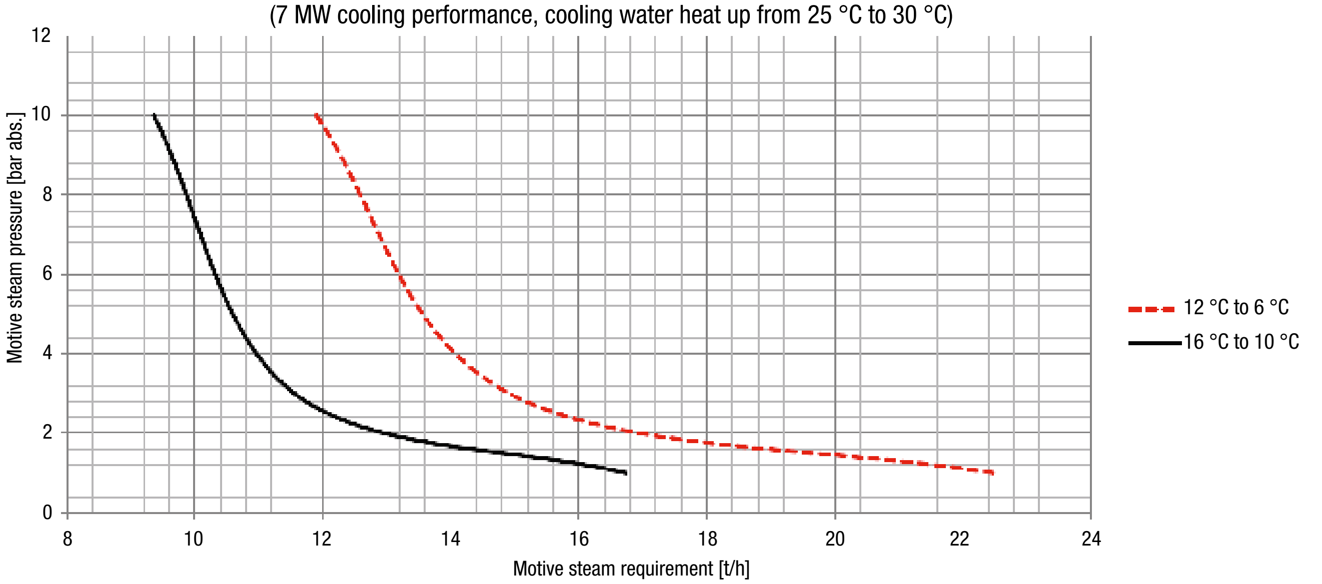
Motive steam requirement in relation to number of plant stages
(7 MW cooling performance, cooling water heat up from 25 °C to 30 °C,
chilled water cool down from 12 °C to 6 °C)



Motive steam requirement in relation to cooling water heat up
using the example of a 3-stage plant
(7 MW cooling performance, chilled water cool down from 12 °C to 6 °C)



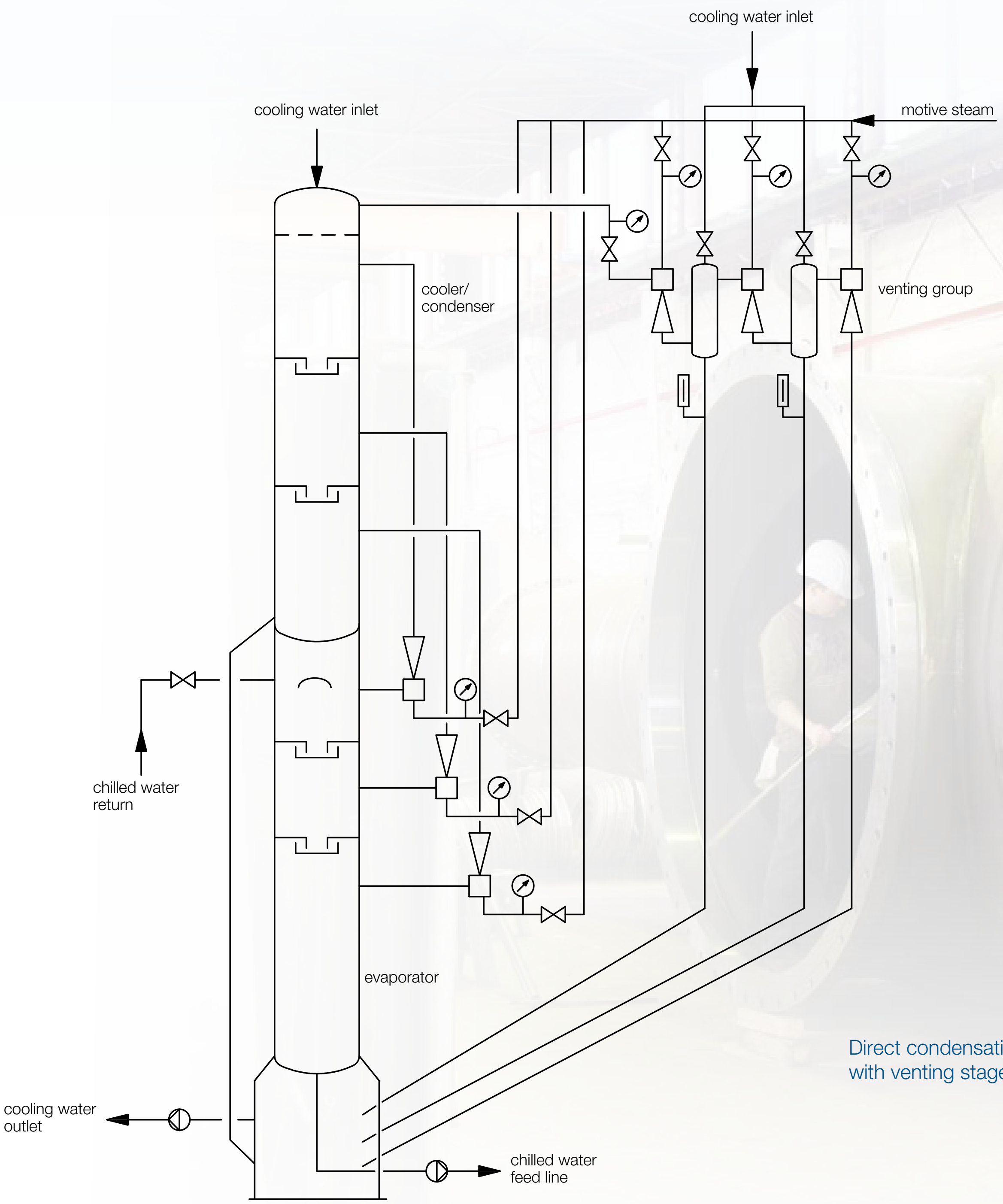
Motive steam requirement in relation to chilled water cool down
using the example of a 3-stage steam jet chilling plant
(7 MW cooling performance, cooling water heat up from 25 °C to 30 °C)



Designs

There are different designs of steam jet chilling plants:

- free- and self-supporting constructions with own steel construction (no separate steel construction)
- constructions fitted in existing steel constructions
- tower design
- bridge design
- cocurrent or countercurrent operation
- direct condensation (with Körting mixing condensers)
- indirect condensation (with Körting surface condensers)

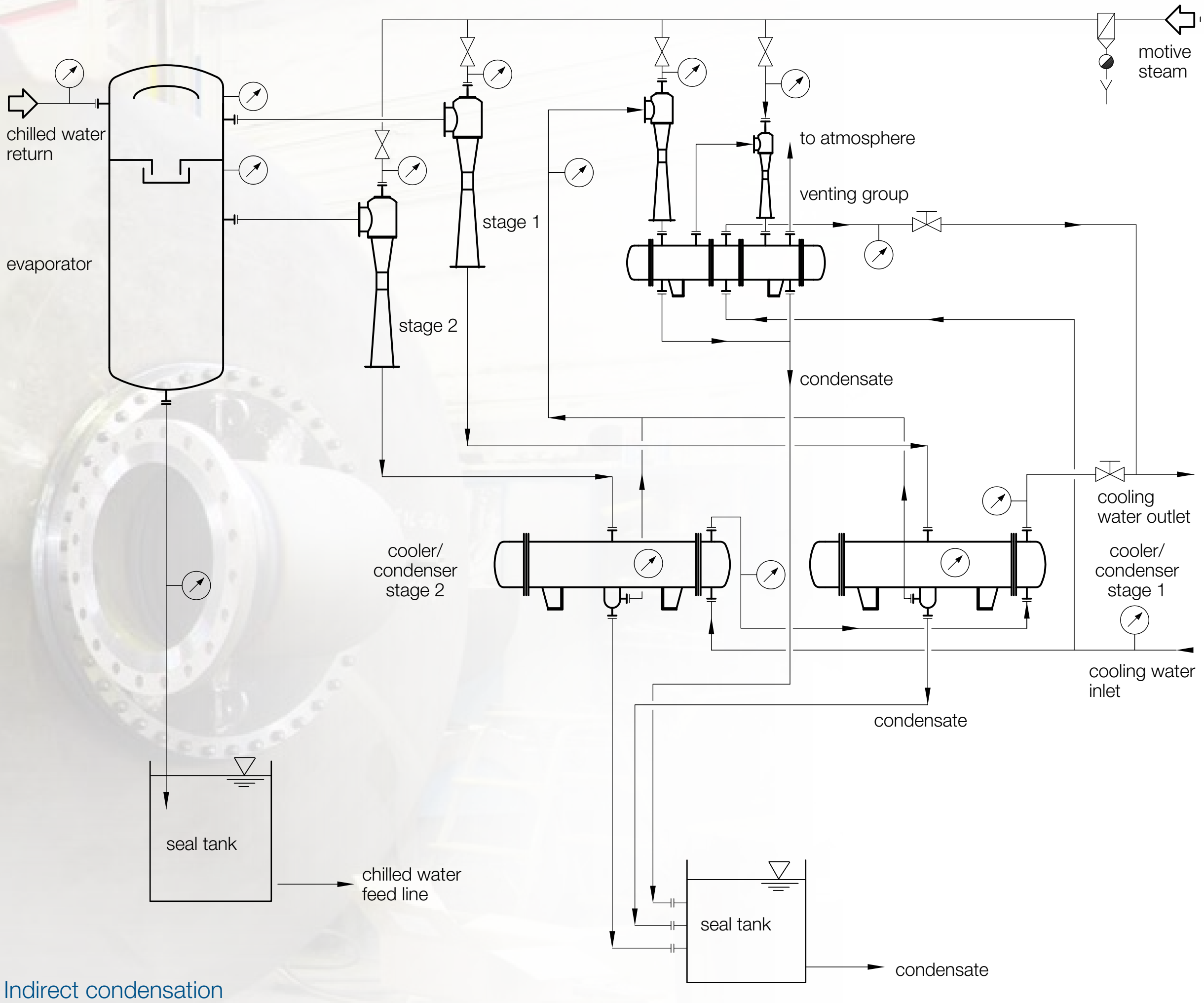


Direct condensation
with venting stages

1-tower design, 3-stage

Bridge design with separate steel construction, option of a 2-tower design, 4-stage, cocurrent plant

Bridge design, self-supporting (without separate steel construction), 2-tower design, 3-stage, countercurrent plant



Indirect condensation
with venting stages

A realised project

Successful operation of a Körting multi-stage steam jet chilling plant in China

The self-supporting construction without secondary steel construction as well as the bridge design of the steam jet vacuum ejectors are just some of the individual characteristics of this unique plant.

With a maximum constructional height of almost 44 m and a maximum plant diameter of about 6 m, this chilling plant is almost as tall as a Saturn One rocket. Körting Hannover AG has planned, manufactured and commissioned this steam jet chilling plant in cooperation with their Chinese end costumer, Petro China/Sichuan refinery.

Daring to build this plant and taking the effort of everyone involved was worth it. After almost one year in operation the plant owner is highly satisfied with this newly developed design of this steam jet chilling plant and its performance.

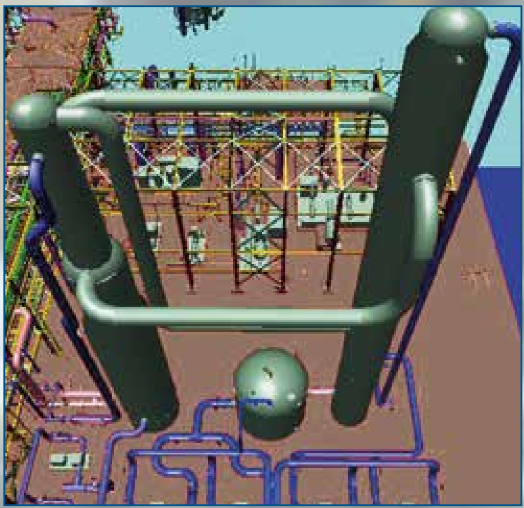
Despite its size this steam jet chilling plant with steam jet vacuum ejectors in bridge design of up to 20 m in length allows an installation without secondary steel construction. Eventually, this saves costs and required space.

The evaporator tower and a downstream condenser in combination with the Körting steam jet vacuum ejectors are the core of the plant. The cooled water is needed to cool down various petro-chemical processes in the newly erected Sichuan refinery.

After the steam jet chilling plant in Egypt (28 MW) delivered by Körting as well, the new plant is the second largest in the world.

Technical data:

cooling performance	24 MW
chilled water flow	2 300 t/h
cooling	29 °C to 20 °C



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