Free cooling with chiller bypass

Industrial chillers are widely used in many industries such as HVAC, data centres, general manufacturing, food processing, pharmaceutical and industrial applications such as packaging material manufacturing and plastics. They deliver cool chilled water to the process with the evaporator, typically with a temperature regime of 7°C to 12°C and collect the heat from the process and release it to atmosphere via the condenser.

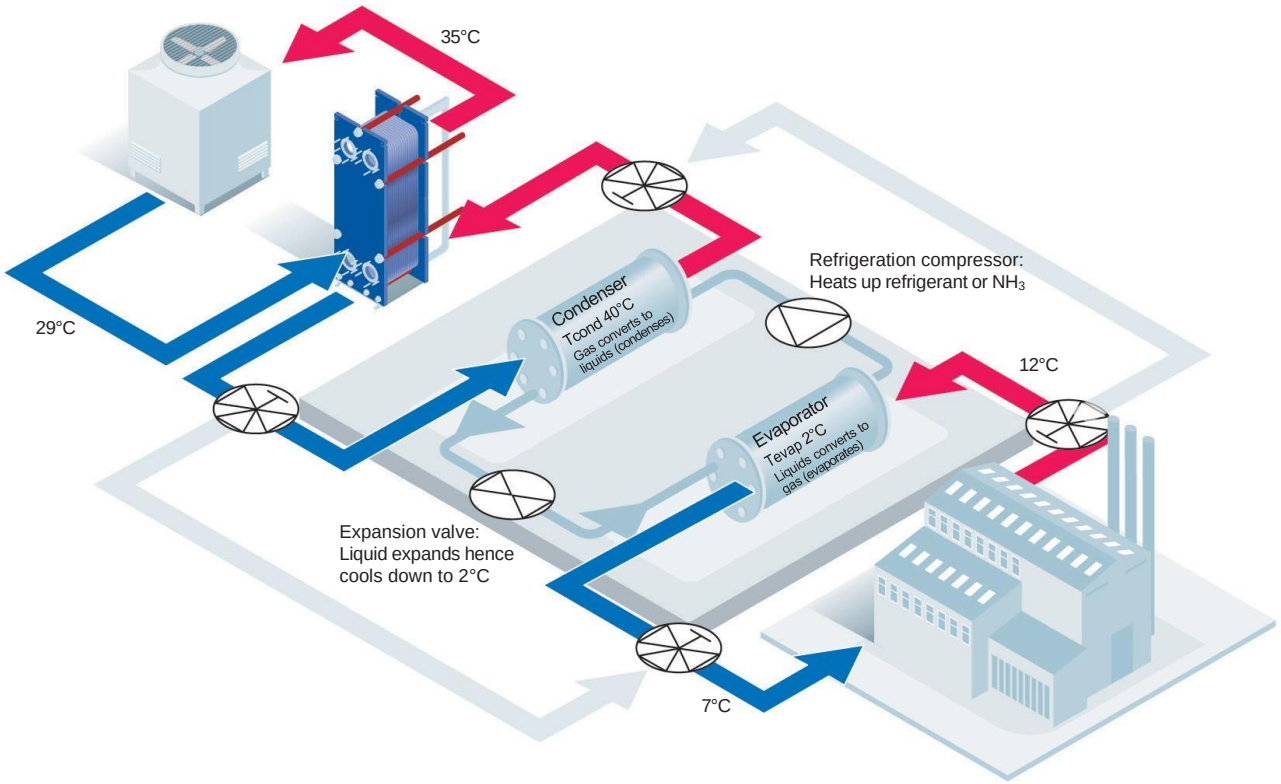
Chillers are one of the highest consumers of electricity in utilities part of a plant with large compressors constantly running to compress the refrigerant gases as a part of the refrigeration cycle — a significant sustainability concern not only with high operating costs but with environmental concerns.

Chiller energy consumption can be estimated by the amount of cooling it needs to deliver. For example, a chiller cooling capacity of 4,000 kW and compressor working with a COP of 5 will have an electricity consumption 800 kW during peak capacity. The chiller compressor is one of the highest running costs in any plant and has a critical influence on plant profitability and sustainability.

The cost to run and the electrical power consumed in 800 kW can be calculated based on the duration of the cooling need. If the chiller is running 24 hrs per day and 30 days per month, assuming the electricity cost is 0.10 euro/kWh:

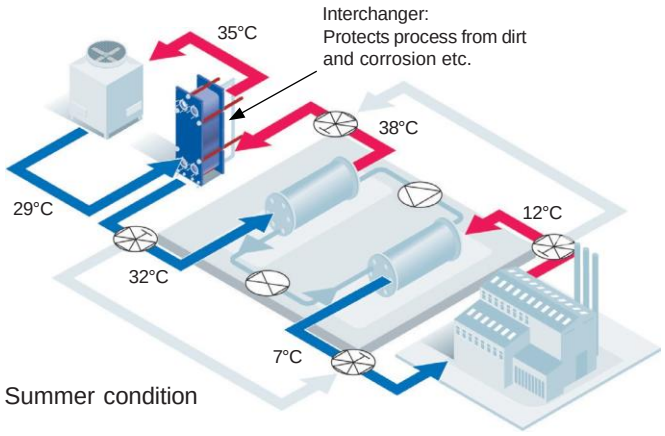
800 kW x 24 hrs x 30 days/month x 0.10 euro/kWh = 57,600 euro per month.

Water cooled condenser

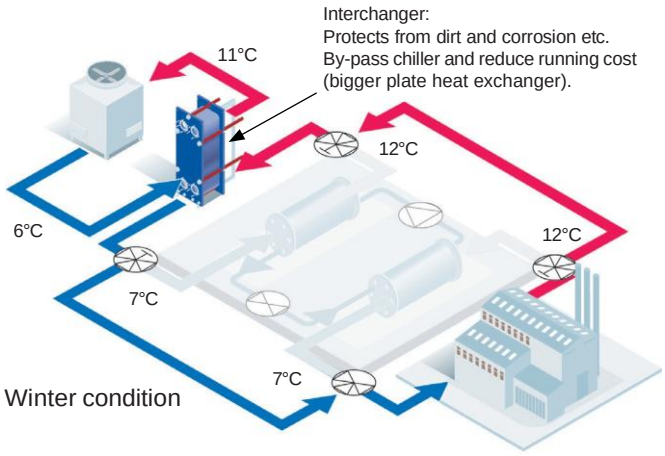


Energy Hunter – HVAC

When a plant needs 7°C cold water supplied by the operation of the chiller and the chiller's condenser is working with an open cooling tower, there is an opportunity to save thousands of euro by turning off the chiller. The possibility for free cooling for certain hours or days in winter, when the open cooling tower water is cold enough for the required cooling needs and is relatively free, with the chiller completely turned off.

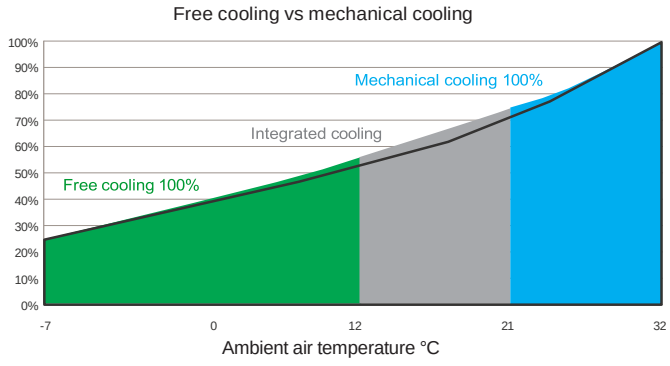


Summer condition



Winter condition

The automation should be designed according to ambient conditions as when the ambient temperature drops to a set level, the modulating valve supplying the condenser should change so that the cold closed-circuit water is directed to the cooling need. In this way, the chiller can be completely turned off, and the savings are impressive without compromising cooling requirements of the plant.



The design and selection of the gasketed plate heat exchanger should be as close approach temperature as possible to maximize the days or hours which the chiller can be turned off. During winter/summer operation, typically the gasketed plate heat exchanger can work as an interchange protecting the condenser from unwanted debris and calcium carbonate formation. Recommended design conditions for summer operation:

Condenser circuit water	38°C → 32°C
Cooling tower water	35°C ← 29°C

The selected gasketed plate heat exchanger should also be able to perform winter conditions with a 1°C approach. Because of economies of scale and investment costs, a 2°C approach designed gasketed plate heat exchanger can also be considered:

Condenser circuit water	12°C → 7°C
Cooling tower water	11°C ← 6°C

The bigger gasketed plate heat exchanger of the winter and summer condition selections should be installed. Most often as the winter conditions is a more thermally difficult duty, the likely gasketed plate heat exchanger to be installed will be the winter design conditions selection.

The design pressure drop limitation is recommended as 100 kPa to ensure high turbulence with the open cooling tower water and minimum fouling, especially with lower than design flow and seasonal operational conditions.

▼ PRACTICAL TIPS

AHRI performance certification – With small approach temperatures, contractors, installers and end-users will be protected from good enough plate heat exchanger performance. Please specify AHRI performance certified plate heat exchangers using the following text:

The plate heat exchangers shall be AHRI-certified in accordance with the AHRI Liquid to Liquid Heat Exchangers Certification Program. The plate heat exchanger specifications as selected shall be verified and registered by AHRI before purchase."