Cooling: Why is it of high importance in E-rooms of paper mills?

Why is the cooling of great importance in the energy efficiency of paper mills? While electrical room cooling is one vital aspect of the reliability of the process, you can also save great amount of energy when you run a well-designed cooling system. The cooling system should also be reliable and the sound levels suitable for the surrounding area. Tailoring the solution to your mill gets you the best performance taking into account the limitations of the environment.

Let us introduce a system we recently build to illustrate the possibilities of modern cooling system and energy saving in cooling. With a Partial PUE of 1,043, the cooling system is very energy efficient and provides 2N redundancy.

The system runs in the middle of the city, so also the sound levels were of high importance. Adiabatic system was installed for the drycoolers to enable lower speeds of the fans and therefore lower sound levels.

New cooling system

In early February 2022, BM Green Cooling finished a new cooling system with some interesting features, most notably the high energy efficiency. For the 3MW of cooling power we use on average 130kW of electrical power, which results to a “partial PUE” of 1,043 for the year.

The cooling system provides 3MW of cooling power and has 75% freecooling share for a year. For the redundancy and the hottest times of a year, the cooling system has 3 Turbocor chillers. The freecooling ratio itself is high, but using the Turbocor chillers for the refrigeration rises the energy efficiency to another level.

The Turbocor technic in chillers allows high EER (Energy Efficiency Ratio), especially in part loads. With an EER of up to 8 on partial loads, we can divide the load between the compressors to reach high energy efficiency constantly when mechanical cooling is needed.

Freecooling

Freecooling was achieved with drycoolers, and with the special units the freecooling can be used up to 16°C, which equals to 75% of the year for the location in Nürnberg, Bayern. Freecooling cools the system with outside air, and only electrical energy needed for the cooling is the electricity used by the fans to move the air through the coil.

The freecooling ratio could be higher, but it was reduced as the sound regulations are tight and the rotation speed of the fans was desired to be lower. During the higher temperatures the Turbocor chillers take over the cooling duty, and the drycoolers are used as condensers for the chillers.

Drycoolers to enable 3 MW of freecooling power

Raising the freecooling ratio

The freecooling ratio was raised with tanks, that are loaded with freecooling during the night when the ambient temperature is lower and us the cooled medium during the day when otherwise the mechanical cooling would be needed.

Mechanical cooling

For redundancy and the hottest times, mechanical cooling was installed. The chillers were chosen to be with Turbocor compressors, which enable highly energy efficient cooling even with the mechanical cooling. The EER of up to 8 can be achieved, also making the mechanical cooling more energy efficient than in more traditional solutions. Turbocor also has an advantage of working oil free.

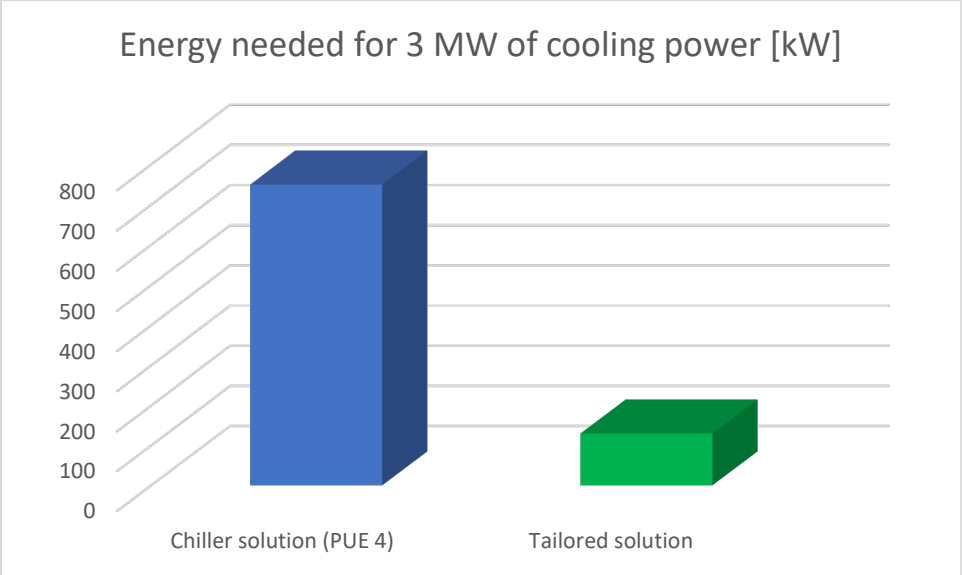
Turbocor Chillers in the technical room

Controls and the best combination of cooling

Even the best system is nothing without the controls. That is why the whole system is controlled by Siemens S7 and an in-house built MCC cabinet, providing always the most effective way of cooling for the moment.

Comparison to old-fashioned cooling systems

When comparing the system to an old-fashioned cooling system, the benefits are clear. If we would use traditional chillers for a year, we would achieve EER of about 4 for an average for a year. If we use the same starting parameters for comparability, EER of 4 would mean that we use 750 kW of electrical power for cooling, plus the energy needed for the condensing. Comparing that to the 130 kW needed by the modern cooling system, we save on average 620 kWh of energy every hour the system runs.



Comparing the energy consumed for 3 MW of cooling power

In a year this result so savings of 5.430 MWh, that is over half a million euros (543.000 €) per year if the price of the electricity is assumed to be 10 cent per kWh. Additionally, the yearly CO2 emission savings are 1.634 tons (German average for year 2020 was 301 grams per kWh).

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