PLATE TECHNOLOGY OPTIMIZES SUGAR COOLING PROCESS

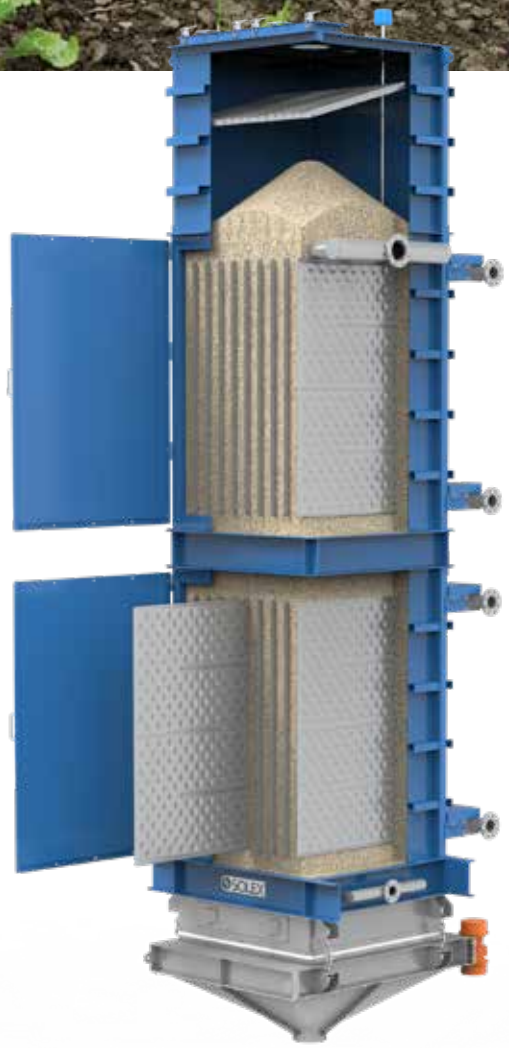
PROVEN TECHNOLOGY FOR ENERGY-EFFICIENT OPERATIONS

Background

Agro-industrial co-operative group Cristal Union faced a looming decision. Its aging vertical disk cooler at the company's sugar beet plant in Bazancourt, France was nearing the end of its lifetime.

This, in turn, had provided the globally recognized sugar maker with an opportunity to re-evaluate the existing sugar cooler, which used direct heat exchange by convection. Or, alternatively, whether more a modern method of indirect heat exchange by thermal conduction would meet its needs moving forward, particularly relating to improving the efficiency of its operations.

Having previously worked with Solex Thermal Science at other plants in France, Cristal Union engaged the Canadian-headquartered experts in bulk solids thermal exchange about the application of its proprietary vertical plate-based technology for the purpose of indirectly cooling the finished product at Bazancourt.



About the technology

The tower-like design of vertical plate technology cools the product by conduction while conventional technology use convection (e.g., Fluid bed cooler). Crystallized sugar flows by gravity between the plates, while the cooling media (e.g., cold water) flows counter-currently through the plates' internal channels. This eliminates any

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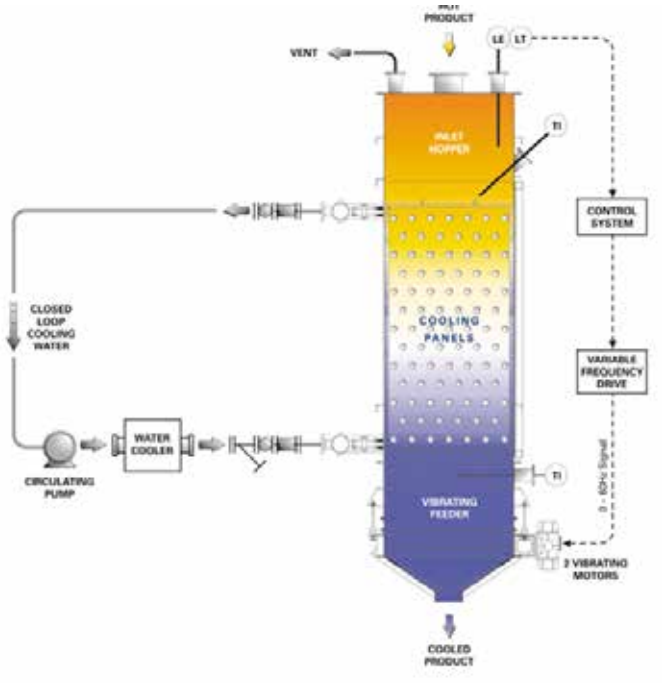
contact between the sugar and the cooling media – and, in turn, any potential contamination (e.g., bacteria and odors) and dust emissions while maintaining product quality.

Furthermore, very little energy is required to move the product as it descends by gravity in a controlled way through the exchanger. Solex has conducted various studies that demonstrate energy consumption can be reduced up to 10 times when compared to direct-contact alternatives such as fluidized beds or rotating tubes.

Under these process conditions, it is not necessary to inject dry air, which eliminates the need for sophisticated air-treatment systems while also reducing emissions outputs to near-zero.



An added benefit to vertical plate technology is its compact size allows for easy integration into existing operations. The exchanger itself takes up very little floor space, typically measuring two meters by two meters and ranging from five to 20 meters tall. (In Bazancourt's case, the height was around 11 meters for a feed rate of 100 tph sugar.)

A bucket elevator brings the sugar into the inlet hopper. The sugar then flows at regular speed thanks to a vibrating outlet hopper that ensures uniform mass flow and even product temperatures at the outlet. (Note: The sugar level is kept constant in the inlet hopper thanks to a level probe that controls the discharge feeder.)

The sugar cooler is static equipment, with the only moving part being the vibrating feeder at the outlet. This device is isolated from the rest of the installation to avoid any transmission of vibrations. Likewise, it has side access doors over the entire height of the plate bank to allow easy cleaning and maintenance.

For the Bazancourt installation, the company added a closed-loop circuit for the cooling water, thereby eliminating the need for external water supply.

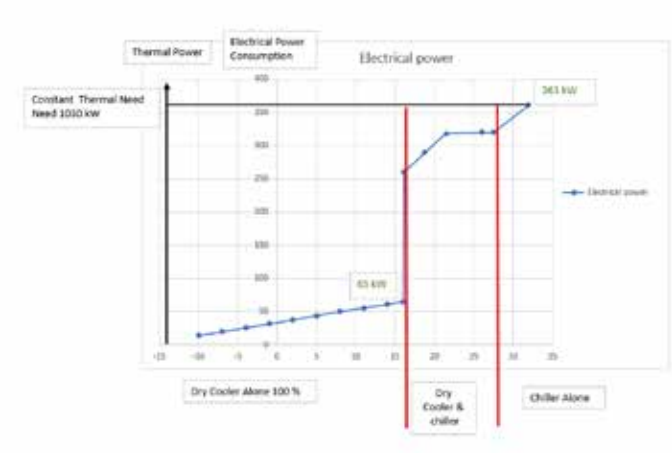
Process conditions

To ensure optimal storage conditions at Bazancourt, it was important to manage the humidity during the drying and the temperature during the cooling stage. Typically, the sugar exits the dryer at a temperature around 55°C. The vertical plate exchanger installed at Bazancourt by

Solex needed to cool the sugar to a consistent temperature of 30°C. To do this, the cooling water had to be at 18°C, independent of the weather conditions.

Note: In general, the cooling water should be, on average, at least 10°C lower than the temperature of the desired product leaving the cooler to limit the size of the unit. In addition, if the water is too cold, it can lead to condensation in the cooler and subsequent caking on the plates.

To ensure consistent operating conditions at Bazancourt, Solex also installed a water temperature control module that will allow plant operators to adjust this temperature, when necessary. This ensures the temperature of the cooling water is always above the dew point of the air surrounding the sugar in the cooler.



When the ambient air is too hot, a water chiller will be necessary to cool the water to the appropriate temperature. The chiller has the advantage of being able to provide the desired temperature of the cooling water regardless of the outside ambient temperature.

However, these chillers tend to be energy intensive. So in the case of Bazancourt, the operators combined a chiller with a dry cooler,

thereby minimizing the average energy consumption during the sugar campaign. When the ambient air is below 15°C, only the dry cooler will operate, while the dry cooler and chiller will work from 15 C to 28°C. At temperatures above 28°C, only the chiller will operate (see Graph 1). With this combination, the cooling water will always be at a consistent 18°C.

The addition of the dry cooler increased Bazancourt's overall capital investment, but will also reduce energy consumption up to 80% during the sugar campaign while still providing cooling water at consistent temperatures.

Conclusion

The units were successfully commissioned over a six-week period in May 2021 during the plant's syrup campaign. Operators at Bazancourt report the thermal performance was easily achieved, with the units being easy to use, reliable and not restrictive.

Since September 2021, the sugar coolers have been fully operational for the annual sugar beet campaign. As expected, cooling the water was preformed almost exclusively by the dry cooler. The chiller was used just a few times during hot days at the beginning of the campaign.

Thanks to the combined installation of the chiller and dry cooler, the plant was able to control its energy consumption costs while guaranteeing a stable temperature of the sugar.

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