Combined cooling and heating system in light metal foundry

Economically recycling heat is the central idea behind a custom-planned decentralised energy system at a new German light metal foundry. In the cooling circuit, three Güntner GFD 090 HydroSpray Professional dry coolers connected in parallel and two JAEGGI HTK hybrid dry coolers also hydraulically connected in parallel ensure cooling in line with demand.

The overarching energy supply concept for this light metal foundry was developed by Gammel Engineering, an engineering service provider located in Abensberg, Lower Bavaria. Once the investment decision had been made and the contracting project team had been put together, Gammel planned all the plant engineering, tweaked the finer details with the foundry and the operators and provided quality assurance for construction and commissioning.

TRANE Klima- und Kältetechnik designed the refrigeration engineering side of things and oversaw the related installation and commissioning. The companies ArGe Siemens and Ulrich Müller GmbH were also involved in the energy-saving contracting commissioned by the client.

Overview

Business line:	EPC
Application:	Machine cooling
Country/Region:	Germany/Bavaria
Fluid:	Water/glycol mixture
Product:	Güntner V-SHAPE Vario GFD HydroSpray Professional dry coolers
	JAEGGI HTK hybrid dry cooler

JAEGGI Hybridtechnologie AG
Hirschgässlein 11
CH-4051 BASEL
SWITZERLAND
www.jaeggi-hybrid.eu

▲ Two JAEGGI HTK hybrid dry coolers hydraulically connected in parallel and three Güntner GFD 090 HydroSpray Professional dry coolers also connected in parallel (only one of which is visible in the background) together dissipate a maximum of 5,100 kW of heat which cannot be economically utilised for production.

▲ A new cogeneration unit provides 2.4 MW of thermal energy and 2.6 MW of electrical energy for production.

The ground-breaking energy concept in particular takes the cooling load of production into account and simultaneously keeps the energy consumption of the entire plant in focus. The cooling load of the aluminium smelting facility increases primarily when external temperatures are higher. The production of cold and production of heat were systematically separated in the previous set-up, which meant that cold was supplied for the aluminium smelting facility via compressors, which is energy-intensive, and the flue gas energy from the smelting facility wasn't utilised.

Flue gas as energy source

The raw material aluminium is smelted in six furnaces by gas burners. Three furnaces work in smelting mode and three in holding mode. The flue gas resulting from this process has a temperature of approx. 640 °C. This heat from the smelting furnaces, which was previously not utilised, is now fed into the existing hot water network via a heat exchanger. A new cogeneration unit with a capacity of 2.4 MW of thermal energy and 2.6 MW of electrical energy has also been constructed. As a result of these innovative changes, the chillers have been replaced with two hot water-operated absorption chillers.

The absorption chillers now provide the entire industrial plant with air conditioning and process cooling and are able to dynamically adapt to fluctuations in production and the relevant external temperatures. Three Güntner GFD 090 HydroSpray Professional dry coolers connected in parallel and two JAEGGI HTK hybrid dry coolers also hydraulically connected in parallel in turn cool the absorption chillers.

Absorption chillers produce heat and cold

The two absorption chillers connected in series on the hot water side ensure the required spread of 70 K in the hot water network. The first machine takes 125 °C hot water from the new cogeneration unit (2.4 MW) and/or from the flue gas (0.5 MW) and provides approx. 97 °C hot water to the second machine which in turn feeds warm water at just below 70 °C into the return. This has helped in considerably reducing the operating time of the existing boilers and hence also emissions and also ensures that the boilers can now cover the medium and peak load of hot water production.

If the external temperatures fall in the interim period and in winter, less cold but therefore more process heat and in particular thermal heat is required, meaning that one of the two absorption chillers can either work in partial load operation or even be completely switched off.

Joint cooling capacity of approx. 2,150 kW

The first absorption chiller provides 1,100 kW of cold for the glycol/water circuit (25 °C/15 °C); approx. 2,600 kW (40 °C/45 °C) of waste heat are dissipated via the three Güntner GFD 090 HydroSpray Professional dry coolers. The second absorption chiller connected in series provides 1,050 kW of cold for the glycol/water circuit (25 °C/15 °C); a maximum of approx. 2,500 kW (34 °C/29 °C) of waste heat are released into the environment via two JAEGGI HTK hybrid dry coolers.

The decision to opt for the two different cooling systems, which at first seems rather surprising, was based on the relevant return temperature of the absorption chillers: In order to cool the first absorption chiller, 8 K must be dissipated from the 48 °C warm flow (30 % glycol/water mixture). The second absorption chiller releases 5 K from the 34 °C warm flow into the environment via the JAEGGI HTK hybrid dry coolers.

Güntner HydroSpray Professional

A Güntner GFD 090 HydroSpray Professional dry cooler recirculates up to 176,000 m³ of air every hour meaning that a total of 528,000 m³ can be recirculated in full load operation. If, as from an external temperature of 23.5 °C, the free cooling is no lon-

JAEGGI Hybridtechnologie AG
Hirschgässlein 11
CH-4051 BASEL
SWITZERLAND
www.jaeggi-hybrid.eu

▲ The two central absorption chillers are enclosed for sound insulation purposes.

ger sufficient in order to reach the target temperature in the system, the HydroSpray Professional module supports the recooling process by specifically using evaporation cooling.

Approx. 0.8 m^3 of on-site treated water is sprayed on the fins per hour for around 395 hours a year (in total approx. 112 m^3 on average a year). Each dry cooler is equipped with 12 fans, which are electronically commutated and managed via the GMM EV/16 motor management system. As such, they meet the efficiency requirements of Directive 2009/125/EC (ErP Directive). The controller automatically recognises which spray section has been operating for the most hours and switches on the sections with the lowest number of operating hours first.

JAEGGI HTK

The JAEGGI HTK hybrid dry coolers are hydraulically connected in parallel in order to always be able to use the entire installed heat exchanger surface area in dry operation. In dry operation, the air flow per unit is 185,033 m^3 per hour. When wetted this is 165,153 m^3. 4.2 m^3 of on-site treated water can be evaporated every hour, and the rest is fed into the circuit. Wetting water is directly evaporated on the heat exchanger fin for heat dissipation purposes.

When the air temperature and performance requirements increase, the coolers are controlled in line with demand for free cooling or for process cooling. In optimised operation, the internal control gauges whether the coolers can be operated more economically with a higher fan speed and/or with (partial) wetting. This ensures that the target fluid temperature is achieved with the smallest number of wetted cooling elements in each case. In partial load operation, wetting has to be switched on later.

If the external temperature drops below 5 °C, it is sufficient for providing the cooling capacity via free cooling. The wetting water for the Güntner and JAEGGI components is fully drained from the system in order to ensure frost protection for the system.

JAEGGI Hybridtechnologie AG
Hirschgässlein 11
CH-4051 BASEL
SWITZERLAND
www.jaeggi-hybrid.eu