Efficiently cooled injection moulding machines

Busch-Jaeger Elektro GmbH, an innovative electrical installation technology market leader, cools its injection moulding tools at its Bad Berleburg-Aue site using combined cooling, heating and power generation, thus reducing its electrical energy consumption by 70 % compared to the previous system. The energy source is the waste heat from a cogeneration unit which is efficiently used by InvenSor adsorption chillers to produce cold. A GFD-type Güntner V-SHAPE Vario is used as a dry cooler for non-usable heat and to provide free cooling for the adsorption chillers.

No mains power is required and water is used as the refrigerant for cooling the injection moulding machines at the Busch-Jaeger site in Bad Berleburg-Aue, which is fully in line with the sustainability concept adopted by the North Rhine-Westphalia-based electrical installation technology market leader.

As waste heat from a cogeneration unit (<80 °C), which cannot be utilised for other processes, is now used as the energy source for the cooling, CO_2 emissions have been reduced by 70 % compared to the previous system, i.e. a saving of 381 tonnes a year. The investment has also paid off financially as Busch-Jaeger has cut its annual energy costs by around 25 % since September 2016.

Overview

Business line:	EPC
Application:	Machine cooling
Country/Region:	Germany / Aue/Bad Berleburg
Fluid:	Water/34 % water/glycol mixture
Product:	Güntner V-SHAPE Vario GFD dry cooler

Güntner GmbH & Co. KG
Hans-Güntner-Straße 2 – 6
82256 FÜRSTENFELDBRUCK
GERMANY
www.guentner.eu

▲ In winter, the free cooling function of the GFD-type Güntner V-SHAPE Vario achieves impressive savings in terms of heat dissipation from the injection moulding plant.

▲ As the boiler room was too small to house seven adsorption chillers, the goal was to place all the cooling equipment in one container, which also had to have special dimensions as it had to be installed in a gap between two buildings.

Huge potential of combined cooling, heating and power generation

The old cooling installation comprised of a classic compression system with 211 kW of cooling capacity. Municipal water was used for emergency cooling purposes. However, the required daily amount of 500 m^3 could only be provided by the local supplier for three days. As such, the risk of production downtime due to the age of the system was so high that the company needed to come up with efficient alternatives.

A master's thesis written by Busch-Jaeger's current Energy Manager formed the basis for the decision to opt for the technology currently being used. The potential of combined cooling, heating and power generation and, in particular an adsorption chiller, was clear to see as a cogeneration unit was already in operation:

- Low energy and maintenance costs
- Investment costs comparable with those of a new compression refrigerating unit
- Financial benefit of funding via the Federal Office for Economic Affairs and Export Control (BAFA)
- Environmentally-friendly refrigerant (water)

160 kW was calculated as the basic cooling load and 211 kW as the peak load on hot summer days for the injection moulding machines requiring cooling. The cogeneration unit provides a total of 290 kW of thermal and 250 kW of electric power over approx. 7,000 operating hours per year. The seven InvenSor adsorption chillers require 230 kW of heat.

Customised container solution

As the boiler room was too small to house seven adsorption chillers, the goal was to place all the cooling equipment in one container, which also had to be positioned between two buildings due to a shortage of available space. The container is 8.80 metres long and 3 metres wide. It also had to be structurally reinforced as the dry cooler and a maintenance catwalk had to be installed on the roof. The empty weight of the dry GFD-type Güntner V-SHAPE Vario alone is 2,950 kg. Four InvenSor LTC 30 e plus units (LTC = low temperature chiller) and three InvenSor HTC 18 plus units (HTC = high temperature chiller) for cooling the tools are located in the container as well as all other cooling components.

The plastic injection moulding process is very energy-intensive as the tools first need to be heated up and then the product has to be cooled down inside the tool. The process for cooling the plastic parts in a cycle accounts for around 70 % of the time. The flow for the tools is a constant 9 °C and the return 14 °C, whilst heat from the hydraulics is dissipated with warm water at approx. 30 °C.

The injection moulding process...

...for plastics is an intermittent process for producing plastic items from dried granulate. This is firstly melted (plasticised) in a rotating screw conveyor. Once enough melted mass has accumulated in front of the tip of the retreating screw, it is pressed (injected) through a nozzle through a channel named sprue channel into the shaping cavity of the injection moulding tool at a pressure of between several hundred and more than 1,000 bar.

The melted mass in the tool cavity solidifies given the reduced pressure. Once the workpiece has hardened, the screw is retracted and filled for the next cycle. The moulded plastic item simultaneously cools down in the mould and is then removed by opening the cavity.

Güntner GmbH & Co. KG
Hans-Güntner-Straße 2 – 6
82256 FÜRSTENFELDBRUCK
GERMANY
www.guentner.eu

Thanks to frequency-controlled water pumps, the water pressure in the tool cycle is always constant regardless of the number of machines in operation, meaning that the tools can be cooled consistently and in line with demand. Thanks to the cooling, which is more reliable than it used to be, the injection moulding machines work with shorter cycle times and are therefore more efficient overall.

Free cooling function

During the winter, the free cooling function of the GFD-type Güntner V-SHAPE Vario achieves impressive savings in terms of heat dissipation from the injection moulding plant; the heat produced by the cogeneration unit is then made available for the plant exclusively for heating purposes. If the external temperature is around 4 to 5 K below the desired flow temperature or even lower, the tools are cooled exclusively via the outdoor air. In other words, if the external temperature is lower than the consumer return temperature, the warm water is fed to the dry cooler which serves as a free cooler and the heat is released into the environment.

Depending on the external temperature, the GFD-type Güntner V-SHAPE Vario either provides the entire cooling function or just parts of it. If the external temperature exceeds the return temperature, the adsorption chillers are switched on.

Unlike the tools, the hydraulics require only moderate flow temperatures. The approx. 30 °C warm flow dissipates the heat from the oil coolers via the GFD-type Güntner V-SHAPE Vario into the environment.

GFD-type Güntner V-SHAPE Vario as evaporator and condenser

An adsorption chiller is an intermittent refrigerating machine which, in order to ensure continuous operations, consists of two adsorbers and one dry cooler, which functions both as an evaporator and a condenser in the process. The refrigerant (water) adsorbs onto and desorbs from the solid and porous sorbent (silica gel). The entire system is placed under vacuum in order to lower the boiling point of the water.

Both adsorbers switch counter-cyclically into the operating statuses of adsorption and regeneration as part of this process, whereby hot water regenerates the adsorbers and the regenerated adsorbers then drive the evaporator for the cooling. The heat absorption from the drive circuit and the cooling circuit is controlled by the dry cooler.

Heat is used for the heating in line with demand and when it is not required, for example in the summer months, it is dissipated into the environment with the help of the GFD-type Güntner V-SHAPE Vario dry cooler.

Güntner GmbH & Co. KG
Hans-Güntner-Straße 2 – 6
82256 FÜRSTENFELDBRUCK
GERMANY
www.guentner.eu

G_REF_105_V1_EN