High
Efficiency
Solutions.

CAREL

Courtesy Of BITZER SE

where

Bitzer Germany

- Rottenburg-Ergenzingen, Germany.

what

New training center for CO2 applications

- Fischer compressor rack
- Fischer-Bitzer-CAREL installation
- CAREL electronics

why

- fully green solution;
- natural refrigerant;
- booster solution;
- parallel compression integrated and optimised to work as a medium temperature compressor;
- high-efficiency heat recovery.

Bitzer

FISCHER KÄLTEKLIMA

Success Story

New BITZER training center

Fischer transcritical CO2 compressor rack with CAREL electronics at the BITZER Schaufler academy

A new transcritical CO2 compressor rack has been developed for the Rottenburg training center, the result of a partnership between Bitzer, Christof Fischer and CAREL Industries. The compressor rack features the most advanced technology in terms of energy efficiency, such as parallel compression with variable set point and heat recovery.

The BITZER group has been operating for more than 80 years in the air-conditioning and refrigeration business, supplying innovative and very high performance products.
The company's working methods are based on perfection and precision, while its philosophy is reflected in product efficiency and sustainability.
With extensive technical expertise and passion, the company develops compressor technology, confirming its role as market leader.

BITZER regularly offers customers specific seminars on its products, delivered in fully-equipped, modern training rooms in Sindelfingen, Rottenburg and Schkeuditz.
The subject of this case study is the Rottenburg site, the venue of training courses with theoretical and practical sessions on subcritical and transcritical CO2 systems, during which the main topics covered are:

- compressors for R744;
- system design;
- safety;
- control;
- commissioning;
- practical workshops.

Partnership for development of the transcritical compressor rack

The main partner in this project is Fischer, operating in the refrigeration and air-conditioning market for more than 90 years. Not only as a distributor, with a product portfolio comprising more than 20,000 items, but also as a system supplier for the development of refrigeration systems.
The company in fact designs and develops solutions and systems for all types of commercial refrigeration applications, with special focus on CO_2 (R744) systems.
These represent the cutting edge in terms of innovative technology, are effective and reliable, and at the same time guarantee very high quality standards.
Fischer offers the market a "one stop shop", not only supplying complete refrigeration units, but also electromechanical setup (panel and controllers), testing and installation.

Fischer compressor rack

Bitzer compressors for low, medium and intermediate temperature

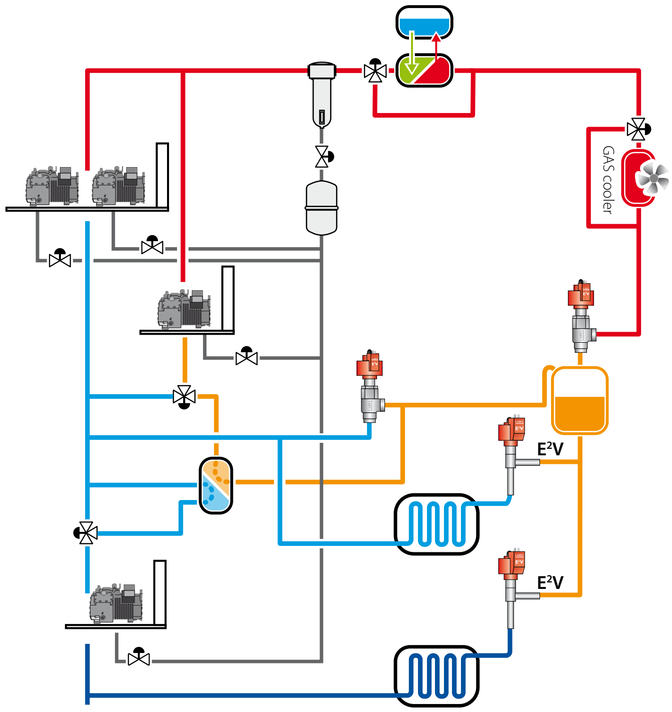
System description

The compressor rack at the training center is a transcritical CO_2 booster system in which the discharge from the single low temperature compressor (-35 °C) is cooled by the suction line on the parallel compressor (when active) via a special heat exchanger, and then discharged to the medium temperature compressor suction line (-10 °C).

The medium temperature line and parallel compressor discharge flow together into the high pressure line, featuring a heat recovery stage.

The CAREL pRack controller manages the gas cooler based on its outlet temperature. The gas cooler provides heat exchange between the refrigerant (R744) and the water cooled by a chiller; the latter can simulate different operating temperatures, with the possibility to have the system work in transcritical conditions.

The HPV valve is controlled based on pressure, with the set point calculated considering the gas cooler outlet temperature, aiming to achieve the optimum pressure for compressor rack COP in transcritical conditions, or the ideal subcooling level in subcritical conditions, with the possibility to increase the minimum value of the set point if needed for heat recovery.



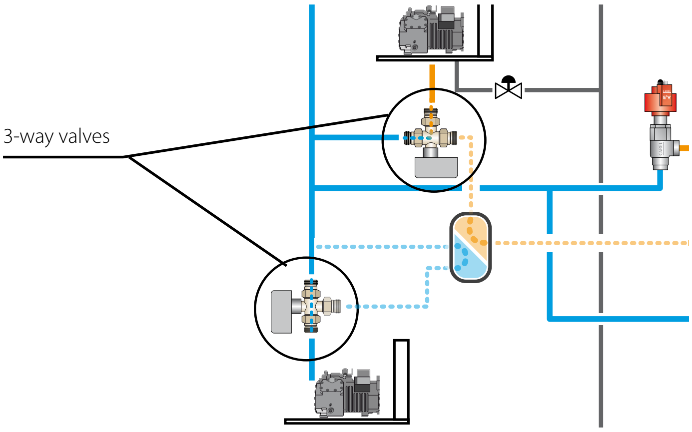
The liquid receiver normally works at around 35 barg (2°C) and the flash valve controls the pressure inside the receiver (safety valves calibrated at 60 bars).
From the CO_2 liquid receiver, the lines branch off to the medium temperature and low temperature units.

The parallel compressor is fundamental in ensuring system efficiency, being able to compress the flash gas directly, starting from the intermediate pressure in the receiver, thus avoiding to need to expand it at lower pressures. This action in fact reduces compression work at high ΔP that would otherwise be necessary, bringing energy benefits (in terms of COP) in typically demanding conditions - such as outdoor temperatures of 30 to 35°C - of around 15%.

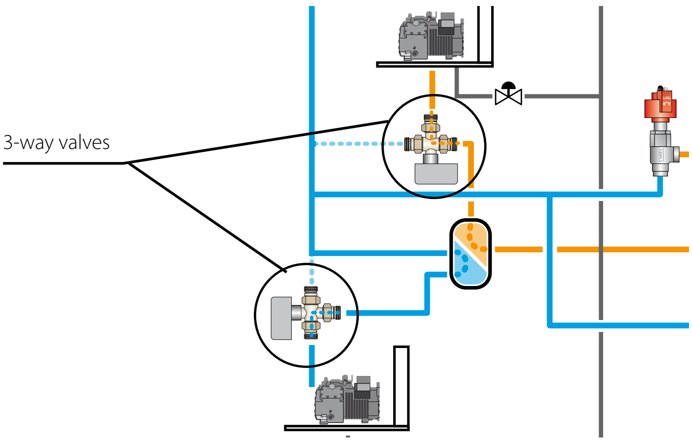
Interaction between compressors

The main feature of this installation is the interaction between the parallel compressor and the medium temperature compressor line.

When the parallel compressor is not working to reduce flash gas valve use or improve system efficiency at high outdoor temperatures, it can be used to control the medium temperature compressors.
When integration of the parallel compressor is required on the medium temperature line, the three-way valves change over, thus connecting the parallel compressor suction line to the MT suction line.
Activation of this compressor therefore depends on the gas cooler outlet temperature (which must be below a certain threshold) and will follow the medium temperature compressor suction temperature control set point.
This function first of all allows a second inverter compressor to be used if the first medium temperature compressor is not sufficient, avoiding possible ON/OFF cycling by the second compressor. Secondly, from a maintenance standpoint, it guarantees a modulating solution in the event of replacement or breakage of the first variable-speed compressor on the rack.



When on the other hand the parallel compressor works to support the flash gas valve (which in the warmer periods of the year will work at higher frequency and with higher opening percentages) so as to stabilise the pressure inside the CO_2 receiver, the two three-way valves changeover at the same time. This allows the CO_2 in the gaseous state to flow from the liquid receiver, via a heat exchanger, to the parallel compressor suction line. This heat exchanger has the additional function of subcooling the low temperature compressor discharge, and at the same time avoiding liquid return to the parallel compressor. The parallel compressor discharge in this case too flows to the common discharge line.
Activation of the parallel compressor always depends on two main variables, i.e. the gas cooler outlet temperature and the flash gas valve opening percentage.



CAREL electronics

pGD touch

The transcritical compressor rack electrical panel is fitted with a touchscreen graphic display used to control the main variables and parameters.
The pGD Touch terminals represent the new range of touchscreen graphic displays designed to simplify the user interface and make interaction between the user and the unit much easier by simplifying navigation between the various screens.
The new pGD Touch range has been designed for high-level applications that require touchscreen technology combined with an attractive design and extensive connectivity.
The main features are:

- advanced HMI interfaces;
- vectorial graphics;
- intuitive navigation;
- simple application development;
- versatility

compressor rack synoptic installed in the electrical panel

pRack pR300T

pR300T is the ideal controller for managing carbon dioxide booster systems.
The new pRack pR300T platform offers the transcritical CO_2 market an extremely high performance product that assists the user in managing intrinsically complex units:

- complete management of transcritical CO_2 systems on a single controller;
- simple and intuitive user interfaces (can be customised);
- easy access to supervisor systems;
- easy access to programming (USB host and device).

The main features that make CAREL controllers unique on the market are:

- integrated management of a third suction line for one parallel compressor;
- direct management of high pressure and flash gas valves.

- also fundamental for control is integration of the stepper expansion valve driver, meaning no external driver is needed to manage the valves. Ultracap technology, finally, maximises system safety.

E3V-C high pressure valves

CAREL's consolidated experience in high-efficiency expansion valves, specifically those working with natural refrigerants, has given rise to a family of valves specifically designed for transcritical carbon dioxide (CO_2) applications, suitable for commercial and industrial refrigeration systems and the food sector in particular.

The main features are:
- equipercentile control;
- mWP up to 140 barg (20314 PSIg);
- perfect tightness on closing;
- compact dimensions.

pRack pR300T expansion card

An I/O expansion card has been used on the transcritical CO_2 compressor rack, providing additional analogue and digital channels to manage the system.

This expansion card is ideal when there is a high number of compressors and corresponding alarms, or in the event of complex heat recovery systems that require numerous water and CO_2 temperature sensors or, as in this case, due to the advanced, innovative algorithms that require the use of additional probes and dedicated outputs.

Conclusions

CAREL has proven to be the ideal partner for the development of systems featuring high technological innovation, and fundamental in providing specialist support for a cutting-edge training centre such as the one in Rottenburg.
The partnership between the different companies involved was very constructive and highlighted how the each is focused on new technologies, with the emphasis on energy saving and reducing environmental impact.

The team:
from the left: Oliver Javerschek (Bitzer project manager), Christian Korn (National sales manager, CAREL DE), Filippo Pizzo (Senior software developer, CAREL), Nicola Pieretti (Application Specialist, CAREL) and Joern Krause (Product Manager, Fischer)

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