High
Efficiency
Solutions.

CAREL

where

Baden Württemberg
Stuttgart Area

what

transcritical CO_2 system

- air-conditioning and heating integration
- parallel compressor
- oil recovery system

why

- complete and integrated system management
- solution ready for warm climates
- variable operating modes
- full-green solution
- energy saving
- dynamic calculation of efficiency and separate energy consumption

Integrated CO_2-only solution for HVAC/R
New-generation system for integration of refrigeration, air-conditioning and heating

Carel has worked together with Advansor and Temtec to install a special system, specifically designed and patented by Advansor, in southern Germany. Commissioned by a large international chain, this small-medium installation, as well as using natural refrigerant only (CO_2) also features a high level of integration, with just one unit providing food cooling, room air-conditioning and heating.
By using the attest technology available on the market, this type of unit can adapt automatically to outside climatic conditions, cabinet cooling demand and specific operating conditions, adjusting its operating cycle so as to maximise system efficiency and exploit all the energy available.
A parallel compressor further improve system energy efficiency, making this type of system especially suitable for milder climates.
Given the extent of system integration, determining actual running costs is quite complex, which is why that Carel also provided a calculation system that, based on unit performance and energy efficiency, can apportion total system energy consumption to the individual functions - food cooling, air-conditioning and domestic hot water.

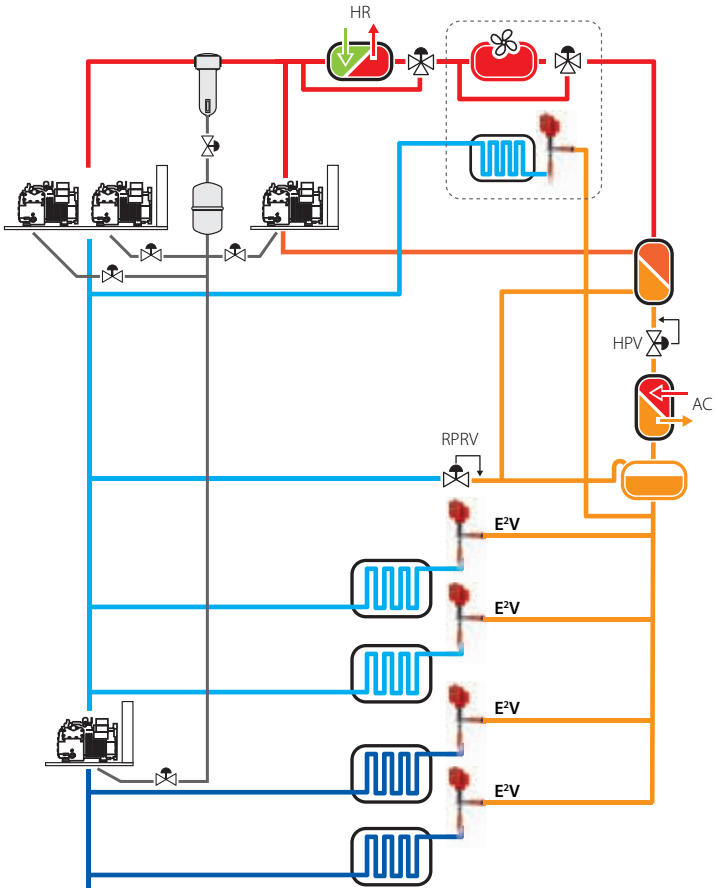
temtec ...one degree better.

ADVANSOR by HEATCRAFT

Success Story

System description

The transcritical CO_2 booster system traditionally sees the low temperature compressor suction line discharging to the medium temperature compressor suction line. In turn, the medium temperature compressors discharge initially to a first plate heat exchanger used to recover heat for domestic hot water.
This heat exchanger is only active when there is heating demand, prevalently in the winter, and can heat the water in the heating circuit up to a temperature of 55°C.
Downstream of the heat recovery exchanger is a special gas cooler, which in normal conditions controls the temperature of the CO_2 based on the outside temperature, however can be bypassed if heating demand is greater than the amount of heat the unit can deliver in current operating conditions, and which also contains an evaporator that is used to increase unit heat load when necessary.
From the gas cooler the refrigerant flows through a traditional transcritical valve that manages the transition between high and intermediate pressure. Based on the outside temperature, this either maximises compressor rack COP in transcritical conditions, or guarantees a certain level of subcooling in subcritical conditions.
Expansion of the gas from the high pressure section into the receiver, which normally works at around 40 barg (6°C), can be exploited during the summer to cool the water circuit for room air-conditioning inside the supermarket.
Then, from the liquid receiver the lines branch out to the medium and low temperature units, to the gas cooler with the backup evaporator, and the bypass, comprising a traditional flash valve and a parallel compressor that takes in the gas directly from the receiver and discharges it to a line in common with the other medium temperature compressors.
Synchronised management of the bypass valve and the parallel compressor, required for the heat recovery and air-conditioning system, can increase system efficiency when operating in transcritical conditions or when air-conditioning demand is high, drastically diminishing the amount of bypassed gas at the intake and guaranteeing perfect receiver pressure control.
The medium and low temperature units receive liquid refrigerant from the receiver, expanding it to cool the cabinets and cold rooms and then injecting the refrigerant into the low or medium temperature suction lines respectively, as well as the additional load and the flash valve.
In addition to the traditional refrigeration cycle, the installation also features an oil recovery system that, from a separator located at the compressor outlets, recirculates the oil by injecting it into the compressors when necessary.



transcritical CO_2 booster rack

Control system

pRack pR300T

In these types of systems, where each individual function is intrinsically linked to the others, the control device needs to independently manage all the operating stages of the unit.
pRack pR300T can in this case manage and synchronise the operation of all components making up the system, on just one individual device:

- Low and medium temperature compressors with synchronisation for booster systems
- Heat recovery system with adaptation of operating conditions, gas cooler bypass and activation of the additional load
- Transcritical valve for cycle optimisation in transcritical operation
- Parallel compressor and flash valve with management of start-ups, transients and emergency conditions
- Complete oil recirculation system with management of the separator, receiver, injection valves and alarms

Ideal for compact installations such as the case in question, it also provides direct control of two stepper valves (HPV transcritical valve and RPRV bypass valve) with built-in backup system (ultracap technology) to guarantee that the valves close completely in the event of power failures, without requiring an additional UPS.
The local graphic user interface provides all the information needed for correct maintenance and service.

pCO platform

The programmability, connectivity and flexibility of the pCO platform has led to the development of a specific device that can read:

- unit operating status;
- global energy consumption measured by the mains analysers installed;
- energy exchanged with the heat recovery and air-conditioning systems;

and apportion unit energy consumption to food cooling, air-conditioning and heat recovery. These data are essential for accurate comparison of this type of system against more traditional systems.

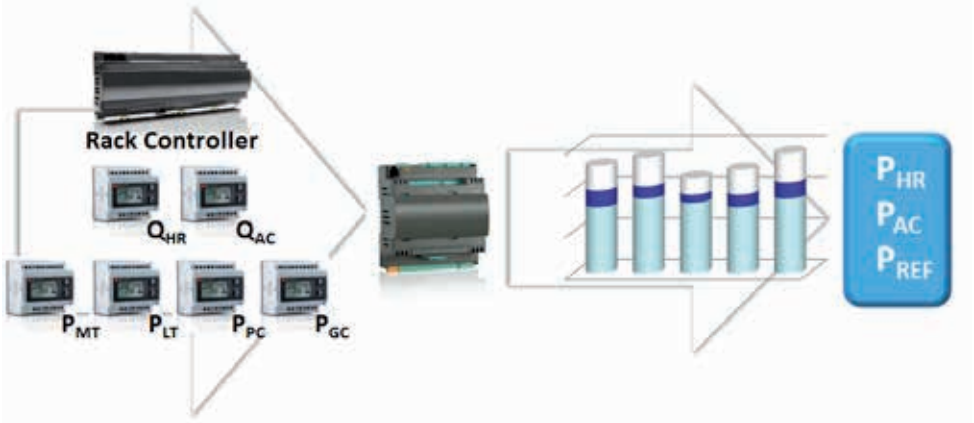
MPXPRO

Installed on all the medium and low temperature units, including the additional evaporator, these devices provide complete control of the unit with integrated management of the electronic expansion valve, adopting smooth line control to link evaporator outlet superheat to actual unit cooling demand.
Also featuring ultracap technology to ensure the electronic stepper valves always close even in cabinet/cold room applications, these represent the ideal solution for fine and stable control of refrigerant charge.

PlantVisorPRO

All the controllers installed are connected to the PlantVisorPRO supervisor that, as well as monitoring all the system variables, sending all the alarms to the service centre and saving all the main operating variables, also:

- optimises refrigerant charge by controlling suction pressure based on actual system cooling demand
- displays compressor rack energy consumption and specifically the parts relating to heating and cooling
- monitors vital parameters to avoid unauthorised modifications
- displays graphs to help understand system operation
- applies safety algorithms that ensure the system remains stable if problems occur on the compressor rack



Comments

This type of system, which represents the "state of the art" in transcritical CO_2 systems, has several interesting features:

- the use of just one individual unit to provide refrigeration, air-conditioning and heating means a significant reduction in upfront investment costs and the space needed to accommodate the systems
- one individual control device that automatically adapts unit operation so as to optimise operating conditions, ensures all the energy produced by the unit is exploited, drastically increasing global system efficiency
- the use of a parallel compressor as a receiver pressure control system means this type of unit can effectively be used in warmer climates
- comparison against traditional systems must be made by analysing energy consumption in detail; as a result, a special tool has been developed that dynamically calculates COP both globally and separately for each individual function, apportioning total energy consumption to the energy used for refrigeration, air-conditioning and heating

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