



where

Bellsolà Food industry

- Girona (Barcelona) Spain.

what

Industrial plant using carbon dioxide

- Compressor rack by SCM
- Installation by FREDVIC
- Electronics by CAREL

why

- Full green solution
- natural refrigerant
- tunnel application
- Chillbooster

Bellsolà - food industry CAREL transcritical CO₂ in warm climate

Thanks to the partnership between Fredvic, SCM and Carel Industries, the Spanish Bellsola chain, as a part of one of the largest industrial groups in Catalonia, installed in its main production plant in Girona two completely green food refrigeration and cooling tunnels.

The freezing tunnel is a system that cools in an extremely short amount of time products requiring extremely low temperatures before proceeding in their productive process, as in case of pre-baked bread from frozen dough.

The concerned compressor racks were provided by SCM, a leader in delivering comprehensive packaged solutions that focuses on a vertical development, high components accessibility and compactness in space.

It's a two machines booster with an evaporating temperature of -42 °C and a low temperature refrigerating power of 275 kW. The total installed power is about 550kW.

The machines are installed in Girona, dealing with demanding environmental conditions for CO₂ transcritical applications. The 38 °C maximum ambient temperature lead the working pressures to tap 100barg in the high-pressure circuit. An adiabatic cooling system (Chillbooster) was installed to optimize the machine operation even under these critical operating conditions.

The two units, made on PNC carpentry, feature an integrated gas cooler. Each unit is composed by 5 Bitzer 4NSL-30K low temperature compressors (-42 °C / -3.5 °F) and 5 4CTC 5-30K Bitzer compressors for midrange temperatures (-3.5° C / 38 °C / 95 bar)
The plant construction was entrusted to FredVic, a company in the field of refrigeration for more than 30 years demonstrating quality, professional skill, experience and a fully customized service based on innovation and power efficiency



Description of the system

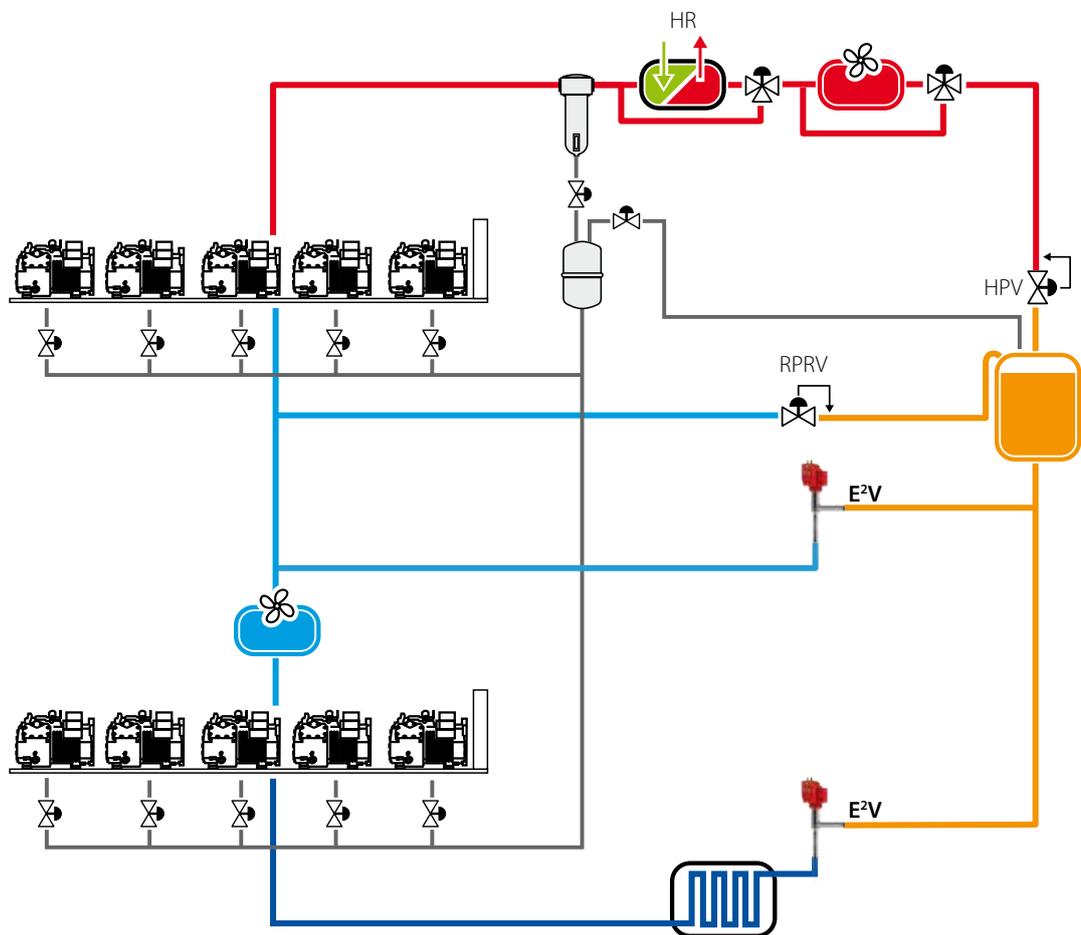
The plant is transcritical CO₂ booster type; the gas delivered by 5 low temperature compressors is cooled by an intercooler consisting of an ON/OFF fan, then it's discharged by the intake medium temperature range line.

The output from the 5 compressors conveys into the condensation line where a heat recovery system provides a 280 kW recovered power used for the washing water in the system. The operating temperatures of the heat exchanger are 40 °C (inlet water) and 55° C (output water)

Downstream the heat recovery system, the gas cooler composed by EC fans exchanges heat with the environment by cooling the CO₂ according to external climatic conditions, the HPV valve produces the pressure drop required to get inside the receiver.

The liquid receiver normally operates around 35barg (2 °C) while the flash valve adjusts the pressure inside the receiver (45bar safety valves).

The CO₂ receiver branches into two lines, one goes exclusively into the single low temperature unit to power the freezing tunnel, the second one injects cold gas through an expansion valve on the suction side of the medium temperature line to control the compressor overheating in order to avoid excess overheating that might affect its operation.



CAREL control system

pRack pR300T

The CAREL solution for the transcritical CO₂ compressor rack control and management is the ideal solution to meet the market requirements about:

- integrated management for medium and low temperature range compressors (double intake line) and transcritical valves: a single control unit with built-in on board driver for the two high pressure valves and the mid range intake line management;
- Transcritical cycle optimisation based on operating conditions: in transcritical operation a maximisation of system COP occurs, while in subcritical operation a proper value of subcooling is maintained
- energy saving algorithms: two heat recovery units; intake setpoints and floating gas coolers, optimised inverter management with minimised inrush events occurrences and reduced compressor operating hours
- universal functions: for intercooler management and liquid injection control between the two intake lines



Chillbooster

In order to optimize efficiency in high ambient temperatures seasons, which normally coincide with those of maximum load, a Chillbooster adiabatic cooling system was installed to allow the gas cooler to reduce the perceived room temperature, reducing the overall energy consumption of the system. All without expensive plant oversizing. ChillBooster is an evaporative cooler that atomises water into very fine droplets that evaporate spontaneously by absorbing heat from the air, the gas cooler is then hit by a cooler airflow which results in more favourable operating conditions, therefore lowering the average gas cooler pressure.



ExV System

The Carel expansion valves range is the result of ten years' experience in the HVAC/R industry and integrates, thanks to a new EVD evolution driver, into the CAREL controllers system for an optimized management of the entire refrigeration cycle.

The main features of the valves are: stepper motor for a fine and continuous adjustment, stainless ball bearings mechanism without mechanical gears to ensure a lasting reliability, removable outer stator and flow rate indicator to facilitate the final installation and maintenance.

The main features of the EVDEVO driver are: single or twin depending on the application, integration within the Carel tools, new integrated ultracap module, removable graphic display to increase usability.



pRack pR300T on-board

Conclusions

The implementation of this solution has proven that:

- the Carel-SCM partnership allowed the installation of a transcritical CO₂ system with hot climates like in Girona, in order to ensure the safety and efficiency of the system
- simple technological measures, if properly exploited, allows even very large plants to be deployed, using natural refrigerants and even at latitudes barely considered a few years ago
- the 15 °C average annual temperature applicability limit for transcritical CO₂ systems is now a technologically surpassed concept
- Carel and SCM are continuing in their present mission to spread the knowledge and the application of natural refrigerants in Europe
- the versatility of the Carel controllers allow manufacturers like SCM to easily adapt their machines to different systems such as a low temperature freezing tunnel provided with heat recovery for machine washing

Headquarters ITALY

CAREL INDUSTRIES Hqs.
Via dell'Industria, 11
35020 Brugine - Padova (Italy)
Tel. (+39) 0499 716611
Fax (+39) 0499 716600
carel@carel.com

Sales organization

CAREL Asia
www.carel.com

CAREL Australia
www.carel.com.au

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