

Energy-efficient refrigeration system Production freezing with natural refrigerants

NH₃ / CO₂ cascade for cooling four production lines for freezing fish products

In this ARCTOS refrigeration system, great emphasis is also placed on energy efficiency, maximum energy savings, and heat recovery.

When selecting the refrigerants, the customer consciously chose the natural refrigerants NH₃ and CO₂ for their ecological sustainability and high volumetric cooling capacity.



Execution

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The NH₃/CO₂ cascade refrigeration system is designed as a cascade refrigeration plant. The usable cooling capacity is 1,940 kW and is provided in the CO₂ cycle at a temperature of -52°C.

The cooling is supplied by two frequency-controlled CO₂ high-pressure screw compressors. The speed regulation of these compressors ensures that the cooling generation can be optimally adjusted to the required cooling demand at any time, while simultaneously ensuring the highest possible efficiency of the compressors. This is one of the key prerequisites for economical refrigeration plant operation.

The heat from the CO₂ cycle is transferred to the NH₃ cycle via three generously dimensioned plate heat exchangers, with the smallest possible driving temperature difference. Two frequency-controlled NH₃ screw compressors ensure a highly efficient refrigeration cycle process on this circuit as well.

The special and currently unique compressor design allows for the highest possible cooling performance density in the smallest space.

The condensation and heat dissipation to the environment is carried out by two suction-ventilated evaporative condensers with axial fans. These condensers are characterized by minimal power consumption while ensuring minimal condensation temperatures, fulfilling another essential requirement for efficient refrigeration system operation.

Technical Data

Refrigerant:	R717 (NH ₃)
Refrigerant Quantity:	3,325 kg
Maximum Operating Pressure:	16.0 / 23.0 bar (Low Pressure / High Pressure)
Evaporation Temperature:	-14° C
Condensation Temperature:	+35° C
Compressor Manufacturer and Type:	GEA Grasso Screw Compressor WB-5A
Compressor Cooling Capacity:	2 x 1,367 kW
COP Value NH₃:	3.4
Refrigerant:	R744 (CO ₂)
Refrigerant Quantity:	5,000 kg
Maximum Operating Pressure:	25.0 / 40.0 bar (Low Pressure / High Pressure)
Evaporation Temperature:	-52° C
Condensation Temperature:	-10° C
Compressor Manufacturer and Type:	GEA Grasso Screw Compressor PP-1A
Compressor Cooling Capacity:	2 x 977 kW
COP Value CO₂:	2.7



Evaporator and cooler of the NH₃ / CO₂ cascade refrigeration system on a steel platform near the machine room. Below are the cooling water facilities, heat recovery components, and water treatment system.

CONSUMERS

The cascade refrigeration system is used for cooling four production lines, each equipped with a spiral freezer. The hot products (crispy fillets, fish sticks, gourmet fillets, and portioned fillets) are quickly cooled to -20°C by the direct evaporation of CO₂ in the heat exchangers of the freezer air coolers.

HEAT RECOVERY

To further optimize the operational efficiency of the refrigeration system, heat recovery has been implemented. It utilizes the waste heat from the oil coolers (about 500 kW, +60°C usable temperature for hot water) of the NH₃ screw compressors.

CONSUMERS

The NH₃/CO₂ cascade refrigeration system is fully automated and controlled via a control panel with a PLC (Programmable Logic Controller). The planning and realization of the new construction project were carried out in direct coordination between the end customer and ARCTOS Industriekälte AG.

Do you have any questions or comments? We are happy to assist you:

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