Arctos Industriekälte AG

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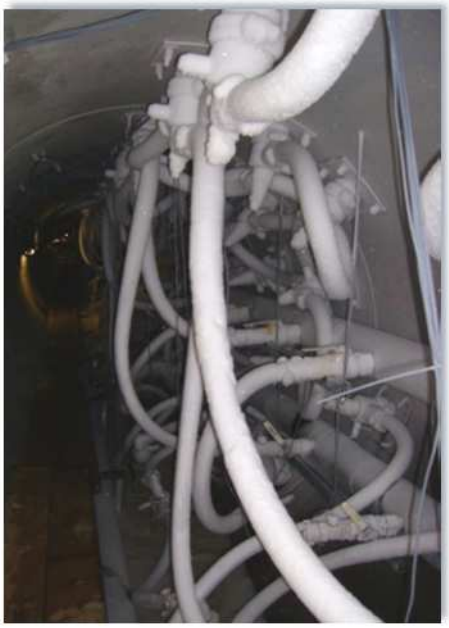
Job Report
Going down into the depths with ARCTOS

CO_2 / NH_3 soil-freezing containerised refrigeration unit

Nowadays buildings grow not only upwards but also deeper into the ground. Underground construction works are often hampered by ground water ingress.
Utilising our soil-freezing refrigeration systems, ARCTOS offers the possibility of freezing the soil around the construction site. This ice shield protects the building site during construction works against penetration by ground water and ensures static safety.



For this purpose a pilot tunnel is drilled. From this tunnel freezing lances supply refrigerant (down to -45°C) to the soil- freezing location. Once the calculated volume of soil has been frozen, the construction work can start and during the construction work the over ground refrigeration system continuously freezes the soil.
When the work is completed, e.g. a concrete shield protects the underground cavity (tunnel, shaft).

Example: special container with soil-freezing unit
The mobile brine cooling system is assembled in a special container as a cascade refrigeration system utilising reciprocating compressor units. The low stage refrigerant is NH_3 and the high stage is CO_2.
The CO_2 / NH_3 cascade refrigeration system is used for cooling brine ($CaCl_2$, 30 %). The brine is employed for freezing the soil, when excavating cross connections between tunnel arms. The cascade refrigeration system has been selected enable lower cooling temperatures. To facilitate these options, different brine types are required. The temperature limits are TYFOXIT F 50 for -50°C or $CaCl_2$ (30%) for -45°C.

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40 ft container with CO_2 / NH_3 soil-freezing containerised refrigeration system

Why a cascade refrigeration system?
The cascade refrigeration system is widely used where low temperatures must be attained economically and within compressor application ranges. Thus a low temperature refrigerant (e.g. CO_2) is used in the lower cascade stage. The evaporator of this stage is used as a condenser for the upper cascade stage which contains a different refrigerant (e.g. NH_3).

Technical data

Refrigerant	NH_3 (R717) / CO_2 (R744)
Refrigerant charge	max. 100 kg NH_3 / max. 200 kg CO_2
Cooling capacity Q_0	275 kW
Heat transfer medium (brine)	$CaCl_2$, 30%
Brine inlet temperature t_{S1}	-33°C
Brine outlet temperature t_{S2}	-38°C
Brine volume V_S	57.3 m^3/h
Heat rejection medium	water / air
Water inlet temperature t_{S3}	+27°C
Water outlet temperature t_{S4}	+31°C
Compressor manufacturer	GEA-Grasso
Compressor type	reciprocating compressor
Plant container	40 ft container housing the brine cooling unit, pumps, control devices and switchboard.