NATURAL REFRIGERANTS

SECONDARY BRINE

ICE SLURRY

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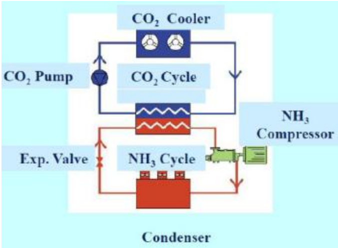
LINE-UP OF ‘NATURAL 5’.

Mayekawa was founded in 1924 and is to-day one of the world’s largest industrial refrigeration companies. It actively promotes the ‘NATURAL 5’ refrigerants, including ammonia, CO2, hydrocarbon gasses, air and water. Mayekawa is active in ammonia compressors for more than 85 years, for hydrocarbons and CO2 for more than 40 years.

The ‘NATURAL 5’ refrigerants cover the full application range -100°C/+100°C from cryogenics, freezing, cooling, air conditioning up to heating.

CO2 SECONDARY BRINE SYSTEMS




The principle scheme shows the CO2 secondary brine circuit(in blue color) and the NH3 compressor circuit (in red color).

The NH3 system exists of a compressor, condenser, expansion device and an evaporator which is used to cool the CO2 as secondary brine.

The CO2 pump in the secondary brine circuit pumps the CO2 to the coolers in the plant.

The test plant in our factory in Japan(Moriya) is used to make ice. The principle scheme shows the ice making room, the ammonia Evacon unit and the CO2 system.

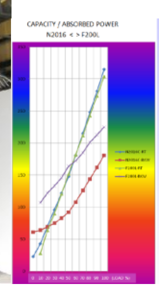
The Evacon unit contains the screw compressor with oil system, CO2 brine cooler and evaporative condenser.

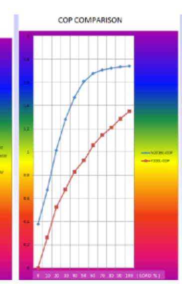
The CO2 system contains the CO2 receiver and CO2 pump.

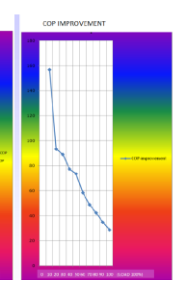
The test plant pictures show the 3 pieces Evacon units on the outside and the CO2 receiver with liquid pump set in the plant.

FIELD CASE.









The field case shows a frozen food storage of size 80000m3, installed in Montpellier in France in 2005.

To-day the machinery has operated average around 30.000 hours.

The used system is an NH3 compression system + CO2 secondary brine system.

The NH3 system uses 3 pieces MYCOM screw compound compressors model N2016LSC with main drive motors 200kW, with frequency convertor for speed regulation 1500->3000rpm, performing 315kW refrigeration capacity at -34°C evaporating temperature, +48°C condensing temperature.

The corresponding absorbed motor power is 181kW.

The liquid subcooling is realized with an openflash type liquid subcooler, the flash gas is taken by the high stage of the compound screw compressor.

The CO2 is cooled at -30°C in a 3500 liter CO2 receiver. The CO2 liquid pumps (hermetic type) produce 15 m3/hr per pump. Total 3 pumps installed of which 1 stand-by. Pump-motor size is 4kW 3000rpm.

The NH3 unit shows the screw compressor unit with condenser and open flash type liquid subcooler as individual skids.

The CO2 skid shows the common CO2 receiver with on top the NH3 evaporator/CO2 condensor and NH3 separator for each compressor unit, and underneath the CO2 liquid pumps stations.

The performance comparison between NH3 and the conventional R22 systems is shown in the 3 graphs :

1. Performance capacity and absorbed motor power
2. COP
3. COP improvement.

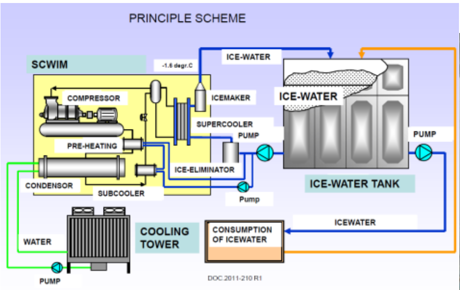
The NH3 system in this field case is based on an ammonia compound screw compressor equipped with frequency convertor for capacity control between 100 and 50%.

The R22 system is based on a single stage screw compressor with economizer and mechanical slide valve control.

It can be concluded from the comparison that the COP improvement in case of NH3 screw compound is more than 40% below 85% of the nominal capacity.

The customer pointed out that the overall energy saving for this NH3/CO2 secondary brine system is more than 40% compared to the conventional R22 systems.

SUPERCOOLED WATER ICE MAKING SYSTEM



The principle scheme shows the ‘SCWIM’ supercooled water ice-maker, the ice-water tank with consumer circuit and the cooling tower.

The ‘SCWIM’ system exists of an ammonia compressor-unit with oil system, condenser, expansion device, an ice-eliminator, a supercooler with gas separator which is used to super-cool the water to -1,6°C and an icemaker.

The ice-water is than flowing to the icewater tank from where it will be pumped to the consumers in the plant.

The condenser is connected to a cooling tower.

FIELD CASE.

The field case is a dairy plant, installed in Tatebayashi in Japan in 2009.

The system uses 3 pieces of SCWIM units size N160VLD single screw compressors with main drive motors 132kW, with frequency convertor for speed regulation 1500->3000rpm, performing 523kW refrigeration capacity at -3.5°C evaporating temperature, +35°C condensing temperature.

The corresponding absorbed motor power is 108kW.

The advantage of the ice slurry system compared to the conventional ice on coil system is that there is no change in evaporating temperature level in case of the ice slurry system. In case of ice on coil there is building-up of ice on the coils which decreases the heat transfer between refrigerant and water what caused the evaporating temperature to drop from -12°C to -20°C.

In the performance table a comparison is made for lower evaporating temperatures between the ‘SCWIM’ and ‘ICE ON COIL’ systems, resulting in a COP difference between 4.8 and 3.0 (average value at TE=-16°C).

The photo shows the ammonia compressor with main drive motor on the oil separator;

The graph with trend of suction pressure/discharge pressure/oil pressure shows the constant evaporating pressure (PS=approx.2.8barg or TE=-3.5°C) during operation.

The plants uses 100 ton of ice per day.

In case of ‘SCWIM’ 17,7 hours of compressor operation are required to produce 100 ton of ice, this requires 1911 kWh per day.

Compared to the conventional system 29.4 hours of compressor operation are required to produce 100 ton of ice, this requires 3057 kWh per day.

This means that SCWIM needs 37.5% less power than the classic ice on coil system.

On the overall plant the features are pointed out by the customer as follows :

1) NH_3 charge is 95% down from 9.000kg in case of ice bank to 450kg in case SCWIM
2) Energy saving by using NH_3 and SCWIM is more than 30%.
3) CO_2 emmision reduction by using NH_3 and SCWIM is more than 30%
4) Customer received a TEC thanking award as power peek was shifted to the nigh tariff period.