October, 2011

Natural Five

FIELD CASE STUDY OF INDUSTRIAL PLANT OPERATING WITH NATURAL REFRIGERANTS

The contractor Cofely Refrigeration bv proposed to the customer to install a CO2-NH3 plant in order to replace the existing R22 plant.

The ammonia parts of the plant are located in the machine room and partly on the roof (condensers).

The supply of freezing on low temperature and cooling (-12°C, -31°C and -51°C) shall be done with CO2.

The new plant has been completed and handed over during 2005 and has several advantages compared to a common plant with the synthetic refrigerant R507.

LOW TEMPERATURE SIDE : FREEZING CAPACITIES (kW)			
CO2 LIQUID T°(°C)	1xGH160	2xC200WMD	2xN6HK
-51	630	2870	
-41	900		820
-31	960		740
HIGH TEMPERATURE SIDE (TC = 32°C)			
NH3 TE (°C)	3xN250VLD	1xN200VLD	
-18	4180	800	

The existing R22 plant has been in operation since 1997 and needs to be converted in capacity and freezing temperature from 1300kW at -42°C to 2900kW at -51°C.
The new plant processes meat frozen during the process, operating 24hrs/day per workweek by using :

Process working room chilling requiring -12°C, plate freezers(4x550kW), quick freezing tunnel (1x600kW) and a spiral freezer(1x600kW) requiring -51°C,
frozen food stores requiring -35°C.

The freezers need to be defrosted by using the CO2 hot gas from the plant.

In addition heat recovery is required to obtain hot water for the process(55°C), floor-/office-/load dock-/expedition room heating(35°C), bottom floor freezing rooms (12-14°C),
and condensing temperature must not exceed 10°K above wet bulb temperature (authority requirement).

Considerations :

- CO2 is a high pressure refrigerant. This means that without any problems a refrigerant temperature of -51°C can be obtained.
  R507 has at this temperature an evaporating pressure of 0.8 bara.
  As the pressure of CO2 is so much higher, the vapor lines have much smaller diameters and also the compressors are sized smaller.
- CO2 and NH3 are natural refrigerants and do not contribute or very limited to the greenhouse-gases effect.
- The new plant is significantly more efficient than a comparable plant using R507.
- The calculated savings amount to 23% on energy and 49% on emission of CO2-equivalents.

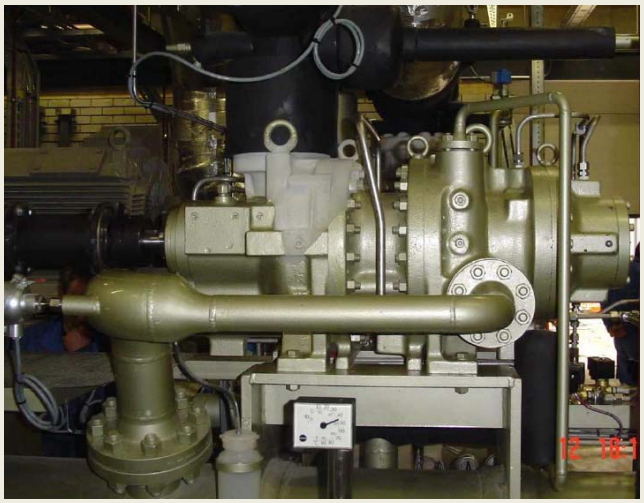
MAYEKAWA
MAYEKAWA Europe nv/sa

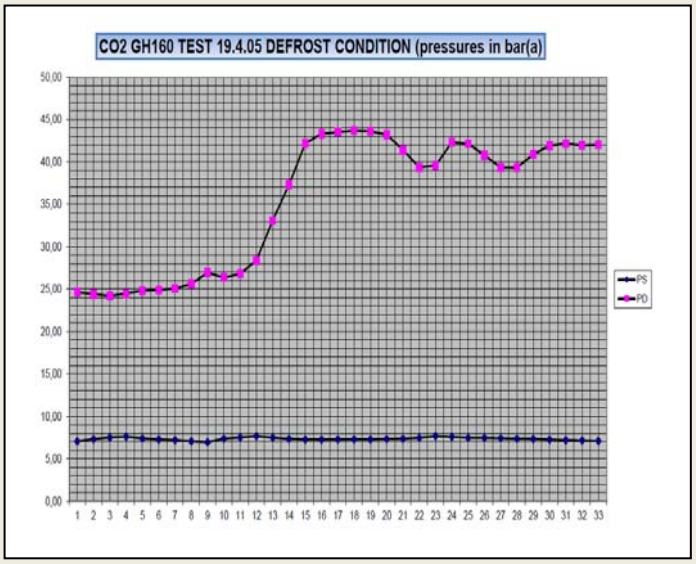
ATMO faster to Europe
EU sphere natural refrigerants

In addition the plant is executed with following energy saving options :

- Heat recovery
- High efficiency motors
- Hot gas defrosting
- Frequency convertors
- Energy saving condensers

The other proposal with R507 has been considered. Cofely Refrigeration bv concluded that it was much more expensive than the choosen CO2/NH3 concept.





OVERVIEW INSTALLED COMPRESSORS :

natural	type	unit	date	hours**	
CO2	C6HK	C5	2005	49027	
CO2	C6HK	C6	2005	2666	
CO2	GH160	C7	2005	41144	
CO2	C200VMD	C8	2005	30878	
CO2	C200VMD	C9	2005	3762	
NH3	N250VLD	C1	1997	61301	*
NH3	N250VLD	C2	1997	39812	*
NH3	N250VLD	C3	1997	38133	*
NH3	N200VLD	C4	2005	54928	

* : Incl. F250VLD use 1997->2005
**: 5-10-2011

At the completion and the acceptance of the new CO2/NH3 plant TNO reported that the CO2/NH3 plant is significantly more efficient than a comparable plant with R507. The calculated savings amount to 23% on energy, resp. 49% on CO2 equivalent emission at that time.

In reality it was possible to run the NH3 high stages at considerable lower condensing temperatures than initially design. The average yearly condensing temperature is 25°C instead of the 32°C initial designed resulting in a yearly saving of 906 MWh.

As this plant was one of the first in Europe realized, supply and availability of high pressure components has been one of the faced bottle necks.
Thanks to the customer which gave full confidence and made strong investment in this new technology to Cofely Refrigeration bv it was possible to succeed and realize this plant with success !

MAYEKAWA Europe nv/sa

ATMO faster to Europe
EU sphere natural refrigerants