

AMMONIA AND CO2 APPLICATIONS IN INDUSTRIAL REFRIGERATION PLANTS













Ammonia/CO2 plant

Reason for building AMMONIA/CO2 system

- 1. Increase capacity
- 2. Phase out existing R22 system
- 3. Phase out R507 system (F-gas) in near future
- 4. Reduction of energy consumption & energy costs



Ammonia/CO2 plant

Hot water needs at 68°C

- 1. Decrease gas consumption
- Heat recovery from the NH3 refrigeration system : from hot gasses and oil coolers. Water is heated from 12°C to 26°C at condensation temperature of 25°C
- In order to get water at a temperature of 68°C in an energy efficient way, we used an ammonia heat pump (ODP & GWP = 0) with condensing temperature of 70°C (32,1 barg)



Ammonia heat pump

HEAT PUMP : using NH3 refrigeration system condensor heat as heat source

- Positive impact on condensor load using 'waste' heat decreasing condensor load
- Recovery of residual heat for hot water production
 -> hot water for cleaning : 65°C



Ammonia heat pump

DEMANDS

- 1. WATER TEMPERATURE 65°C heat demand : 425 KW (hot water 70 m3/day)
- 2. WATER TEMPERATURE 25°C heat demand : 150 KW (10 m3/hr)
- 3. COOLING DEMAND : 1000 kW
- -> CO2 pump circulation refrigeration system (CO2 at -7°C)



EQUIPMENT





DOC.2015-698 R1

PRINCIPLE SCHEME





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EQUIPMENT



MODEL		N6	N6HK	
QTY		1	1	
SITE LOCATION				
COUNTRY		NEDEF	NEDERLAND	
TOWN				
REFRIGERANT		N	NH3	
TE	°C	17	25	
TC	°C	70	70	
PS	barg	6,8	9	
PD	barg	32,1	32,1	
RPM	rpm	1600	1600	
QC	kW	357	468	
BKW	kW	80	84	
СОР-Н		4,5	5,6	
OPERATING HOURS			?	
HP	hrs		?	

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UNIT LAYOUT





LAYOUT

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Installation date : December 2011

Operating hours per year ±7000 hrs

Calculation detail : POWER DRIVE Efficiency = 97~98%

DRIVE MOTOR WEG 315S/M 75kW $\cos^{\varphi} = 0.87/0.75$ efficiency = 93,7/93,2 (100%/50% load)

OPERATION SAVINGS



	HEAT PUMP	BOILER
Performance (COP)	4,48(*)	0,85
Hot water(26->68)	425 kW	425 kW
Energy consumption primary (2040 hrs/yr)	193.526 kWh	102.000 m3 natural gas
Energy prices	€ 0,06/kWh	€ 0,50 /m3
Energy costs	€ 11,611,-	€ 51.000,-
CO2 emissions	97 tons	180 tons



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(*):incl.losses

OPERATION SAVINGS



	HEAT PUMP	BOILER
Performance (COP)	N.A.	0,85
Hot water(12->26)		142 kW
Energy consumption primary (2040 hrs/yr)		34.080 m3 natural gas
Energy prices		€ 0,50 /m3
Energy costs		€ 17.040,-
CO2 emissions		60 tons
SUMMARY (12->68)		
ENERGY COST	€ 11,611,-	€ 68,040,-
CO2 EMMISION	97 tons	240 tons
SAVINGS		
COST	€ 56,429,-	
CO2 EMISSION	143 tons	

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OPERATION SAVINGS



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CONCLUSION :



ANNUAL SAVINGS :

OPERATION 56.429 € CO2 EMISSION 143 tons CONDENSOR-WATER (+ treatment) NATURAL WASTE HEAT CONDENSOR

INVESTMENT : €200.000 (boiler:€25.000) RETURN OF INVESTMENT < 5 YRS In the Netherlands, the investment in a heat pump is eligible for **SUBSIDY** in the form of tax reduction on the investment HIGHER EFFICIENCY THAN COMPARABLE TECHNOLOGIES

LONG LIFE TIME (>25 YEARS)

MAINTENANCE LOW-COST



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THANKS FOR YOUR ATTENTION ! special thanks to :

Willy van Leeuwen Projectleiding

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