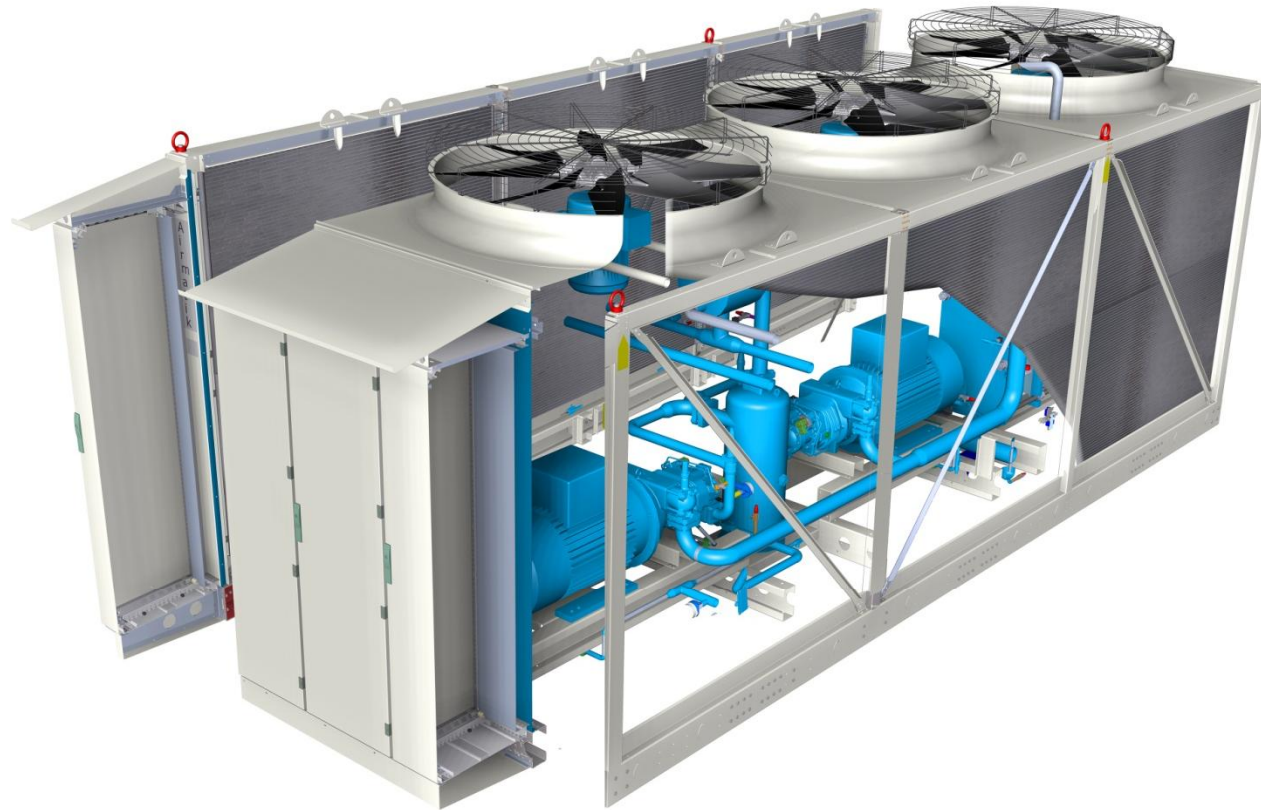


zudekoo Airmatik®



The company was established in Trieste in 1990 .

Manufacturing of innovative ammonia chillers:

- Varimatik®, water cooled single compressor chiller
- Ecomatik®, watercooled dual compressor chiller
- Icematik®, ice generator
- Airmatik®, air cooled chiller
- Geomatik®, heat pump and refrigerator
- Recumatik®, heat pump and refrigerator for total heat recovery



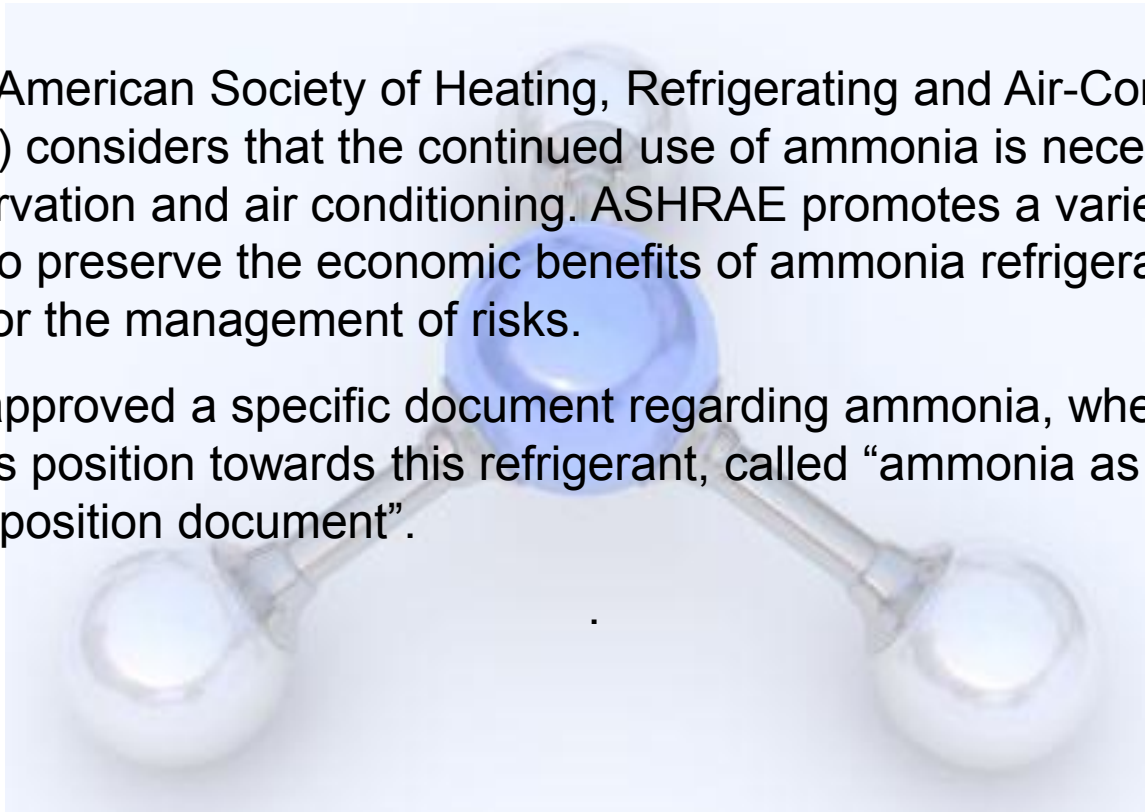
Ammonia

- one of the first natural gas to be used for refrigeration (XIX century)
- GWP (global warming potential)=0; if dispersed in the ambient, it is absorbed by natural cycle of ozone. Ammonia doesn't affect greenhouse effect.
- ODP (ozone depletion potential)=0. Not dangerous for ozone layer.
- high latent heat of vaporization → Low charge fluid required, small dimension chiller
- easy maintenance and easy detection of possible leaks
- high heat exchange efficiency → Small heat exchanger dimension
- easy availability and low cost of refrigerant
- compatibility with common construction materials

Ammonia

ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) considers that the continued use of ammonia is necessary for food preservation and air conditioning. ASHRAE promotes a variety of programs to preserve the economic benefits of ammonia refrigeration while providing for the management of risks.

ASHRAE approved a specific document regarding ammonia, where it explains his position towards this refrigerant, called “ammonia as a refrigerant:position document”.



Ammonia

ASHRAE will:

- promote authoritative information on ammonia by seminars and publications.
- continue research on ammonia topics such as handling, application, operation, control of emissions and new technology.
- maintain and develop standards and guidelines for practical and safe application of ammonia in refrigeration systems.
- provide programs and publication of innovative designs and application of ammonia refrigeration.
- advise governments and code officials with information regarding ammonia.

Many Energy and Development european insitutes gave their support to Ammonia as refrigerant. Legislations and laws are changing according to this trend (for example Switzerland).

Comparison Ammonia - Freon

Considering same condition → better efficiency than Freons

Low charge of refrigerant → small chiller and pipes dimensions



COOLPACK	ΔT_{sc}	[K]	4	Δp_{dl}	[bar]	0,2	Q_{loss}	[kW]	10
	Δp_{sl}	[bar]	0,2	Q_e	[kW]	700	ΔT_{sh}	[K]	1

Tcond	[°C]	35			35			45			45			20		
Tevap	[°C]	3			-15			3			-15			3		
REFRIGERANT	COP	Flow	Flow	COP	Flow	Flow	COP	Flow	Flow	COP	Flow	Flow	COP	Flow	Flow	
	kW/kW	m3/h	kg/h	kW/kW	m3/h	kg/h	kW/kW	m3/h	kg/h	kW/kW	m3/h	kg/h	kW/kW	m3/h	kg/h	
NH3 R717	5,267	593,2	0,626	2,937	1184,4	0,638	3,860	621,0	0,655	2,346	1241,0	0,668	10,417	556,5	0,587	
PROPANO R290	5,108	761,4	2,358	2,828	1419,3	2,536	3,644	845,3	2,609	2,182	1582,9	2,829	10,329	668,1	2,069	
R404a	4,800	625,9	5,748	2,607	1229,6	6,236	3,302	722,4	6,634	1,928	1438,0	7,293	10,03	526,8	4,838	
R507a	4,829	602,7	5,851	2,603	1174,8	6,348	3,321	695,7	6,753	1,944	1374,1	7,425	10,072	508,9	4,94	
R410a	4,953	438,7	4,047	2,763	825,4	4,187	3,463	490,8	4,527	2,098	927,3	4,703	10,21	382,2	3,526	
R134a	5,189	1014,0	4,479	2,876	2100,0	4,797	3,714	1119,2	4,944	2,227	2335,1	5,334	10,454	892,9	3,944	
CO2 R744	2,496	171,8	4,944	1,547	287,3	4,7207	1,458	294,0	8,4634	0,933	476,5	7,8295	3,319	129,2	3,7186	

Differences referred to Ammonia

REFRIGERANT	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
NH3 R717	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
PROPANO R290	-3,019	28,355	276,677	-3,711	19,833	297,492	-5,596	36,119	298,321	-6,991	27,550	323,503	-0,845	20,054	252,470
R404a	-8,867	5,512	818,211	-11,236	3,816	877,429	-14,456	16,329	912,824	-17,818	15,874	991,766	-3,715	-5,337	724,191
R507a	-8,316	1,601	834,665	-11,372	-0,811	894,984	-13,964	12,029	930,992	-17,136	10,725	1011,527	-3,312	-8,553	741,567
R410a	-5,962	-26,045	546,486	-5,924	-30,311	556,270	-10,285	-20,966	591,145	-10,571	-25,278	604,042	-1,987	-31,321	500,681
R134a	-1,481	70,937	615,495	-2,077	77,305	651,881	-3,782	80,225	654,809	-5,072	88,163	698,503	0,355	60,449	571,891
CO2 R744	-52,611	-71,038	689,776	-47,327	-75,743	639,922	-62,228	-52,657	1192,122	-60,251	-61,604	1072,081	-68,139	-76,783	533,492

Comparison Ammonia – Freon

Ammonia has no impact on environment

	R717	R507A	R290	R404A	R134A	R410A	R744 (CO ₂)
GWP (100 yrs ITH)	0	3300	3	3260	1300	1720	1
P abs. [kWh]^a	133	145	137	146	135	141	280
kg CO₂^b	89	97	92	98	90	95	188

a) Considering T_c=35°C ; T_e=3°C and cooling power 700 kW (see previous slide)

b) Considering 0,67 kg of CO₂ produced for electric kWh

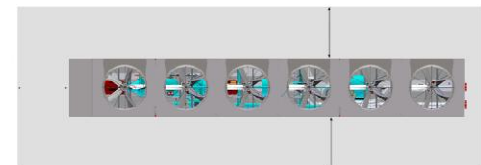
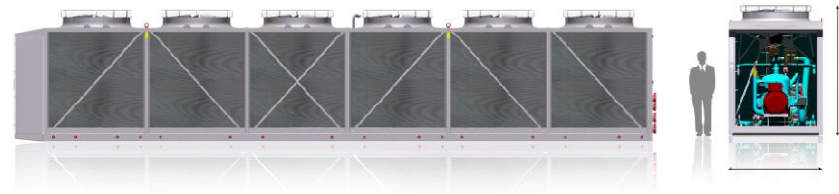
In 1987 Montreal Protocol limits the use of CFC and HCFC.

In the Kyoto protocol also HFC are considered responsables of Greenhouse effect.

From 1 January 2010, with CE 1005, it's forbidden produce and put on the market CFC, HCFC and halons (R22 included).

Chiller features

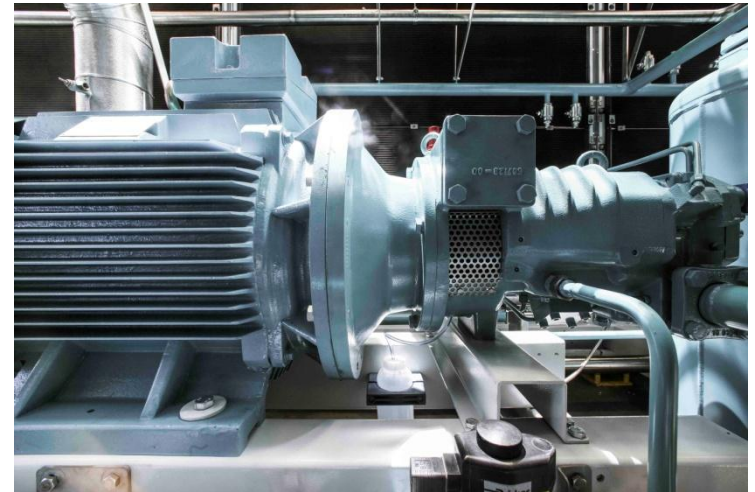
- high efficiency air cooled chiller, compression cycle type
- plug-in type, single block chiller, external use.
- capacity from 150 to 900 kW.
- field operation from -15°C to 20°C
- air condensation with external ambient temperature to 47°C
- 4 standard sizes of chillers



Chiller features

High efficiency compressor:

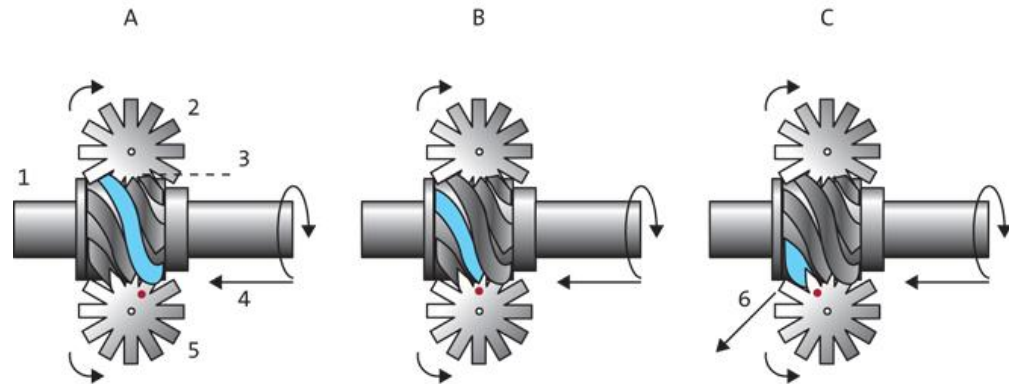
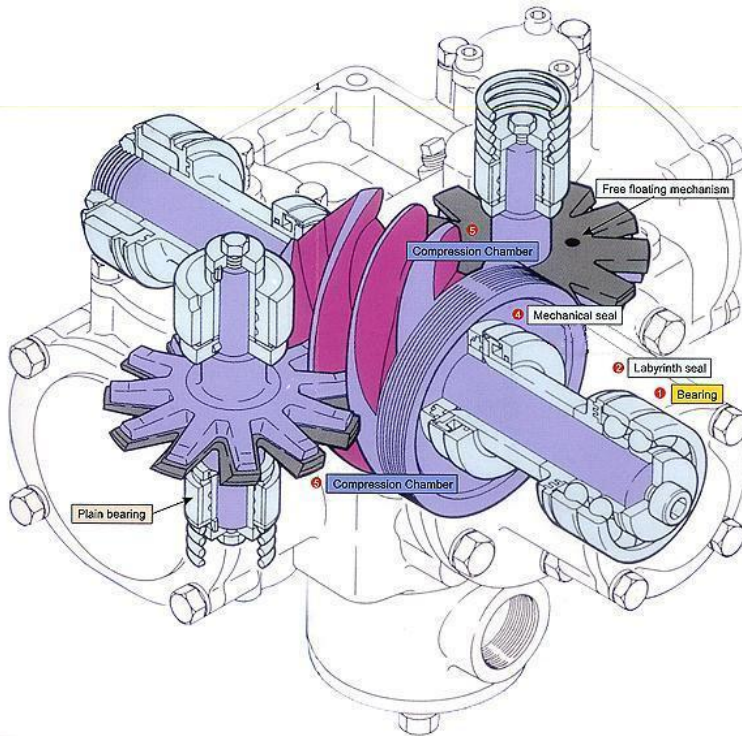
- reciprocating type (capacity control on speed and on cylinder unload)



Chiller features

High efficiency compressor:

- screw type (capacity control speed and on slide valve)



Chiller features

Servoventilated asynchronous three phase motors:

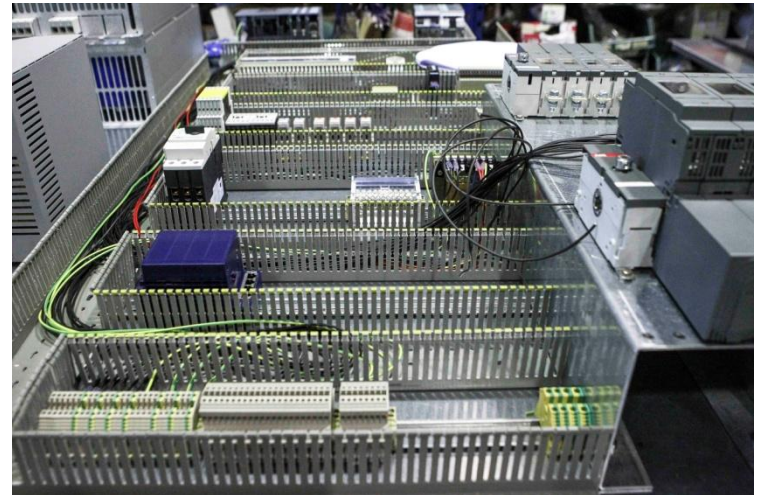
- low noise
- direct coupling with compressor
- inverter control



Chiller features

Inverter benefits :

- 30% - 50% cheaper to run as it consumes less power
- low motor starting current
- reduction of thermal and mechanical stresses on motors during starts
- chiller adapts continuously to cooling load
- modulate power factor ($\cos(\varphi) \approx 1$)
- lifetime of compressor increases



zudek

Airmatik®



Chiller features

Stainless steel structure:

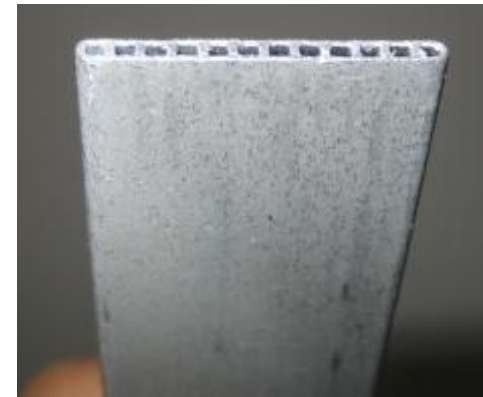
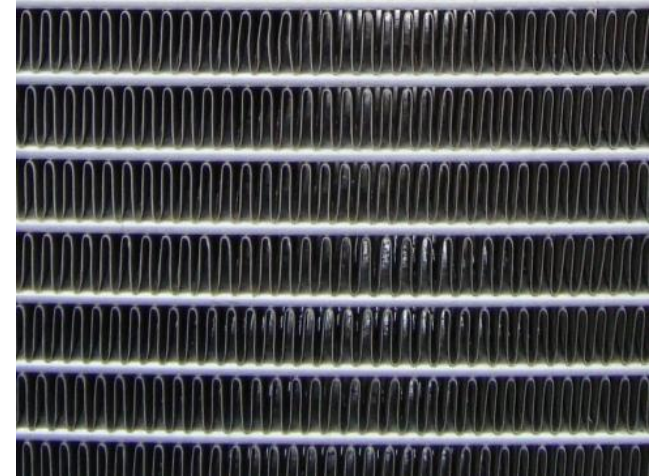
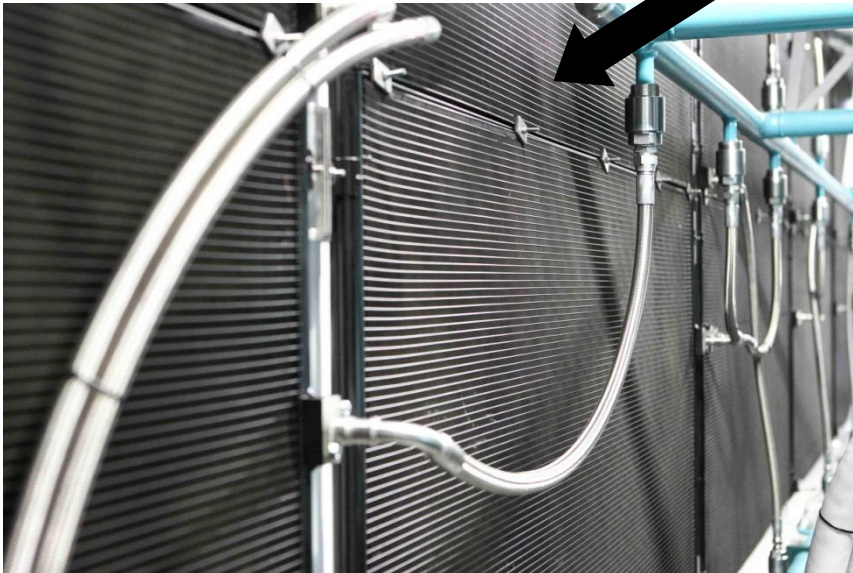
- long lasting structure
- resistance to corrosion



Chiller features

Air cooled condenser:

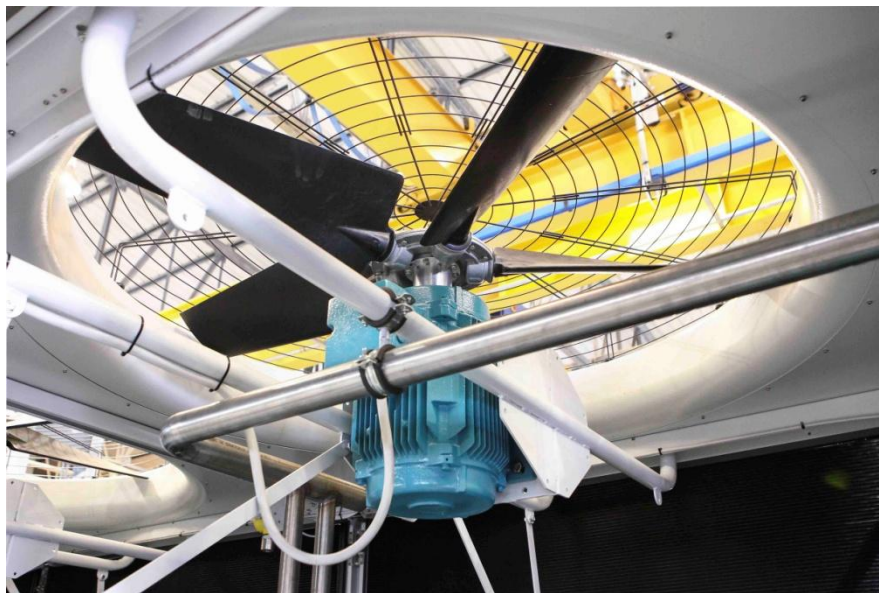
- aluminium microchannel condensers
- high heat exchange coefficient
- easy cleaning and maintenance



Chiller features

Axial fans activated by inverter :

- airfoil shape type(better efficiency)
- sickle shape blades type (lower noise)
- control on condensing pressure



Chiller features

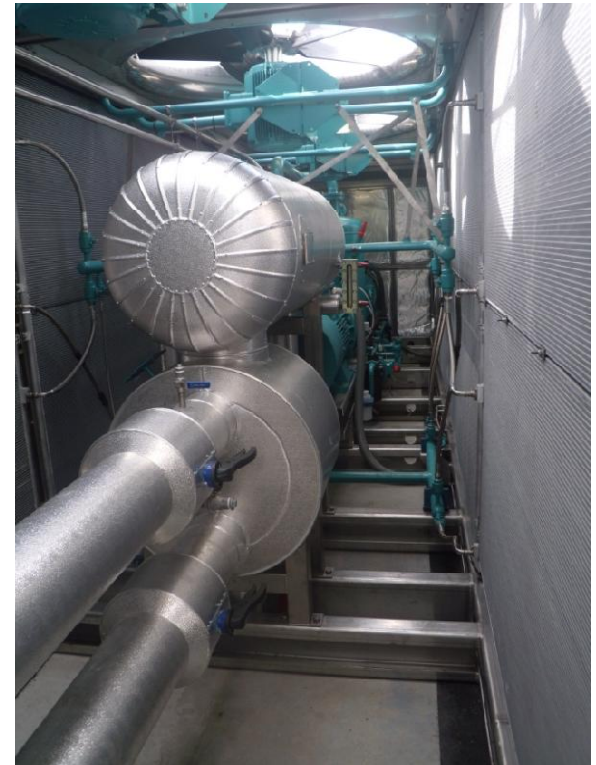
Flooded evaporators in stainless steel (or titanium for special projects):

- compact
- efficiency increase with decreasing capacity
- superheating is almost 0 (efficiency increased)
- expansion valve controlled by high pressure side

Liquid separator above evaporator:

- permits natural circulation of refrigerant
- optimized to reduce to minimum the ammonia charge in the chiller

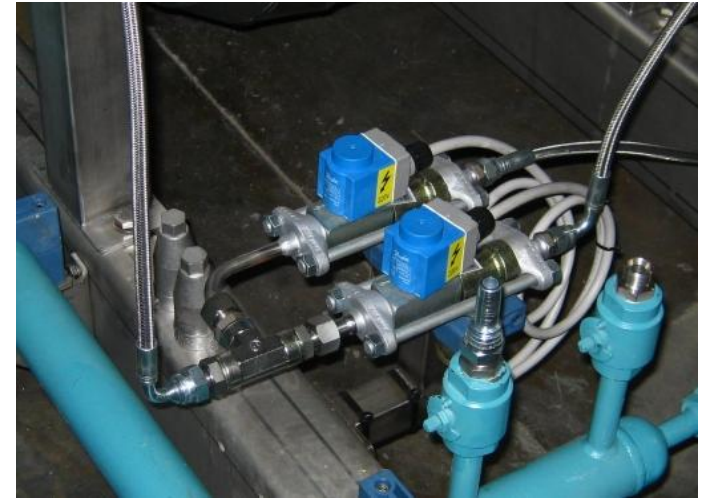
Cold part insulation with insulating cover, polyurethane foam with embossed aluminium coating.



Chiller features

Automatic oil recovery system:

- based on Venturi effect (ejector)
- from evaporator, oil is conveyed to compressor suction



Possibility of heat recovery:

- partial heat recovery (around 10% of condensing capacity) at high temperature with desuperheater
- total heat recovery at medium temperature with condenser (redirecting ammonia flow from microchannels to water condenser)

Chiller features

Compatibility with many media fluids :

- water
- sea water
- glycol
- ammonia
- ammina
- brine
- CO2
- many more



Telemetry

Chiller “PLC controlled”:

- Automatic self regulating device based on control of parameters such as:

- temperature (external, condensing, evaporating, discharge, oil, media inlet and outlet,...)
- pressure (condensing, evaporating, oil pump, oil filter,...)
- level (ammonia on evaporator, receiver, oil)
- electric and electronic values (motors, magnetothermic switches,...)
- ammonia (ammonia detectors)

- “Best COP” logic (chiller setups himself to achieve the best performance)

- monitoring system and remote control via Internet or modem

- customizable and updatable software



Chiller features

Frontal electric board:

- touchscreen
- power and control board in same cabinet
- general sectioning lever
- PLC



Carrying

Easy transportable with normal means of carrying.



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Installations



...the future of
Ammonia...

The past of
Freons...



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