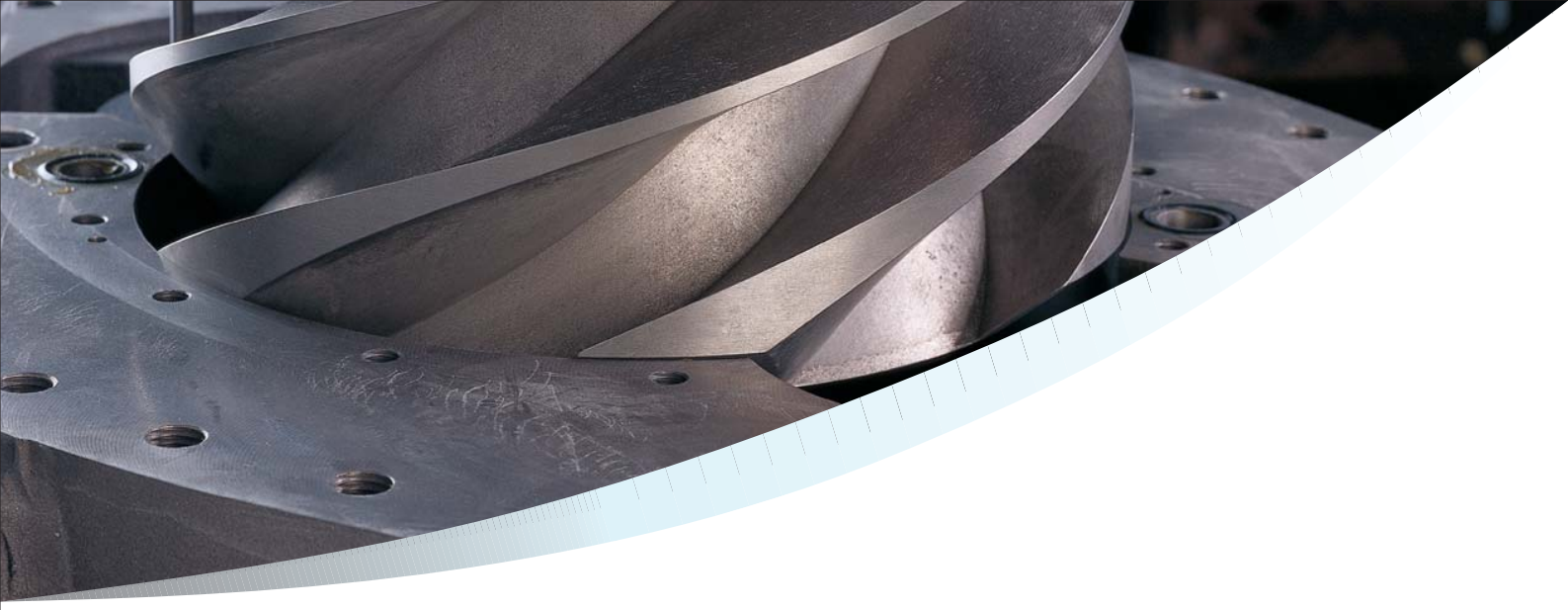
VILTER®
Since 1867

Single Screw Ammonia Heat Pumps

Harness Your Heat... Don't Reject It

EMERSON™
Climate Technologies



Harness Your Heat...Don't Reject It

Industrial processes consume considerable energy from two primary sources in the production of their products. Mechanical refrigeration applied in the processing and preservation of products consumes electrical energy, while the hot water supplied for clean-up, cooking and process heating employs mostly fossil fuels.

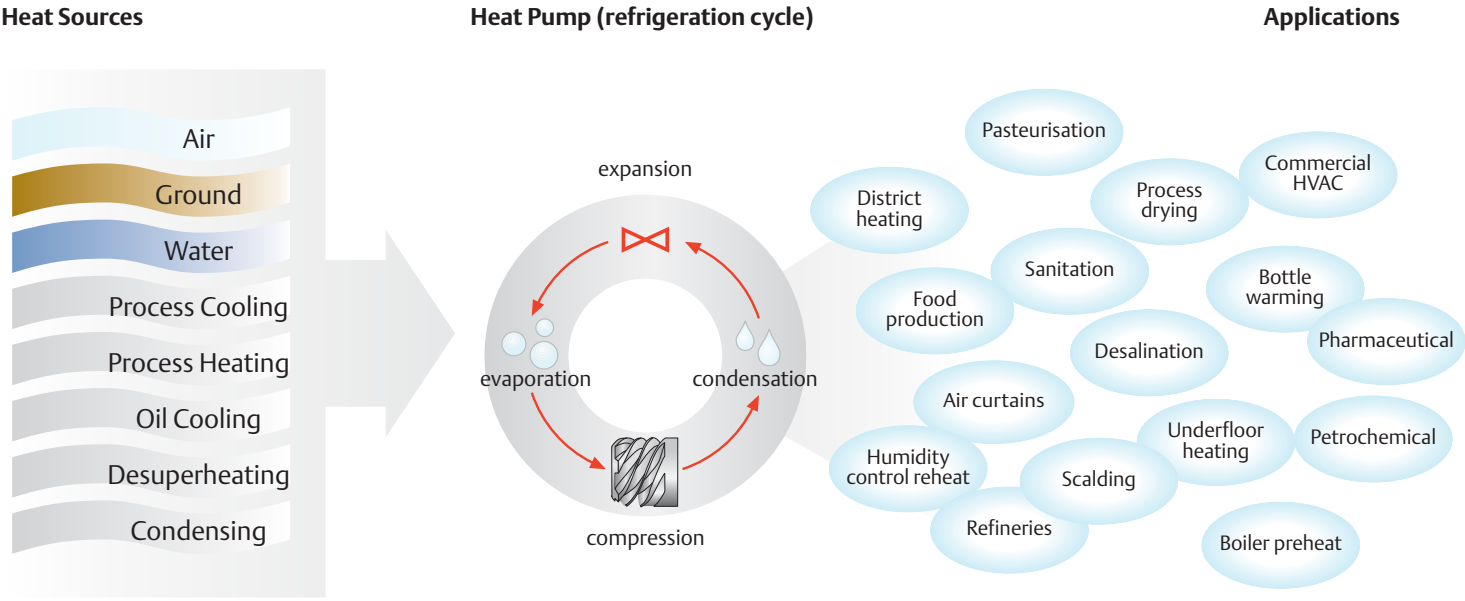
The considerable energy absorbed by ammonia in industrial refrigeration is usually discarded to the atmosphere as wasted heat. The entering flow of gas or oil used to produce hot water bypasses the significant energy potential of the exhausted heat of rejection from refrigeration.

With a growing interest in conserving energy and renewing their refrigeration system's wasted heat of rejection, industrial processors are tapping into recent screw compressor developments in making the most of their energy resources. End-users are realising the powerful potential of applying industrial heat pumps to their processes and converting their waste heat into useable heat, afforded through the use of the high pressure capabilities of single screw compressor technology.

Vilter has extended the Single Screw compressor line with the addition of high pressure heat pump screw compressor models. These screw compressor units, with frames constructed of cast steel, are capable of operating with ammonia at extremely high condensing temperatures. Integrated into existing ammonia refrigeration systems, the heat pump compressors provide a cost effective solution to harnessing and converting your heat of rejection to high grade hot water, up to 90°C.

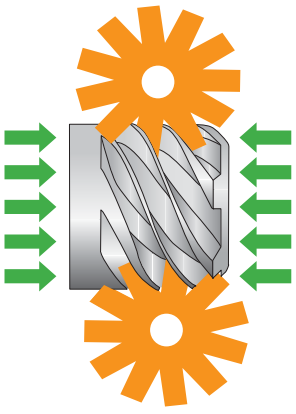
The Vilter high pressure heat pump compressors retain the single screw's inherent design advantages of balanced forces for long life and high reliability, and parallel slides for peak performance at full or part load performance and reliability superior to any twin screw compressor.

Heat pumps extract heat from a variety of sources and convert the heat to higher temperatures for use in many industrial applications. The advanced compression capabilities of Vilter's single screw technology have contributed to the development of heat pumps for industrial applications, providing higher capacities and a greater range of temperatures than prior generations of heat pump compressors.

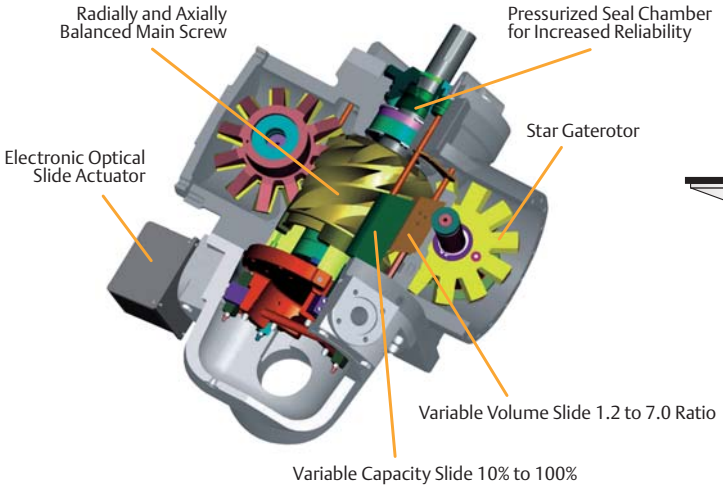


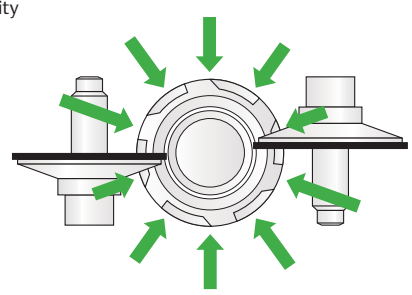
Single Screw Balanced Loading: Superior Technology for High Pressure Operation

The advantage of the Single Screw compressor over other technologies is the fact that there are no net radial or axial forces exerted on the main screw or drive shaft components due to the work of compression. Since compression occurs symmetrically and simultaneously on opposite sides of the screw, the compression forces are canceled out. The only vertical loads exerted on the main screw bearings are due to gravity. Since the discharge end of the screw is vented to suction, the suction gas pressure is exerted on both ends of the screw resulting in balanced axial loads.



Balanced Axial Loads

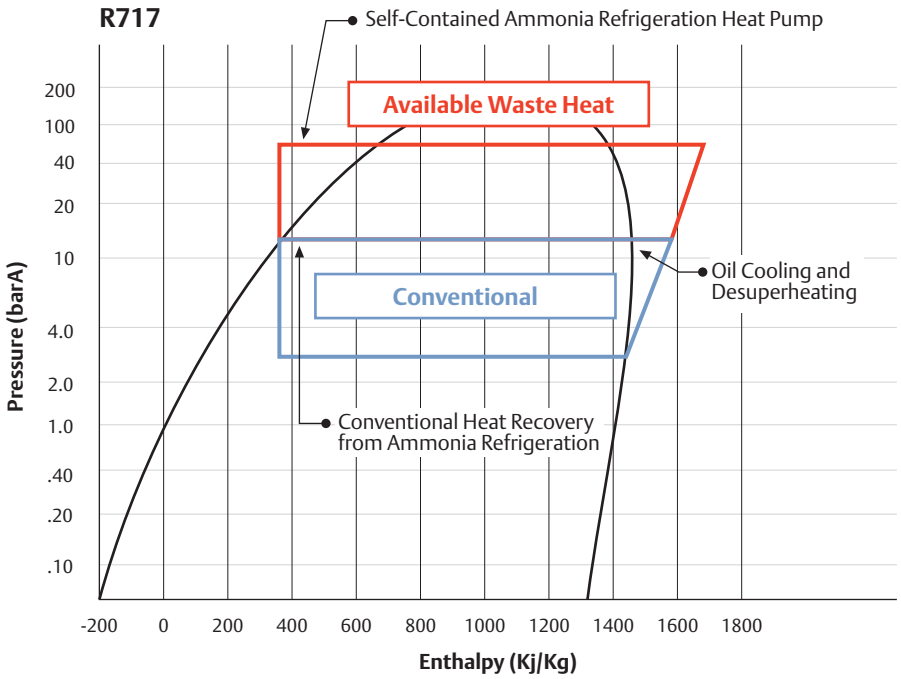


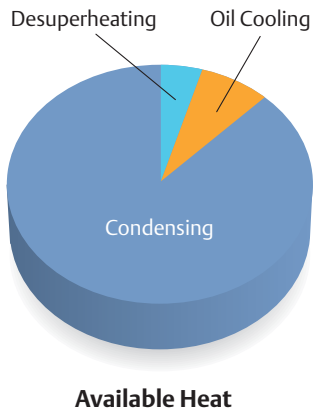


Balanced Radial Loads

Conventional Heat Recovery vs. Ammonia Heat Pump System

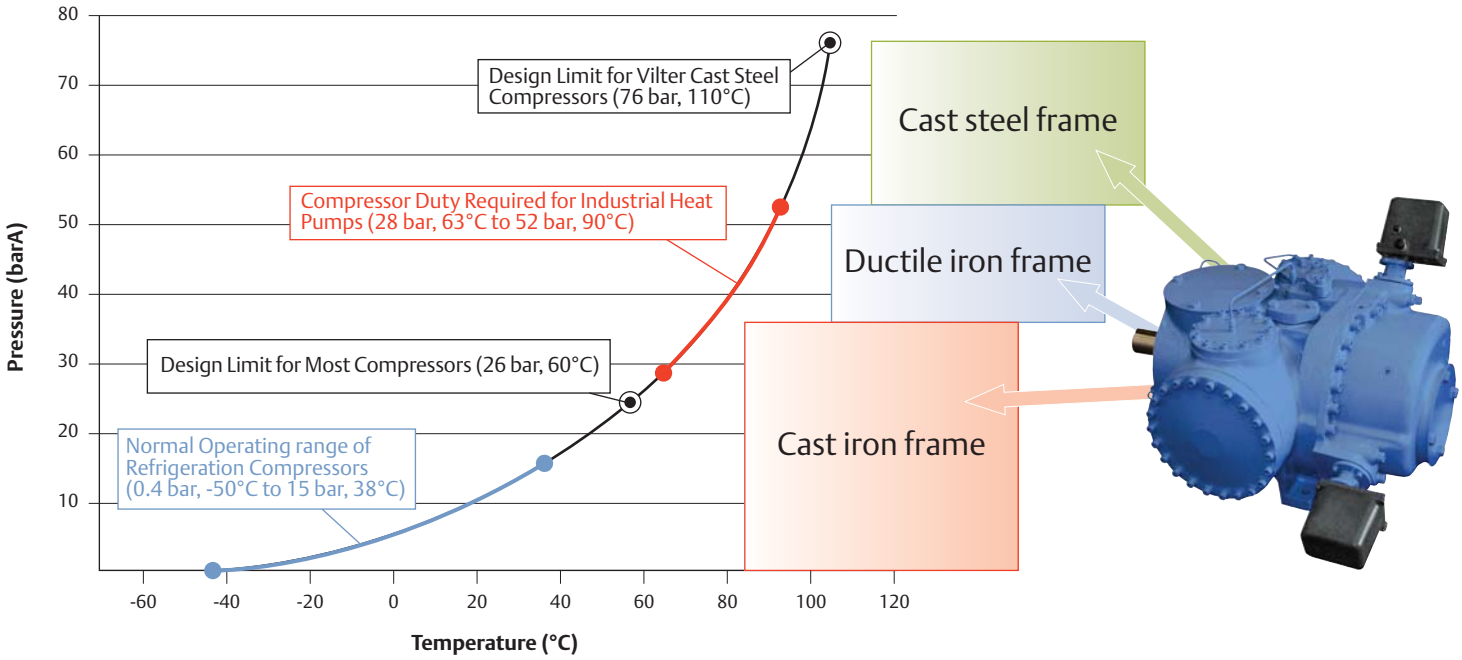
Single screw compressor technology allows for sustained operation at higher saturated condensing temperatures than conventional systems, providing for the full use of the system's heat of rejection for high temperature heating.



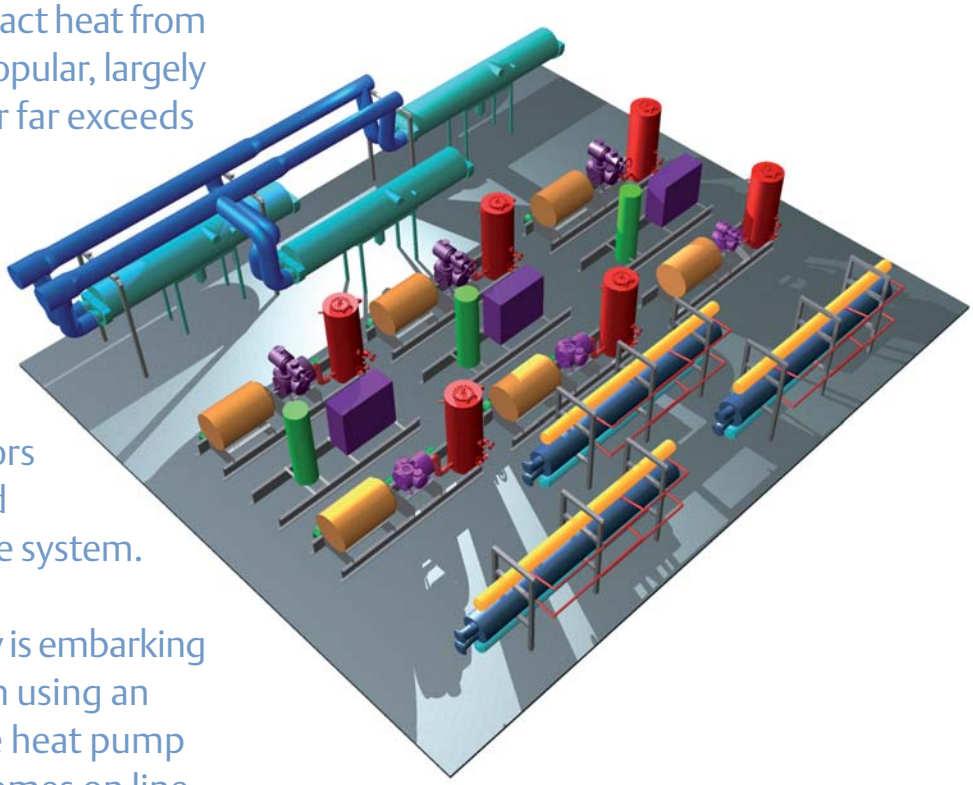


Conventional heat recovery in industrial refrigeration systems utilise only 10 to 15% of the total heat of rejection including superheat and oil cooling. The majority of the heat is rejected through the condenser. However the temperature of this heat source is typically too low for beneficial use

Ammonia Pressure-Temperature Relationship



The use of heat pumps to extract heat from air and water is increasingly popular, largely because the heat they deliver far exceeds the energy they consume.



Vilter engineers, collaborating with Star Refrigeration** and Norsk-Kulde, made use of Vilter single screw compressors to produce the pressures and temperatures required for the system.

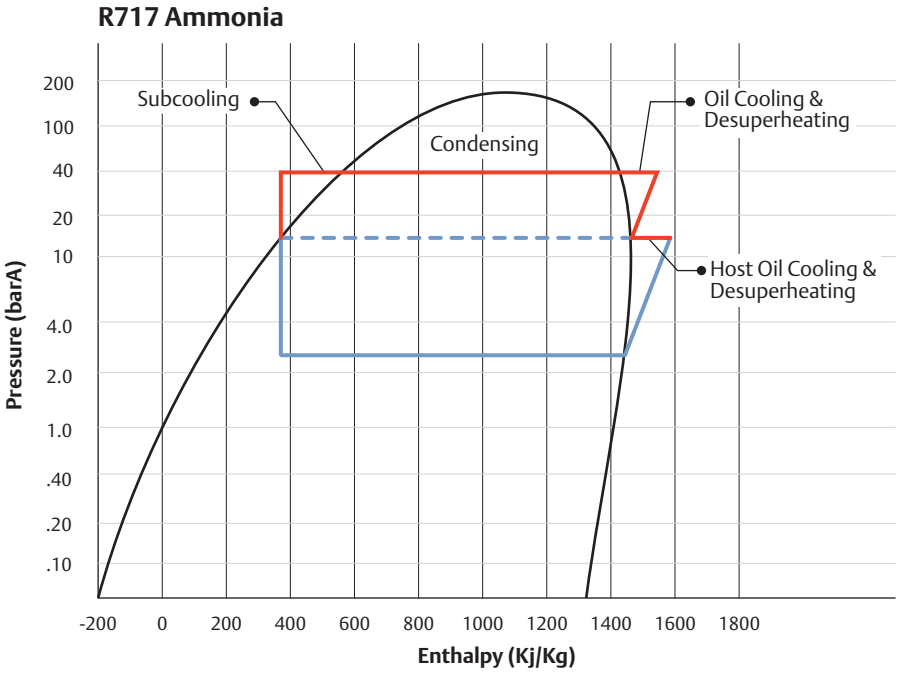
The city of Drammen, Norway is embarking on a novel energy saving plan using an ammonia-based stand-alone heat pump system. When the project comes on line, all of Drammen's hot water heating needs with be supplied with energy extracted from the frigid North Sea, greatly reducing the use and emissions of fossil fuels.

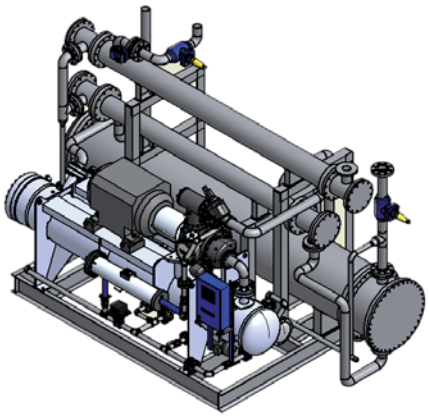
The city of Drammen (population 60,000) needed hot water at 90°C for their new district heating system. Using ammonia refrigerant (R-717) the project is highly efficient, greatly reduces the use of fossil fuels, and has no negative impact on the ozone layer or global warming.

Single Stage Scavenging Heat Pump System

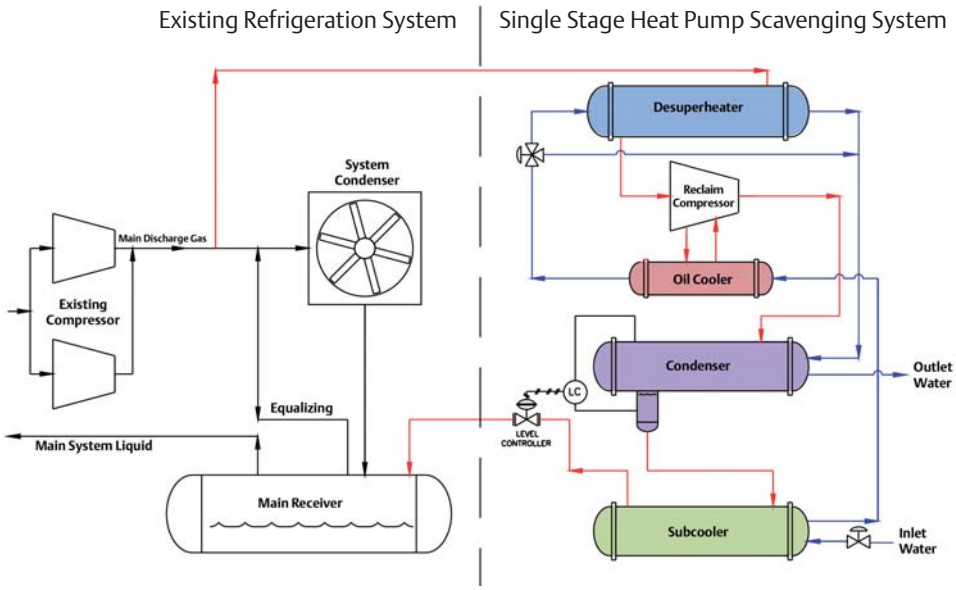
A scavenging heat pump system is designed to pull heat out of an existing refrigeration system by diverting ammonia discharge gas away from refrigeration system condensers to the suction inlet of the heat pump system. Vilter single screw compressors are designed to handle the high suction pressures required of this duty, and deliver the very high discharge temperature vapors for water heating in order to make use of the refrigeration system's waste heat. In heating water to moderate temperatures, up to 71°C, single stage single screw heat pump systems provide optimal performance (COP's) due to the duty's relatively low differential pressures, up to 24,2 bar.

Ammonia heat pump scavenging system





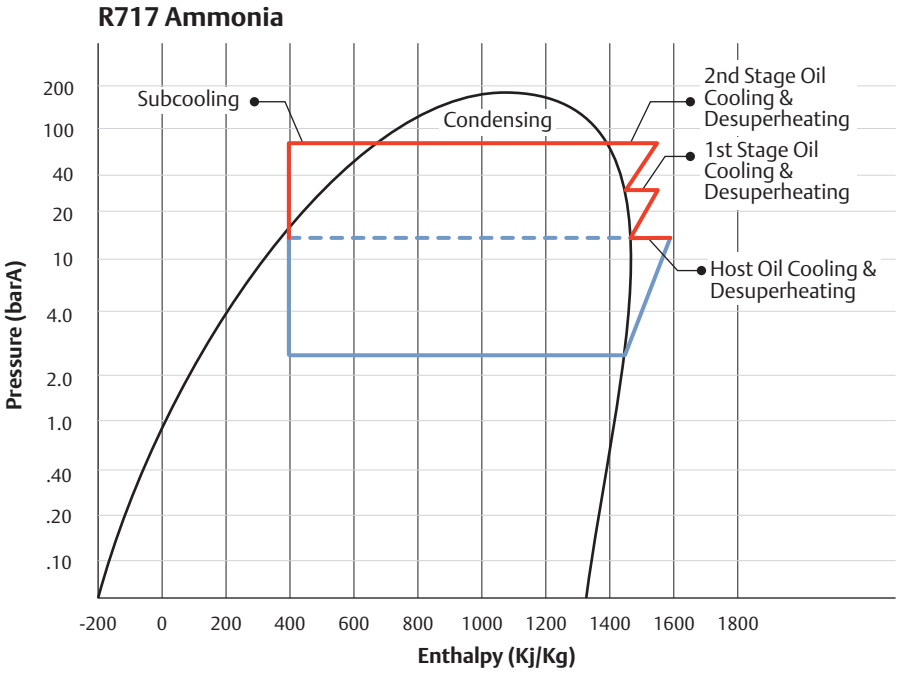
Single Stage Ammonia Scavenging Heat Pump Package

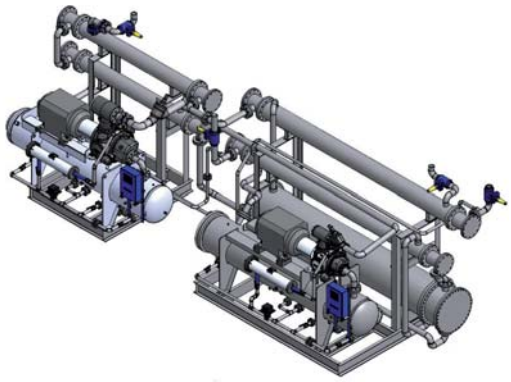


Two-Stage Scavenging Heat Pump System

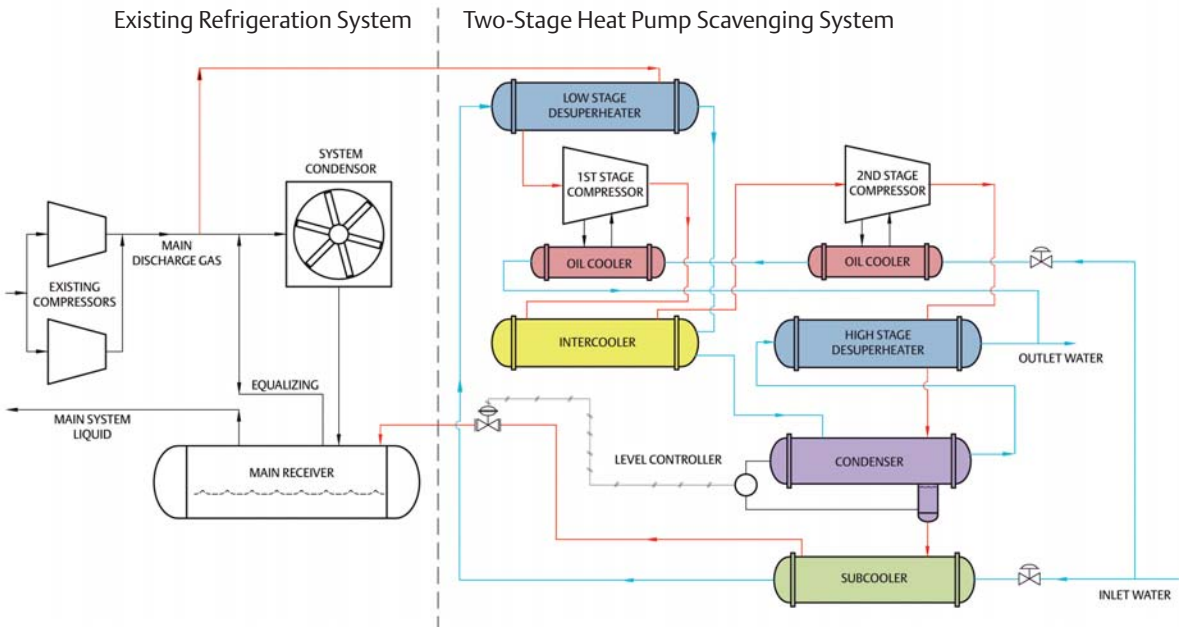
Two-stage scavenging heat pump systems are utilized where the desired water temperatures are higher than those provided by single stage systems. Higher differential water temperatures correlate to higher differential pressures in heat pump compressors. By splitting the heat pump design from a single stage to a two-stage system, superior COP's are realized in achieving very high water temperatures, up to 90°C. Vilter single screw compressors employed to satisfy the high pressures and temperatures of two-stage ammonia heat pumps operate reliably and efficiently at such intensive duties due to their naturally balanced axial and radial design.

Ammonia heat pump scavenging system





Two-Stage Ammonia Scavenging Heat Pump Package



Technical Overview

Single stage ammonia heat pumps

Model	Suction Pressure Barg	SST °C	Discharge Pressure Barg	SDT °C	Nominal Water Flow m^3/hr	Heat Recoverd kW	Total Absorbed Power kW	COP
VSS-291	12.1	34.5	32.5	71	16.4	1429	228	6.28
VSS-341	12.1	34.5	32.2	70.5	19.1	1658	264	6.28
VSS-451	12.1	34.5	31.9	70	28.6	2503	386	6.49
VSS-601	12.1	34.5	31.9	70	33.9	2946	447	6.59

* Based upon compressors operating at 3550 RPM (60Hz)

Two-stage ammonia heat pumps

	Model	Suction Pressure Barg	SST °C	Discharge Pressure Barg	SDT °C	Power kW	Nominal Water Flow m^3/hr	Heat Recoverd kW	Total Absorbed Power kW	COP
Low **High**	**VSS-451** **VSS-291**	12.1 24.9	34.5 60	25.2 49.0	60.5 89.5	286 317	29.5	2571	603	4.27
Low **High**	**VSS-601** **VSS-341**	12.1 24.9	34.5 60	25.2 49.0	60.5 89.5	332 371	35.9	3130	703	4.45
Low **High**	**VSS-901** **VSS-451**	12.1 24.9	34.5 60	25.2 49.0	60.5 89.5	571 573	53.2	4636	1144	4.06
Low **High**	**VSS-1051** **VSS-601**	12.1 24.8	34.5 60	25.2 49.0	60.5 89.5	618 647	61,6	5375	1264	4.25

* Based upon compressors operating at 3550 RPM (60Hz)

** Emerson Climate Technologies has a working agreement with Star Refrigeration on providing the European Market with industrial heat pump packages.

OTH002-EN-1009

VILTER® Since 1867

Emerson Climate Technologies - European Headquarters - Pascalstrasse 65 - 52076 Aachen, Germany
Phone: +49 (0) 2408 929 0 - Fax: +49 (0) 2408 929 570 - Internet: www.emersonclimate.eu or www.vilter.com

EMERSON™ Climate Technologies