

Hydrocarbon Heat Pump / FC-compressor

Mayekawa Europe NV

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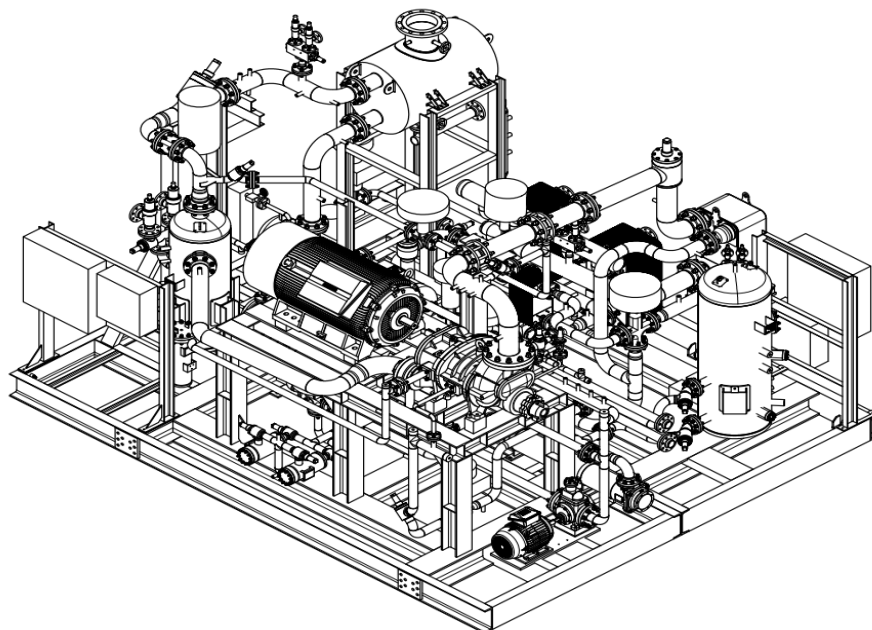


Figure 1: General layout

Summary of technology

In steam generating applications the heat is commonly produced by combustion. This FC compressor heat pump package was specifically developed to replace or reduce the use of the burners by generating steam up to 145°C.

The heat pump is a closed loop plug & play package which uses water as the heat source medium.

The heat source temperature is considered to be 90 °C and the heat source outlet temperature approximately 85°C, focusing primarily on heat recovery from water.

At the heat sink side, the heat pump will boil 90°C supplied water up to 145°C steam.

To achieve high efficiencies and a low GWP, Pentane (R601) is considered as refrigerant. The use of R601 refrigerant results in very low operating pressures combined with high operating temperatures, which allows the use of conventional refrigeration compressors with some minor modifications.

The compressor is an oil lubricated screw type with a heating capacity of around 1000 kW. The compressor is driven by an electromotor. The heating capacity can be modified by changing the rotational speed of the motor with an inverter and during start-up/turndown by means of the mechanical slide valve.

Although it is possible to use several types of alternative heat exchanger technology on the heat source side, a water-to-refrigerant heat exchanger was selected because of the reduced footprint and the ease to recover heat from other/remote processes and transport it to the heat pump.

Due to the high discharge gas temperature, a separated oil circuit is used. The bearing oil lubrication is a separate closed loop system maintained at lower temperature with a focus on degassing the oil before supplying it to the compressor bearings. The oil injection circuit is a conventional oil lubrication cycle designed in order to recover the oil from the discharge gas and resupply it to the compressor rotors for optimal efficiency on the gas compression.



Both oil circuits and the oil return system from low temperature liquid receiver side are integrated within the heat pump package.

A secondary outboard shaft seal with Nitrogen flushing with safety monitoring is installed on the compressor in order to minimize the hazard of flammable gas leakage into the machine room.

Performance of the heat pump is shown in Table 1. The COP is calculated theoretically by means of our in-house empirically developed compressor selection software. It does not yet consider additional electrical losses & power consumption of auxiliary equipment.

Table 1: Performance.

$T_{\text{source,in}}$	$T_{\text{source,out}}$	$T_{\text{sink,in}}$	$T_{\text{sink,out}}$	$\text{COP}_{\text{heating}}$
[°C]	[°C]	[°C]	[°C]	[-]
90	85	90	145	2.6

Project example

Technology has been validated in relevant environment and is currently in preparation for demonstration in relevant environment by autumn of 2022.

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 1000 kW

Temperature range: T_{source} , out 85°C and T_{sink} , out 145°C steam

Working fluid: R601

Compressor technology: Screw

Specific investment cost for installed system without integration: +/- 720€/kW

TRL level: 5

Expected lifetime: 20 years

Size: 20000 kg, 25 m² footprint

Contact information

Mayekawa Europe NV, 1930 Zaventem (Belgium)

✉ sales@mayekawa.eu

☎ +32 (0)2 757 90 75

All information were provided by the supplier without third-party validation. The information was provided as an indicative basis and may be different in final installations depending on application specific parameters.

