HoegTemp UHT heat pump

Enerin AS

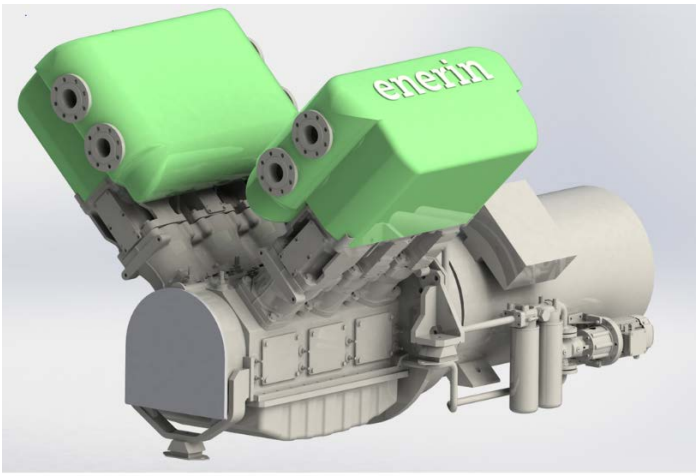

Figure 1: Enerin HoegTemp UHT heat pump

Summary of technology

The HoegTemp heat pump operates on the stirling cycle, with a closed single phase system undergoing compression and expansion by double-acting pistons. Heat exchangers for heat source and heat sink are integrated with the compressors assembly, making up a standard stand-alone unit of 300 to 1000 kW_{th}.

The closed process volume of the heat pump is oil-free, compressor crank and associated systems are lubricated by standard engine oil (0W-50) with integrated oil pump, filters and water cooling.

The HoegTemp heat pump is designed based on more than 30 000 hours of industrial operating experience with prototypes, and it will be qualified for industrial application through pilot installations in 2022 and 2023.

Heat transfer media in secondary circuits will be water based, pressurized water in the hot circuit, glycol/water mix may be used in the cold circuits if the source is close to, or below 0°C. The heat exchangers are welded in AISI 316L stainless steel, and a variety of heat transfer media may be used.

Very short start-up and shut-down times can be achieved, as well as nearly immediate regulation of output. With the design freedom on the heat transfer circuits, combination with heat storage is possible.

Helium (R704) is non-toxic, non-flammable and has zero ODP and GWP. Nitrogen or hydrogen are suitable alternative refrigerants.

Performance data is given in Table 1. COPs were calculated for heating of steam generators making 16 barG and 4 barG steam, from heat sources such as sea water, humid air, and hot cooling water. Published measurements on prototypes show good relation with simulated performance. Lowest COP at peak heat output, highest COP at rated heat output.

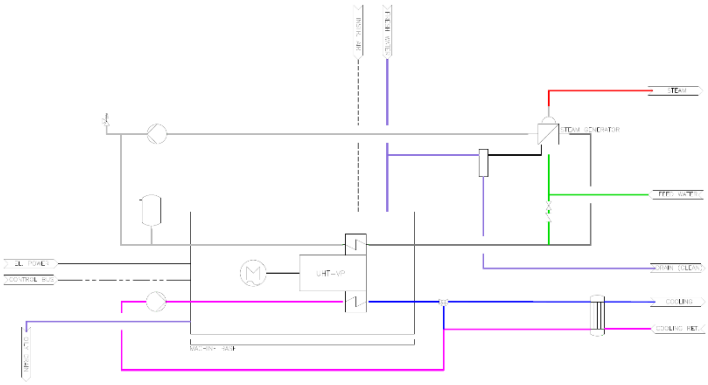

Figure 2: Process diagram of the UHT heat pump

Table 1: Performance.

$T_{source,in}$ [°C]	$T_{source,out}$ [°C]	$T_{sink,in}$ [°C]	$T_{sink,out}$ [°C]	$COP_{heating}$ [-]
85	65	206	212	2.0-2.15
16	12	206	212	1.6-1.7
135	113	154	160	3.3-3.7
80	50	154	160	2.2-2.45
16	12	154	160	1.75-1.9

Project example

Generation of 4 bar_G process steam for an animal feed plant, using humid air with 90% humidity as heat source. The source heat is transferred through a water circuit with high glide, and the heat pump heats a steam generator (shell and plate type) through a pressurized hot-water circuit.

Expected COP is 2.5. Relative to the condensation temperature of the steam, the fraction of carnot COP is 50%. Comparing with the commonly used natural gas boilers with an efficiency of 85%, the ratio between electricity consumption, and a boiler, is 2.95.

Typical operating time per year is 5000 hours. Per MW installed capacity, annual energy consumption is then reduced from 5.9 to 2 GWh/a. With gas and electricity cost at 70 €/MWh, maintenance contract at 10 €/MWh recycled heat, the annual savings are $230 000, while the difference in installation cost compared to a boiler, is $550 000. Annual ROI is 42%. End users evaluating the heat pump for their plants, are satisfied with the expected return on investment, and the expectation for the technology is that it will be scaled to more use cases in the future.

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 0.3 MW to 10 MW

Temperature range: Maximum supply temperature 250°C, maximum temperature lift 200°C, minimum source temperature -100°C, temperature glide in hot circuit from 5°C to 40°C, temperature glide in cold circuit from 4°C to 25°C

Working fluid: R704 (He), (N2 may be used with reduced heat output)

Compressor technology: piston

Specific investment cost for installed system without integration: 600 €/kW to 800 €/kW thermal supply capacity

TRL level: TRL 6 (technology demonstrated in relevant environment, >30 000 hours of prototype testing)

Expected lifetime: 20 years.

Size: 10 000 kg, 10 m² (2 m x 5 m) for 1 MW system

Contact information

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