HoegTemp UHT heat pump

Enerin AS

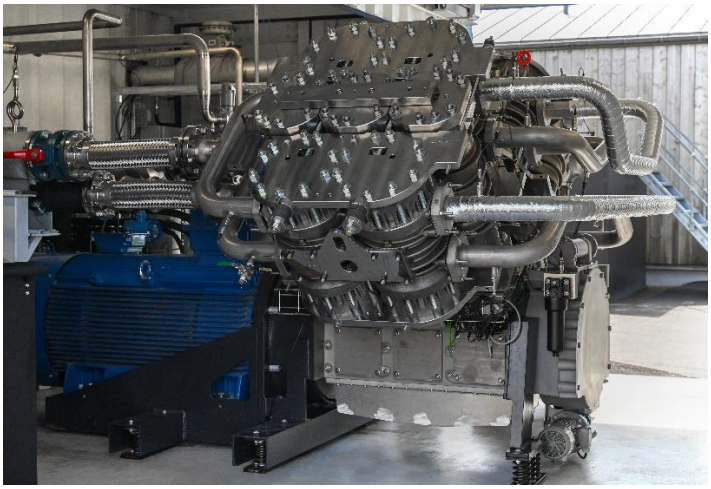

Figure 1: Enerin HoegTemp UHT heat pump

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 is qualified for industrial application through three pilot installations in 2023 and 2024.

Heat transfer media in secondary circuits are 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 are 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.

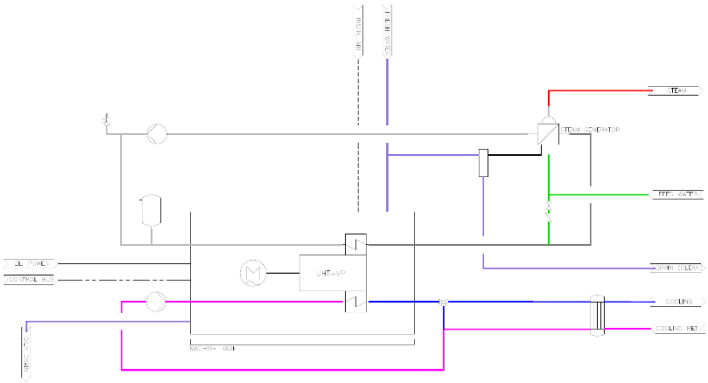

Figure 2: Process diagram of the UHT heat pump

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 3 bar_G process steam for CO_2 capture at a biogas plant, using the 20°C cooling circuit as heat source. The steam generator (shell and plate type) is heated by a pressurized hot-water circuit from the heat pump.

System COP is 1.7-1.8. 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 2.1.

Typical operating time per year is 8000 hours. Per MW installed capacity, annual energy consumption is then reduced from 9.4 to 4.5 GWh/a. With gas and electricity cost at 70 €/MWh, maintenance contract at 10 €/MWh recycled heat, the annual savings are $300 000, while the difference in installation cost compared to a boiler, is $550 000. Annual ROI is 50%. Two more heat pumps are being installed in 2024 and several projects are planned for 2025.

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 -30°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: 800 €/kW to 1000 €/kW thermal supply capacity

TRL level: TRL 8 (full-scale HP in automatic opertion)

Expected lifetime: 20 years.

Size: 17 000 kg, 10 m² (2 m x 5 m) for 1 MW system

Contact information

Arne Høeg, Enerin AS
arne@enerin.no
+47 92 20 60 59

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.