

GEA Ammonia Steam Generator

GEA Heating and Refrigeration Technologies



Figure 1: Ammonia heat pump and steam compression installation

Summary of technology

Low pressure steam heat pump using a combination of ammonia heat pumps and steam compression.

- Ammonia heat pump in cascade with steam compression system
- It is a mechanical compression heat pump
- Ammonia circuit is with Screw or Piston Compressor technology.
- Steam compression is with Turbo fan technology or Screw compressors
- Application specific design based on temperature and capacities
- In the table the heating COP is given based on different source temperatures and a given steam pressure of 3.5 bar(a) - 140°C.
 - The COPs are calculated but have also been proven in a field application.
- Suitable for heat sources between 20°C to 65°C
- System can be designed for steam pressure between 1 bara to 9 bara (100°C to 175°C)
- The ammonia piston compressors are available in the range 2 – 8 tons steam per hour. The ammonia screw compressor range is available in the range 8 – 12 tons per hour. The selected compressor technology for steam compression depends on both temperature lift and capacity.
- In 2025 only one combined system is in operation, but 100's of GEA ammonia heat pumps are in operation and 100's of GEA steam compression heat pump are in operation.
- Low ammonia charge
- Depending on system solution minimum part load can vary from 30 to 50%
- The system is designed of steady operation with slow variations in capacity and temperature requirements. For large variations in capacity the system can be used in combination with Caldera steam storage.
- Available in Europe and North America
- With long term operational knowledge of both compression technologies, these heat pumps have Technology Readiness Level (TRL) of 8-9

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.



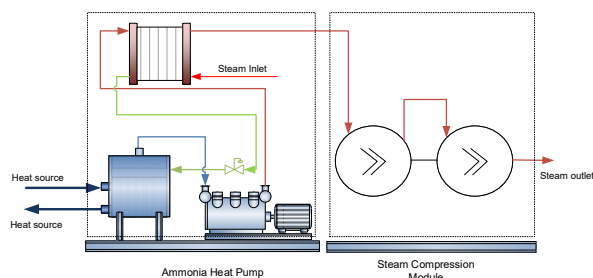


Figure 2: Ammonia and Steam compression heat pump

Table 1: Performance, 2 t/h steam

T _{source,in} [°C]	T _{source,out} [°C]	T _{sink,in} [°C]	T _{sink,out} [°C]	COP _{heating} [-]
55	50	90	140	2.7
45	40	90	140	2.5
35	30	90	140	2.3
25	20	90	140	2.1

Project example

At an animal feed pellet manufacturer in Norway a steam generating heat pump is installed. The heat source is the moist, warm air coming from the ventilation air during the drying process of the pellets after they have been formed in the pelleting machine. 120°C steam is injected into the process to shape the pellets.

- The moist air needs to be cooled to 30°C to have sufficient energy uptake to feed 2 t/h steam into the process.
- The ammonia compression heat pump is evaporating steam in a cascade heat exchanger, with ammonia condensing.
- Steam is compressed from 0.5 bar to 2.0 bar through a 4 stage turbo fan compression process
- In addition to the steam generation the heat pump also heats incoming water from 4°C to 85°C, which is done by free energy helping to improve the heating COP from 2.5 to 3.0

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 1.2 MW to 10 MW per heat pump

Supply Temperature, max: 175 °C

Temperature lift, max: 125 K (more is possible, but the efficiency at high temperature lift often makes it uneconomical)

Working fluid: ammonia, water

Heat carrier: water, steam

Compressor technology: Ammonia: piston, screw and for steam compression turbo or screw.

Specific investment cost for installed system without integration: The installed cost of these systems depends on many factors like temperature lift, capacity and access to site. Typically, a cascade heat pump installation cost can vary from 500 - 1000 €/kW.

TRL level: 8-9

Operational hours achieved: 2000 hours in 2025

Expected lifetime: 20 years.

Size: Big variation depending on compression technology and temperature lift.

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