ENOUGH
EUROPEAN FOOD CHAIN SUPPLY
TO REDUCE GHG EMISSIONS BY 2050

Factsheet 6
May 2023

Ammonia-water absorption-compression heat pump (ACHP) for steam generation in food processing

Performance modelling

ACHPs using an ammonia-water mixture as the working fluid can provide high heat sink temperatures up to 140 °C. They are an economical alternative to gas boilers in the food industry.

Main results: The ACHP system COP was 2.85 for a pressurized hot water supply temperature of 105 °C.

The system performance was affected by the heat sink outlet temperature, as well as part-load and overload conditions.

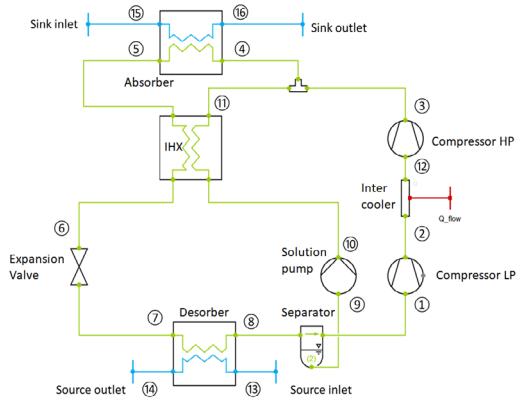
In this study, the authors modelled the performance of an existing ACHP using ammonia-water mixture as working fluid for hot water and steam production.

The simulation model was based on the ACHP prototype in the NTNU lab.

A case of 150 kW heating capacity was simulated with a high pressure of 23.65 bar and a low pressure of 4 bar.

Using an oil-free twin-screw compressor with liquid injection, the compressor discharge temperature and compression power can be decreased (Ahrens et al., 2023), which might ensure the safe operation of the ACHP with a high heat supply temperature and a high energy efficiency.

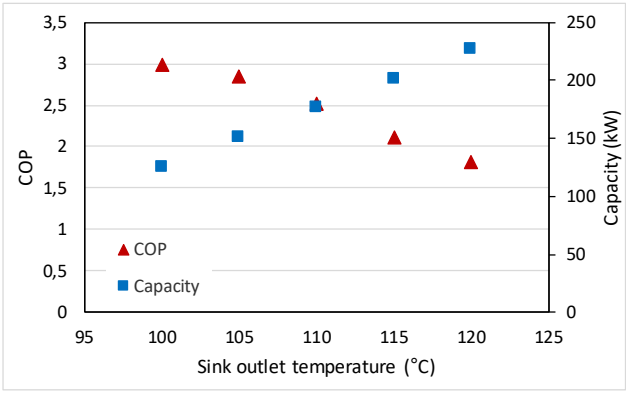
The ACHP prototype in the NTNU lab



Simplified Dymola model of the ACHP

The performance of the ACHP at different operating conditions was investigated.

- At a high sink supply temperature of 120 °C and a temperature lift of 50 K, the ACHP still achieved a COP of 1.83.
- With the compressor intercooling, the discharge temperature decreased from 276 °C to 160.3 °C and the COP of the ACHP increased from 2.14 to 2.85.
- When the heat load of the heat pump decreased from 110 % to 60 %, the COP increased 19.3 % and the discharge pressure decreased 7 %.



COPs and heat capacities at different heat sink outlet temperature

Find more about this study from the original publication: 10.18462/iir.nh3-co2.2023.0022 .

ENOUGH webpage: https://enough-emissions.eu/
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