Horizon SPIRIT - Demonstration Case 2

High-Temperature Heat Pump Symposium

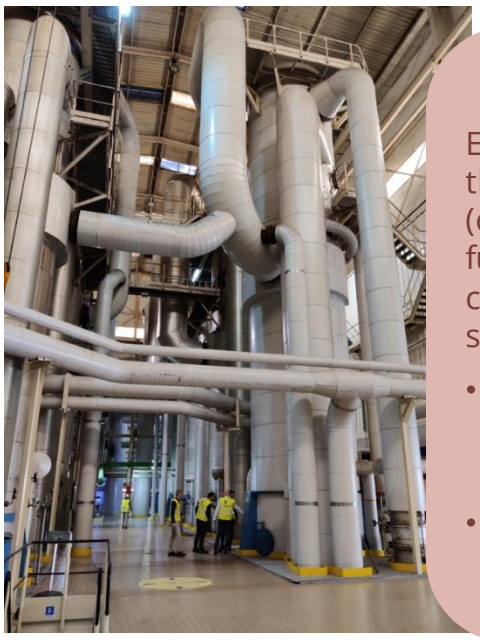
Integration of Heat Pump Technology in a Sugar Production Plant

Virginia Amato (vgm@dti.dk), Jonas Lundsted Poulsen, Emil Navntoft Pedersen, Benjamin Zühlsdorf | Danish Technological Institute, Aarhus, Denmark
Sebastian Schultze, Ole Fredrich | GEA Refrigeration, Berlin, Germany
Bart Aerts, Olivier Knaepen | Tiense Suikerraffinaderij, Tienen, Belgium

Demonstration Case

Full-scale demonstration of HTHP technology in an industrial process

- End-user (sugar factory): **Tiense Suikerraffinaderij**
- Technology supplier: **GEA Refrigeration Germany**
- Knowledge and innovation center: **Danish Technological Institute**



Sugar production

Energy-intensive process that requires steam (currently generated by fossil fuel driven boiler) to crystalize sugar from a solution

- Main (beet) campaign: from September to January, **steam at 138 °C**
- Secondary (thick juice) campaign: from March to May, **steam at 114 °C**

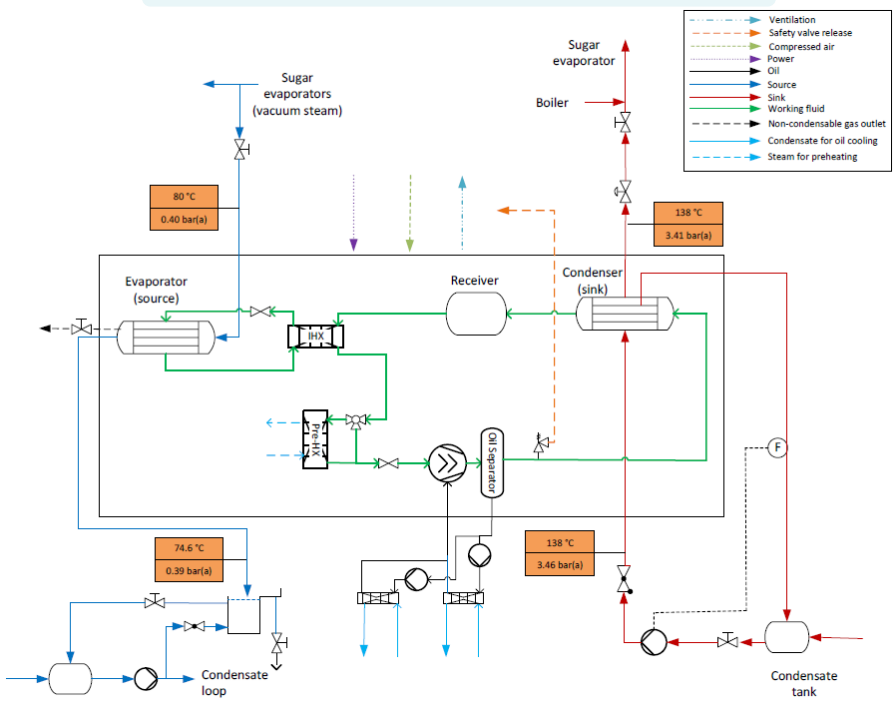
Heat pump integration

Demonstration: divert 4 MW of heat from the boiler to a HTHP, **saving 2439 and 1560 tons of CO_2 *** during the main and secondary campaign, respectively.

➡ **Overall goal: replace the boiler and electrify the whole process**

*Assuming emissions-free future electricity and 208 g_{CO2eq}/kW_{th} in the present heat production.

Process flow diagram



System design

- Refrigerant: **n-Pentane (R-601)**
- Compressor: GEA **screw compressor**
- Heat exchangers: **shell-and-tube**
- Heat source: **vacuum steam at T = 80 °C**
- Heat sink: **steam at T_{Sat} = 138/114 °C**

Testing program

- Long-term demonstration (at least 2000 hours) to prove robustness and reliability
- Determine **heating and cooling load** and **COP** at different operating conditions
- Test **startup** and **shutdown** process
- Monitor **oil quality**, **noise** and **vibration** level
- **Optimize** process conditions
- **Generate data** for modelling a digital twin

Progress and next steps

Basic engineering and P&ID completed
Detailed engineering in progress
Main components designed and ordered

Funded by the European Union

SPIRIT