DryFiciency - Industrial heat pump for a climate-neutral European industry

Figure 1: *DryFiciency Heat Pump at Wienerberger brick production facility in Uttendorf, Austria*

Summary of demonstration case

In the H2020 project DryFiciency, high temperature heat pumps were developed and demonstrated to supply process heat with up to 160°C for industrial drying processes to increase energy efficiency and to lower CO_2 emissions. Wienerberger AG, the largest brick producer in the world, operates around 200 brick dryers. The DryFiciency heat pump was integrated in the brick production process in Uttendorf, Austria, supplying heat for the drying process. A thermally driven heat pump uses hot air from the kiln and moist exhaust air from the dryer to supply hot water at 90°C for the dryers. The DryFiciency heat pump uses the hot water from the thermal heat pump as the heat source and provides hot air at up to 160°C for the last zone of the dryer, where higher temperatures are needed.

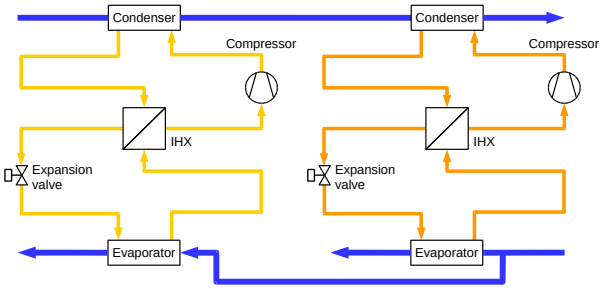

Figure 2: Layout of the DryFiciency heat pump

Johannes Rath, CTO at Wienerberger Building Solutions: "Sustainability has always been at the core of the Wienerberger world. As part of the DryFiciency research project, together with AIT, we were able to set another milestone in the direction of decarbonisation of the brick industry and create a prime example of how innovations from research can be brought to market quickly"

It is a closed loop vapor compression heat pump, the development and demonstration work included:

- **The use of the synthetic low GWP refrigerant R-1336mzz(Z) by Chemours**
- **8 piston compressors designed for high temperature applications by Viking Heat Engines**
- **Fine-tuned, synthetic lubricant working stable with the refrigerant by Fuchs Schmierstoffe**

- **Refrigerant cycle designed as twin cycle for efficient operation over a wide range of operation conditions**

Operating experiences

The DryFiciency heat pump was operated for more than 4000 h covering a large range of operation conditions
(heat supply temperatures from 104°C – 160°C, design point at 120°C). Compared to a natural gas burner providing the same amount of process heat, the DryFiciency heat pump reduces end energy consumption by 2200 MWh/a, primary energy consumption by 1900 MWh/a, CO_2 emission by 590 t/a, resulting in 60500 €/a of energy cost savings. The increase in drying air temperature in the last zone of the dryer has beneficial effects on brick drying time and quality.

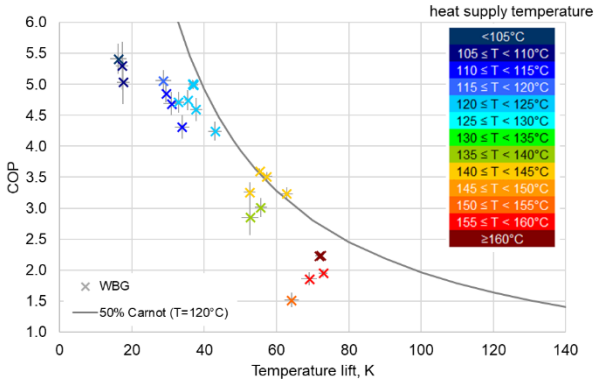

Figure 3: Measured COP of the DryFiciency heat pump at Wienerberger

Special learnings

Challenges encountered during the development of the high temperature heat pumps included material compatibility (lubricant, refrigerant, sealing materials), mechanical design (vibrations), integration infrastructure (e.g. pressure maintenance, flow measurement) and in the process control (e.g. start up procedure, data transfer, measurement devices).

DryFiciency demonstrated the successful component development for high temperature applications such as compressors, lubricant and refrigerant as well as the successful operation of the closed loop heat pumps in industrial environment.

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

FACTS ABOUT THE CASE

Installation year: 2019
Operating hours: over 4,000 hours
Working fluid used: HFO-1336mzz(Z)
Compressor technology: piston compressors
System manufacturer: built by AMT
Kältetechnik based on the design by AIT
Performance in design point:
- **Heat source: 88°C → 84°C, water**
- **Heat sink: 96°C → 121°C, water**
- **Heat supply capacity: 296 kW**
- **$COP_{Heating}$: 5.0**

Performance at 160°C heat supply temperature:
- **Heat source: 91°C → 88°C, water**
- **Heat sink: 131°C → 160°C, water**
- **Heat supply capacity: 190 kW**
- **$COP_{Heating}$: 2.2**

Investment cost: -
Savings: 60,500 €/a at 120°C
Estimated annual CO_2 savings: 590 t/a at 120°C
Link to webpage or report: