INDUSTRIAL HIGH-TEMPERATURE HEAT PUMPS

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MOTIVATION

The electrification of process heat in the industrial sector is a current topic of great interest. The potential of using heat pumps has a high potential in terms of energy efficiency and reduction of CO₂ emissions. A lot of research is performed in this area.

Of particular interest are industrial high temperature heat pumps (HTHPs), which generally supply heat above 100°C and are mainly used in industrial processes, but also for district heating applications and large residential buildings.

MARKET OVERVIEW

Industrial HTHPs are slowly entering the market. Various product types are already commercially available with heat supply temperatures up to 165°C.

POTENTIAL APPLICATIONS

- Food and beverages: hot water and steam for sterilization, process heat for concentration and pasteurization
- Bottles and wine tanks: hot steam and steam for washing and sterilizing during bottling processes
- Slaughterhouses: steam and hot water for cleaning
- Cheese factories: process heat for pasteurization and hot water
- Brick drying: Air preheating to 120°C with moist exhaust air (70°C, 50% r.h.)
- Starch drying: Air preheating for steam generation 150°C
- Drying of animal fodder: Low pressure steam for chamber dryer
- Milk powder production: Air preheating to 120 to 150°C for spray drying
- Wood drying: Air heating to 120°C to 150°C with moist exhaust air
- Paper drying: Low-pressure steam 130°C using cooling water (60°C) or humid exhaust air (78°C, 56% r.h.) as heat source

CASE STUDIES SWITZERLAND

25 application examples of industrial heat pumps in Switzerland were analyzed on behalf of the SFOE and summarized in a report. Most applications are found in the food sector for heating and cooling. The average COP was around 4.0 at 50 K temperature lift (heat source inlet to sink outlet). The highest heat supply temperature was slightly above 90°C. Multiplication potential for similar heat pump systems was identified in other processes industries.

KEY RESULTS

- By replacing gas and oil boilers with electrically driven industrial HTHPs, significant energy savings (20% to 80%) and a reduction in CO₂ emissions (30% to 90%) are achieved.
- Using industrial HTHPs to generate low-pressure steam (133°C, 3 bar) requires less than half the energy as direct electrical heating if waste heat is available as a heat source at 55°C.
- Potential applications for industrial HTHPs have been identified in various sectors, mainly for the generation of hot water, hot air, and steam.