

## Heat Pump Drying – Potentials for Energy Saving with Heat Pumps in High Temperature Applications

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### Abstract

There is an interest among dryer manufacturers in gaining more knowledge on possibilities and limitations for the integration of heat pumps into dryer installations. The aim is to reduce energy costs. For this purpose an introductory survey of this matter was done at SINTEF Energy Research / The Center for Dewatering R&D. The paper describes possible heat pump designs for typical dryer installations with low side temperatures in the 50 – 100 °C range and high side temperatures in the 150 – 300 °C range.

One high temperature heat pump design is presented. The heat pump was designed to operate at 75 °C evaporating temperature and 250 °C condensing temperature. For this specific design point 2 refrigerants were found to be suitable; R123 from 75 °C to 140 °C and R718 (water) from 140 °C to 250 °C. This design resulted in a calculated COP of 1.89.

A brief discussion is included on possible candidates for refrigerants for high temperature applications and also compressor availability, especially for water vapor compression and smaller capacities.

The study was based on 2 commonly used dryer process layouts, Case 1 and Case 2. Case 1 is a dryer process with recirculation of the drying air. There is indirect air heating from a steam heat exchanger to air temperature 170 °C. Exit air from the drying chamber was 90 °C. There was calculated with an air cooler for lowering the exit air temperature to 60 °C. Case 2 is a simpler, open dryer process with 20 °C entering the heater. The air is heated to 280 °C before the drying chamber. Exit air has 95 °C. Evaporator capacity of both designs was calculated to 1 MW.