

Energy-saving exhaust air dryer for industry

Development of sustainable technologies

Graduate



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Introduction: Existing industrial exhaust air dryers have short drying times, but require a lot of energy. In order to save this, more efficient approaches are being sought which nevertheless have the same drying times.

The company Schulthess specializes in washing machines and dryers and has commissioned this work. The aim is to design a concept that is at least 35% more efficient than the exhaust air dryers used up to now. The heating elements used up to now were electrically powered in Switzerland and often gas powered in Europe. In order to find a suitable solution concept, various drying processes will be tested for their suitability and their efficiency compared with each other. A statement is to be made as to which technology is worthwhile in terms of energy and cost.

Approach: First, a broad search was made for possible drying concepts. Then eleven types of drying were examined for their applicability to efficient laundry drying. The concepts were roughly filtered by means of an advantage-disadvantage list. Simulations were created for the three most promising concepts in order to test and compare their energy consumption. To test the plausibility of the simulations, a simulation of the conventional exhaust air dryer was created. Schulthess provided measurement data to verify this basic program. The simulations were created using the "Engineering Equation Solver" (EES for short) software. The focus was on energy efficiency, but the simulations also provide information on how the drying process could be further optimized. The simulated and optimized concepts are heat recovery and heat pump systems. An Excel tool from VDI was also used to produce a pinch analysis showing the heating and cooling requirements of the systems. Finally, a qualitative cost estimate was made to compare the economics of the concepts.

Result: Three simulated concepts are deemed suitable to meet the energy requirements. The concepts are:

- An exhaust air dryer with heat recovery
 - A heat pump dryer
 - A dryer with a transcritical CO₂ heat pump
- The heat pump dryers operate more efficiently than simple exhaust air dryers with heat recovery, but are more complex and expensive. So the simplest solution that meets the specifications is a simple heat recovery system.

Advisor

Prof. Stefan Bertsch

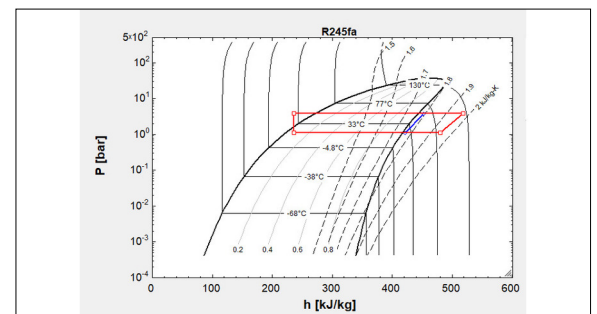
Co-Examiner

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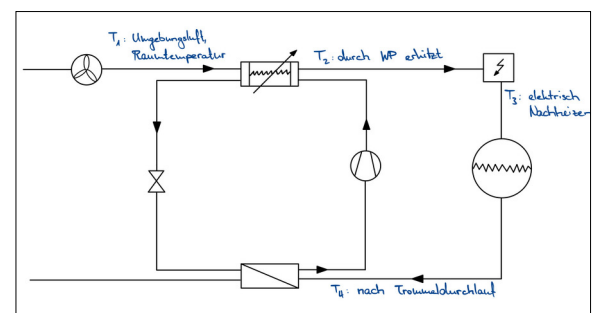
Subject Area

Mechanical Engineering

Pressure-enthalpy diagram of the heat pump with refrigerant R245fa
Own presentation



Process diagram of a dryer with a transcritical CO₂ heat pump
Own presentation



Pinch analysis of the exhaust air dryer with heat recovery
Own presentation

