New heat pump technologies for industrial drying

The European DryFiciency project is developing two new types of heat pump technology that use waste heat to produce high temperatures suitable for industrial drying processes. These heat pumps are being tested in three real industrial settings, with the aim of helping energy intensive industries to improve energy efficiency and reduce carbon emissions.

Heat pumps are already regarded as an essential technology in residential buildings for reducing carbon emissions and improving energy efficiency. For industrial applications, heat pump applications are still in their infancy, primarily because the temperatures they typically produce are too low to be efficiently used in most industrial processes.

Nevertheless, many industries stand to benefit significantly from the introduction of heat pump technologies in their industrial processes, using waste energy to provide heating and cooling. Increasing the energy efficiency of an industrial process by installing heat pumps provides substantial cost reductions for the industry. Furthermore, industrial heat pumps have important positive environmental impacts for society in the form of reduced energy use and carbon emissions.

The EU-funded DryFiciency project is looking into technically and economically viable solutions for turning waste heat into useable heat at temperature levels of up to...
160°C. The focus of the project is on industrial drying applications, which typically account for 12-25 per cent of the total energy demand in industrial processes.

The project outcomes are two pioneering high temperature heat pump technologies: a closed loop heat pump for air drying processes and an open loop heat pump for steam drying processes.

The closed loop heat pump

Closed loop heat pump systems work by evaporating a synthetic refrigerant with waste heat, compressing the refrigerant and thereby providing heat at higher temperature levels. This delivers a much higher amount of energy in heat than the amount of electric energy needed for this operation due to the reuse of the existing waste heat as a valuable heat source.

The closed loop heat pump technology being developed in DryFiciency is being managed by Veronika Wilk, senior research engineer at AIT Austrian Institute of Technology. Several significant innovations will allow the closed heat pump to produce temperatures of up to 160°C, a temperature which can be used for several industrial drying options. Amongst these improvements is a previously-developed refrigerant known as OpteonMZ, which is well-matched to high temperatures, is non-flammable and non-toxic. Two new compressors are also being used which will work at the required temperatures.

The closed loop heat pump is being tested in two industrial settings. The first of these is with AGRANA, the leading Austrian food industry company that applies dryers in the production of sugar and starch. The heat for the dryers is normally provided through the burning of natural gas, but in this advanced demonstration a closed loop heat pump will be integrated into a continuous starch drying process. The heat pump prototype will deliver up to ten per cent of the heat demand of the dryer and thereby reduce the CO2 emissions by about 500 tonnes per year and end energy consumption by 2200 MWh per year.

The other demonstration site for the closed loop heat pump is at Wienerberger, a global supplier of building materials, where, similar to AGRANA’s food drying processes, heat pump drying is replacing fossil-fuel-based combustion-driven drying in the brick making process.

"Many of the aspects we are looking at in the demonstrations are related to the high temperatures," Wilk explains. "The process is a challenge not only for the refrigerant but for all components that are used in the manufacturing of the heat pump, including the sealant and the lubrication oil for the compressors. We will use online monitoring throughout the demonstrations to evaluate how efficiently the heat pumps are working, and to examine the heat pumps regularly for durability and degradation."