Rotation Heat Pump

ecop Technologies GmbH

Figure 1: Rotation Heat Pump – RHP K7.

Summary of technology

The Rotation Heat Pump is based on the Joule-Cycle realized in a closed pipe system and allows energy-efficient heating and cooling in industrial applications as well as in district heating system. The integrated regulation enables a wide variety of application cases. Those are for example

- Pulp and Paper industries,
- Food & Beverage
- Chemical Industry
- District heating applications
- Drying (bricks, wood, etc.)
- Pasteurization
- Distillation

Since the compression of the environmentally friendly refrigerant is achieved by centrifugal forces it is very efficient and not depending on special lubrication. The working fluid, consisting of Helium, Argon and Krypton, is not flammable and not toxic while the Global Warming Potential (GWP) is zero. Further, the working fluid is always gaseous and not condensing and evaporating in the heat exchangers. This allows higher temperature spread of sink and source, the heat transfer is sensible. Another important advantage is the flexibility in terms of the temperature level. The Joule cycle allows to switch between different temperature levels always having a high efficiency.

The regulation in temperature lift is realized by a change in rotational speed. For an energy-efficient and flexible operation the machine is driven by frequency converter controlled electric motors.

One demonstration plant of the type RHP K7 is already installed in Austria close to Vienna. This implementation uses waste heat of a steam turbine where the heat was previously dissipated via fans. The Rotation Heat Pump lifts this low temperature heat to temperatures of the district heating system. Due to the flexibility daily and seasonal variations can be covered easily. A further plant is already finally assembled and tested at the company's site where also continuous improvements are done. Also, this RHP K7 will be implemented as a demonstration plant in a good fitting case. The nominal thermal power of each machines is defined as 700kW at the sink. Figure 1 shows a Rotation Heat Pump where the housing is raised and the rotor is clearly visible.

Table 1: Performance.

$T_{source,in}$ [°C]	$T_{source,out}$ [°C]	$T_{sink,in}$ [°C]	$T_{sink,out}$ [°C]	$COP_{heating}$ [-]
120	102	120	150	5.8
90	58	95	130	4.5
85	67	90	120	5.0
50	33	70	90	4.4

Brick drying process (not realized yet)

The drying of bricks requires an enormous amount of heat. The humid air with a temperature of approx. 40°C, which is generated during this process, is usually not further used or utilized in this form because the temperature level is too low. By using a heat pump in combination with a condensation heat exchanger, this residual energy, which is in the range of several MW, can be recuperated back into the cycle. Due to shift operation or fluctuating temperatures, conventional heat pumps are usually not optimally suited for these drying processes.

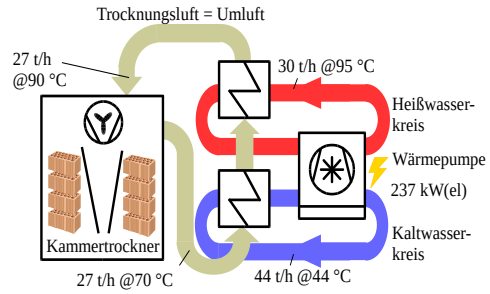

Figure 2: Brick drying process, Source: AIT, DKV-2016, Kassel.

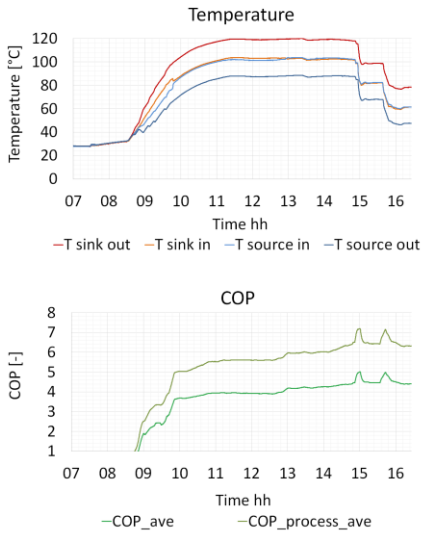

Figure 3: Example for flexible Temperature levels at almost constant COP based on test results of an RHP K7.

Figure 2 and Figure 3 show an example for the brick drying process including a Heat Pump and how the temperature can be varied.

The Rotation Heat Pump (RHP), can achieve more full-load hours with a high COP due to its flexibility in terms of operating range. Due to the lower primary energy consumption, CO_2 emissions can thus be significantly reduced and economic efficiency increased.

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 700 kW

Temperature range:

- Max. supply temperature: 150°C
- Max. temperature lift: 40°C (Sink outlet – source inlet), 70°C (Sink outlet – source outlet)
- Max. temperature glide source: 30°C
- Max. temperature glide sink: 30°C

Working fluid: ecop fluid 1

Compressor technology: centrifugal compression

Specific investment cost for installed system without integration: 700€/kW (08/2021)

TRL level: 6/7

Expected lifetime: 20 years

Size: 16 to; 17,8m²

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