Energy-Transfer-System: Novelty at Prodega Dietikon-Zurich

In autumn 2022, an energy-saving novelty went into operation at Prodega-Market in Dietikon-Zurich, Switzerland. The Energy-Transfer-System (ETS) was integrated into a transcritical CO2 refrigeration system just in time for the upcoming winter with a predicted power shortage. The Energy-Transfer-System converts high-temperature waste heat from the CO2 refrigeration system into cooling capacity by means of a rankine cycle and in turn supports the CO2 refrigeration system. Overall, an annual reduction in electricity consumption of approximately 8% is expected.

CO2 REFRIGERATION SYSTEM

In the Prodega-Market in Dietikon-Zurich, the entire refrigeration system was replaced as part of a store-remodelling. The new refrigeration system relies entirely on the natural refrigerant CO2, which has become the standard in the food retail sector. In addition to the climate-friendliness of CO2 as a refrigerant, it has the advantage that it is non-flammable and non-toxic. CO2 has been widely used as a refrigerant for over a decade. Despite the advanced state of the CO2 technology, engineering on its efficiency is ongoing. In recent years, CO2 refrigeration systems have been supplemented with ejectors and parallel compressors, resulting in significant energy savings. Another innovative step in this direction is now taken with the Energy-Transfer-System in Prodega Dietikon-Zurich.

Figure 1: Energy-Transfer-System of Prodega Dietikon-Zurich, a world first unit in operation since autumn 2022.

EFFICIENCY INCREASE

A remaining potential for optimisation of CO2 refrigeration systems lies in the high-temperature waste heat at approx. +100°C. This waste heat is perfectly suited for the production of hot tap water. However, the available waste heat capacity of the refrigeration system usually exceeds the demand for hot tap water by far. In addition to the preparation of hot tap water, the waste heat is used for facility-heating during the winter season. In the transitional period and especially in summer, a large amount of waste heat is released into the ambient air. This unused potential contained in high temperatures can be used effectively to drive the newly developed Energy-Transfer-System.

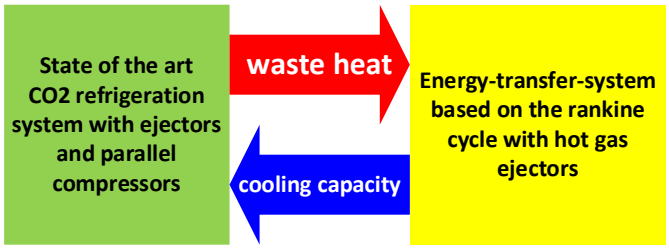

Figure 2: Energetic interfaces between the CO2 refrigeration system and the innovative Energy-Transfer-System.

RANKINE CYCLE

In this first installation at Prodega Dietikon-Zurich, waste heat at a high-temperature is used to run the Rankine Cycle, where additional cooling capacity is generated. This is then directly used to support the conventional CO2 refrigeration system. In contrast to a counter clockwise running refrigeration system, the Rankine Cycle is a clockwise running process found in a steam power plant. While a refrigeration system converts electrical work into a temperature difference (cooling capacity and waste heat), a steam power plant converts a temperature difference (steam and outside air) into electrical work. In the case of Prodega Dietikon-Zurich however, the process is not operated with steam, but with liquid and gaseous CO2. In addition, the energy in the above-mentioned installation is not converted into electricity by means of a generator, but into a suction effect by means of a newly developed hot gas ejector. The suction effect of the

ejector is utilised to achieve a cooling capacity, which in turn subcools the conventional CO2 refrigeration system. Overall, the refrigeration system is supported and operated more efficiently.

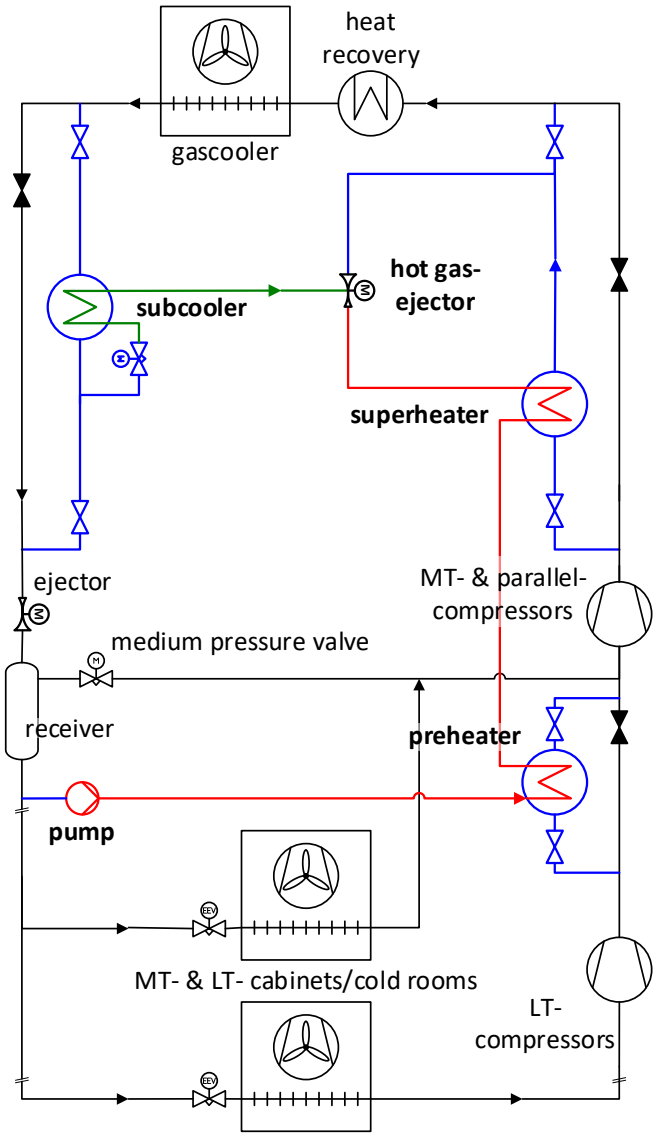

Figure 3: P&I-diagram of the CO2 refrigeration system with integrated Energy-Transfer-System.

PROMISING OPERATION STARTED

After an intensive development and engineering phase, the ambitious project was installed and successfully commissioned last autumn, just in time for the upcoming winter with its predicted energy shortage. Transgourmet Schweiz AG has once again demonstrated its foresight and commitment to sustainability. Since the commissioning, the system and its operating modes are monitored closely. Various influencing factors are being examined and the system is being fine-tuned continuously. To verify the energy saving potential of the Energy-Transfer-System, data across all four seasons is considered. Thanks to the support of the Swiss Federal Office of Energy, the development and implementation was possible in short term and the overall system performance will be evaluated in detail within the current year. A reduction in electricity consumption of approximately 8% is expected, which contributes to a significant increase in efficiency. The final goal is to further optimise the Energy-Transfer-System so that it may be optionally integrated into existing CO2 refrigeration systems.

In addition, the engineers at Frigo-Consulting have spotted further application potential. Wherever waste heat accumulates at a high-temperature level, the waste heat may be converted into a cooling capacity by means of an Energy-Transfer-System.

THE ROLE OF FRIGO-CONSULTING

in this mile-stone-project was:

- Idea and concept
- Engineering and design
- Commissioning and monitoring

Frigo-Consulting also focuses on the following topics:

- Engineering and optimisation of HVAC concepts
- Developing innovative technologies for energy savings
- Training and audits

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PRODEGA

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