High-capacity storage and power management for industrial cold energy at -20 °C by developing a thermochemical refrigeration machine.

Korhammer, K., Rammelberg*, H. U., Opel, O., Ruck, K.L.

Nachhaltigkeitsforschung Energie, Leuphana Universität Lüneburg, Scharnhorststraße 1, 21335 Lüneburg

In times of climate change and economic pressure from globalization it is astonishing, that the potential of combined consumption and production of heat energy (5.2 EJ; 55.9 %) and cold energy (194 PJ; 2.1 %) (Bundesministerium für Wirtschaft & Technologie BMWi 2014) in an integrated system has not yet been fully exploited in industrial processes. The application of a refrigeration machine based on thermochemical reactions also has additional benefits along the obvious more efficient use of energy. Another major advantage of thermochemical reactions is that both heat and cold energy can be stored loss-free over a long period. At present physisorption refrigeration systems show similarity to thermochemical based machines, but their energy storage capacity is low and the process needs higher operation temperatures. So far, there is no thermochemical (chemisorption) refrigeration machine commercially available. The overall aim of our project is the development of a high-capacity and cost-effective refrigeration machine using chemical reactions of inorganic salts (e.g. $MgCl_2$, $CaCl_2$, $SrCl_2$) with refrigerant fluids (e.g. NH_3, CH_3OH, C_2H_5OH) (Wang et al. 2009). The machine to be designed needs to store energy for stationary or mobile applications (mobile energy) (Figure 1). Furthermore, used heat energy input and stored cold energy output can possibly be decoupled. The system should be capable of using waste heat below 100 °C (e.g. exhaust heat from CHPs). The smart-grid integration in terms of load management is planned. The manufacturing and operating costs are expected to be low (1200 €/kW and 7 €/MWh). This ZIM project is funded by the Federal Ministry of Economic Affairs and Energy.

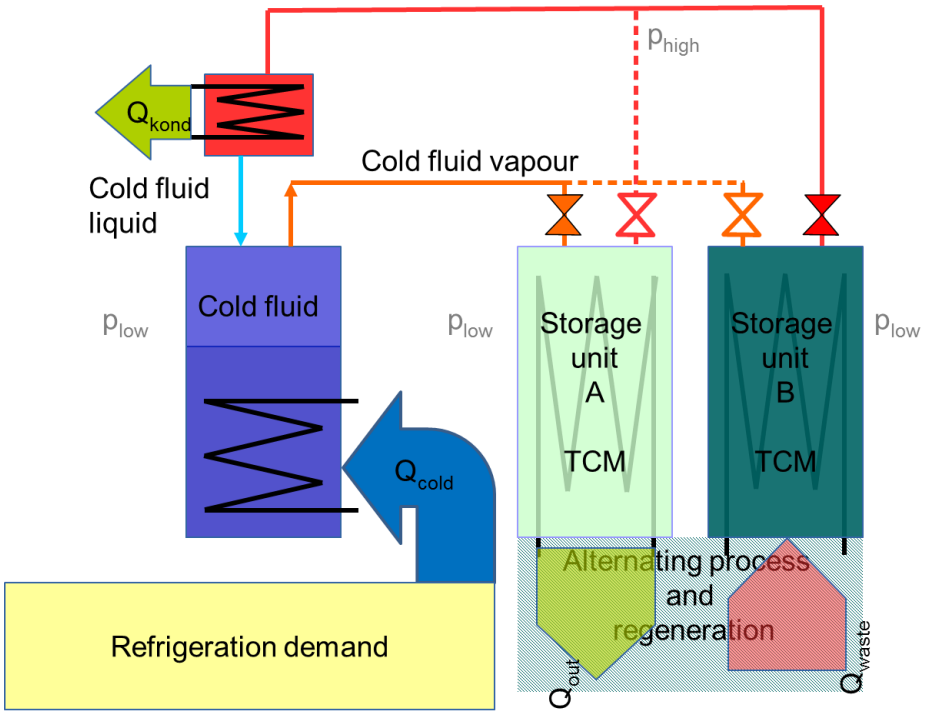

Figure 1: Schematic diagram of the refrigeration process by thermochemical reactions.

* Corresponding author: Holger Rammelberg, Rammelberg@leuphana.de, (+49)41316771768

Literaturverzeichnis

Bundesministerium für Wirtschaft & Technologie BMWi (Hg.) (2014): Zahlen und Fakten. Energiedaten. Nationale und Internationale Entwicklung. Bundesministerium für Wirtschaft & Technologie BMWi. Online verfügbar unter http://www.bmwi.de/DE/Themen/Energie/energiedaten.html.

Wang, L.W; Bao, H.S; Wang, R.Z (2009): A comparison of the performances of adsorption and resorption refrigeration systems powered by the low grade heat. In: *Renewable Energy* 34 (11), S. 2373–2379. DOI: 10.1016/j.renene.2009.02.011.