# Application of frequency response methods for measuring heat and mass transfer in sorption materials for heat transformation

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Periodically operated heat transformers use the difference in vapor pressure of the pure refrigerant (here water) and the refrigerant bound to a sorption material. They allow the construction of efficient thermally driven heat pumps, chillers or compact heat storages [1]. The principal component of such equipment is the sorption heat exchanger (SHX) which is in contact with the sorption material on one side. It is operated alternatingly between sorption and desorption of the refrigerant at low pressure/low temperature and at high pressure/high temperature respectively. The SHX acts as thermally driven compressor. In combination with an evaporator and a condenser, heat pumps and chillers are realized. Next to conventional sorption materials like zeolites and silica gels, hygroscopic salts have a high potential for the use in SHX [2, 3].

Mass transfer (mostly diffusion) of the refrigerant and the transfer of heat of sorption in the SHX are important transport mechanisms that often limit the overall performance. Design and optimization depend on a thorough understanding of these mechanisms. Challenges are their typically non-linear nature and the strong coupling between heat and mass transfer.

One approach to identify the transport coefficients is the volume swing frequency response (FR) method [4]. The experiment depicted in Figure 21 has been set up. A sample of sorption material (e.g. a cutout from a SHX) is placed in a small measuring chamber with a pure refrigerant atmosphere. After a preconditioning phase, the chamber volume is excited sinusoidally so that the pressure and sample surface temperature response with sinusoidal

signals. The amplitude ratios and phase shifts between excitation and response are measured for different frequencies. By comparison to a heat and mass transfer model the transport coefficients (e.g. diffusion coefficients) can be identified.

First FR measurements were conducted on zeolite Y samples with water as refrigerant. Results are presented and compared to results from pressure jump and temperature jump experiments [5].

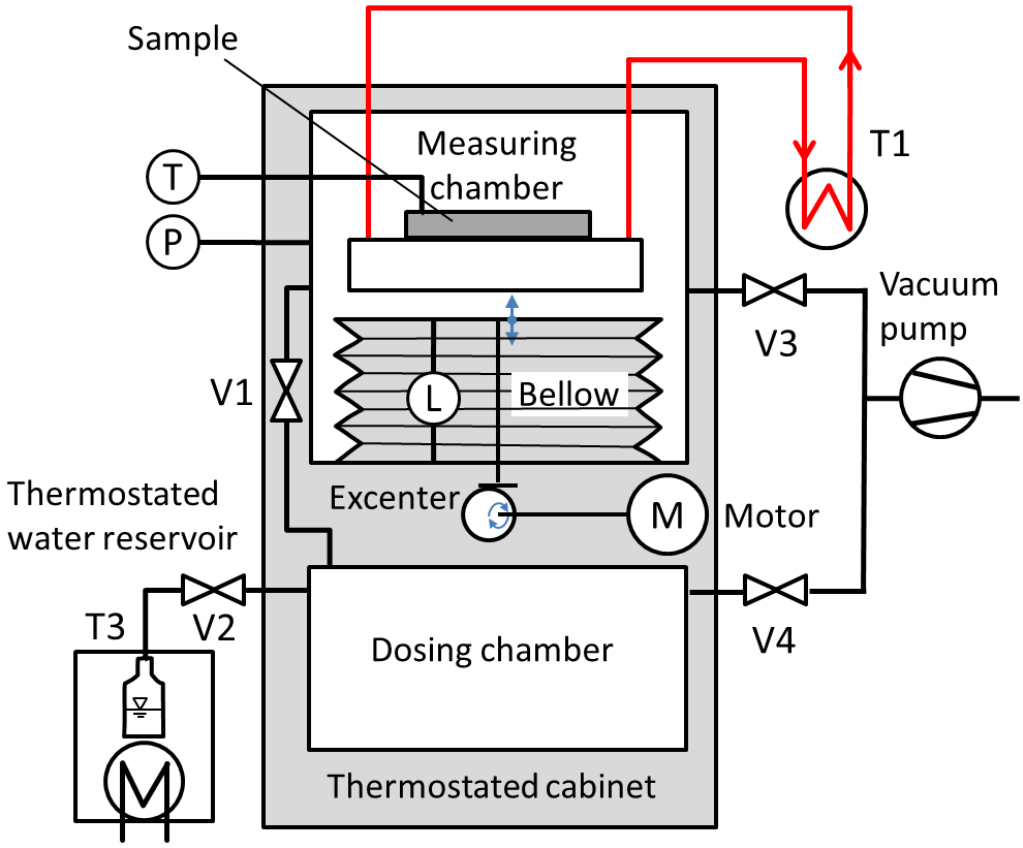


Figure 21: Schematic of the new volume swing frequency response apparatus

**References**


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