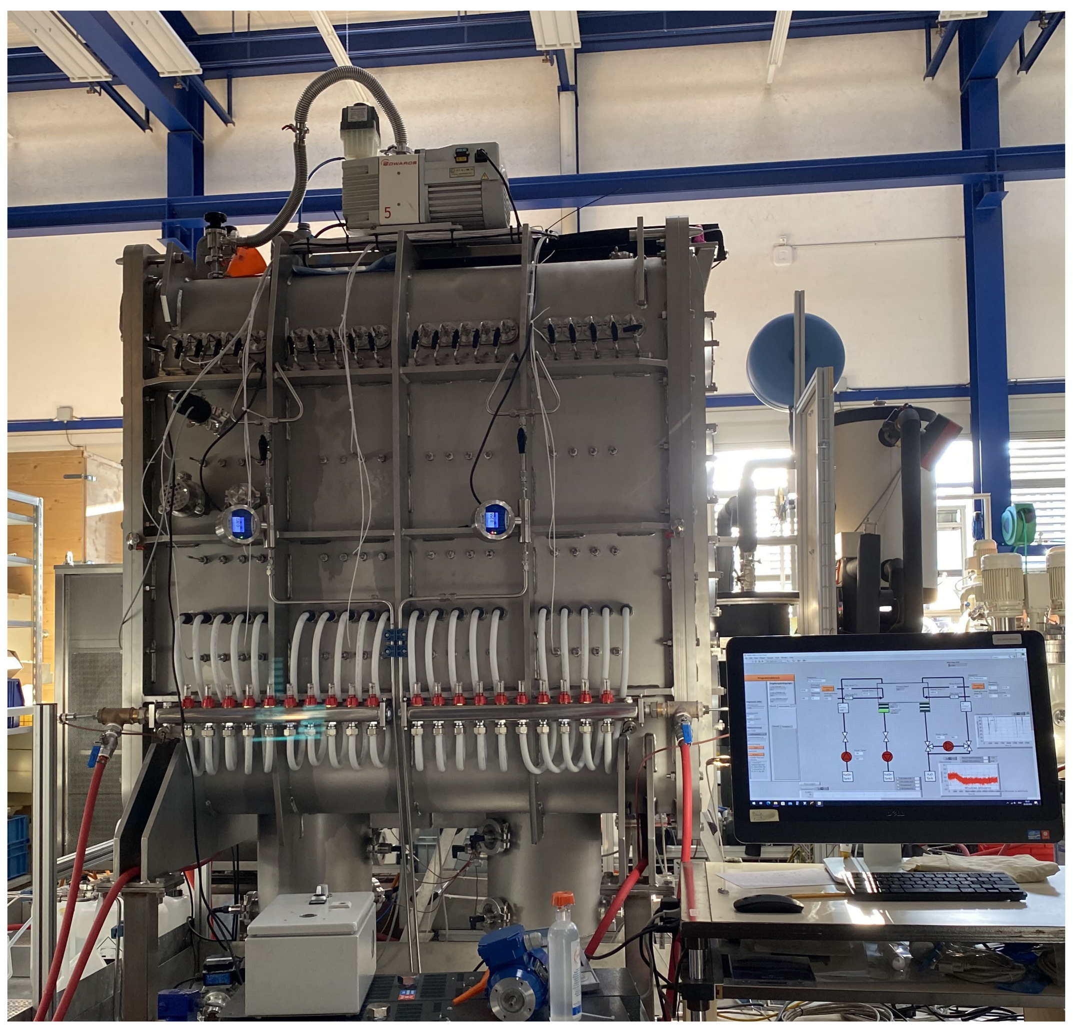
Technik & Architektur

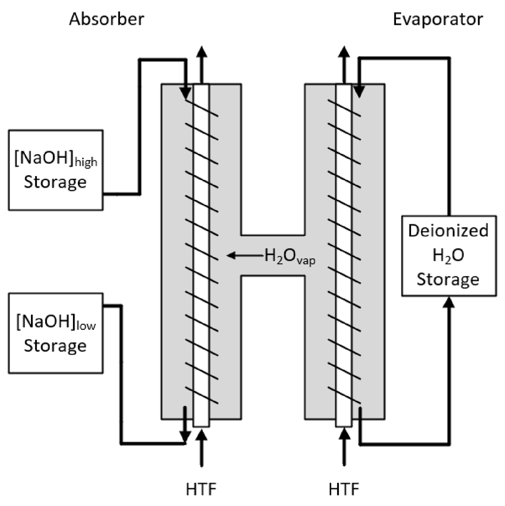
Energy and Environment

NaOH-based liquid absorption heat storage system model

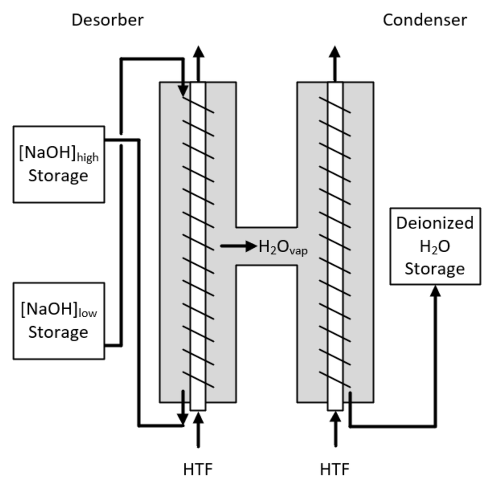
NLA-StorM



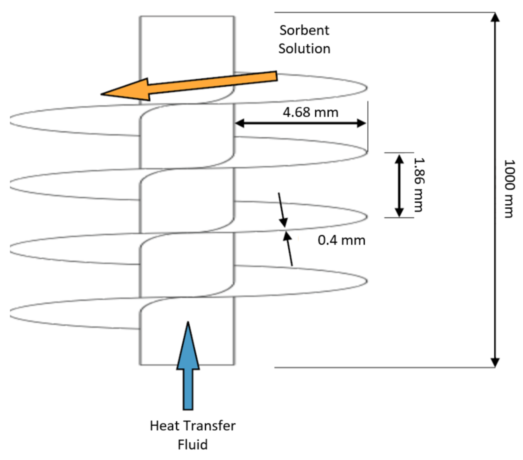
Sorption heat storage demonstrator



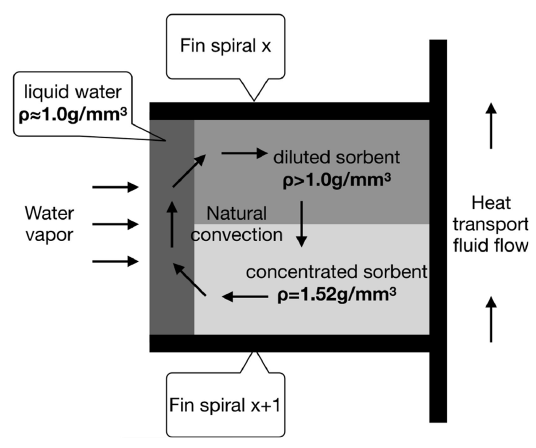
Absorption



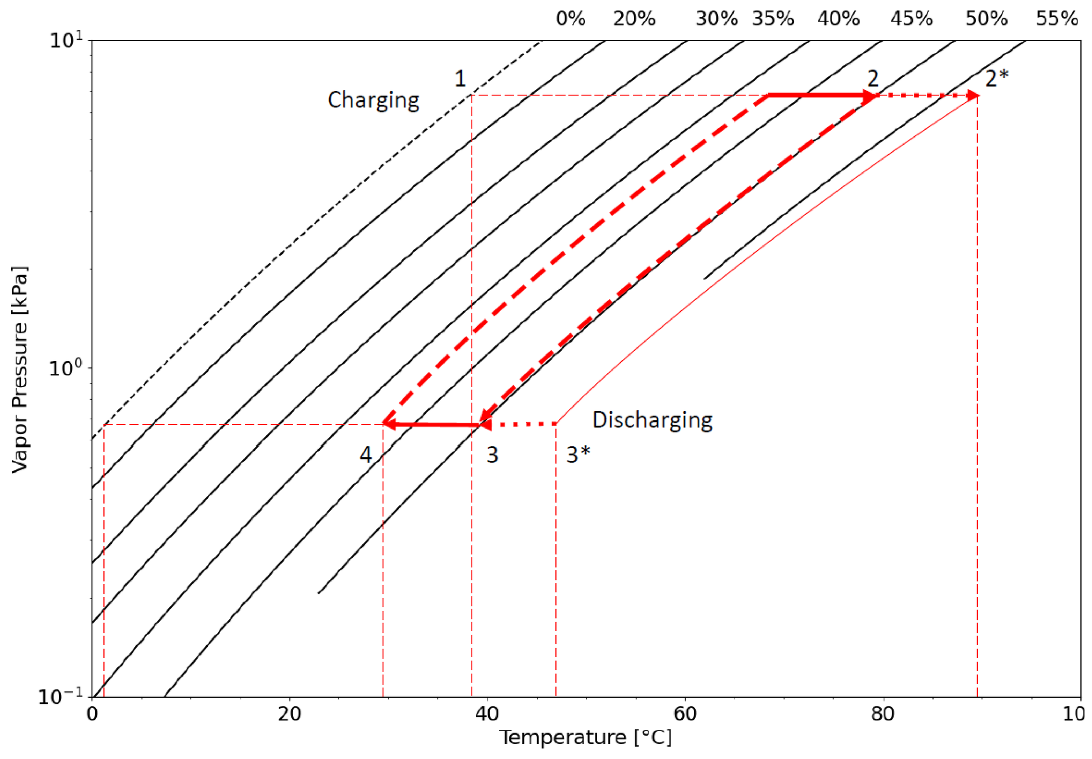
Desorption



Spiral-finned tube

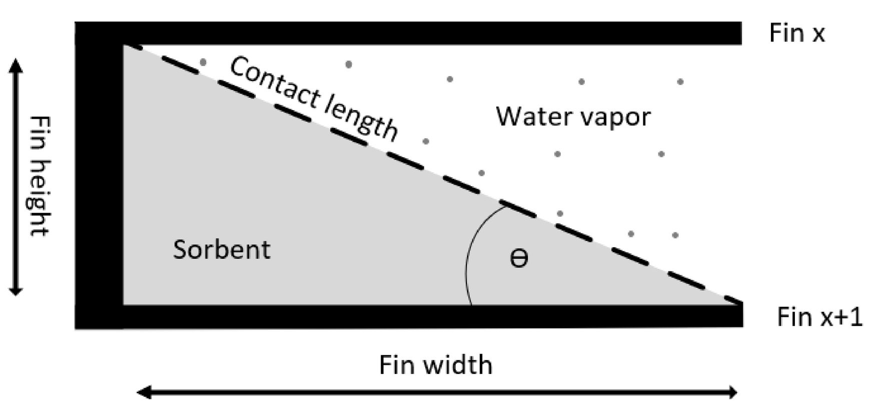


Natural Convection

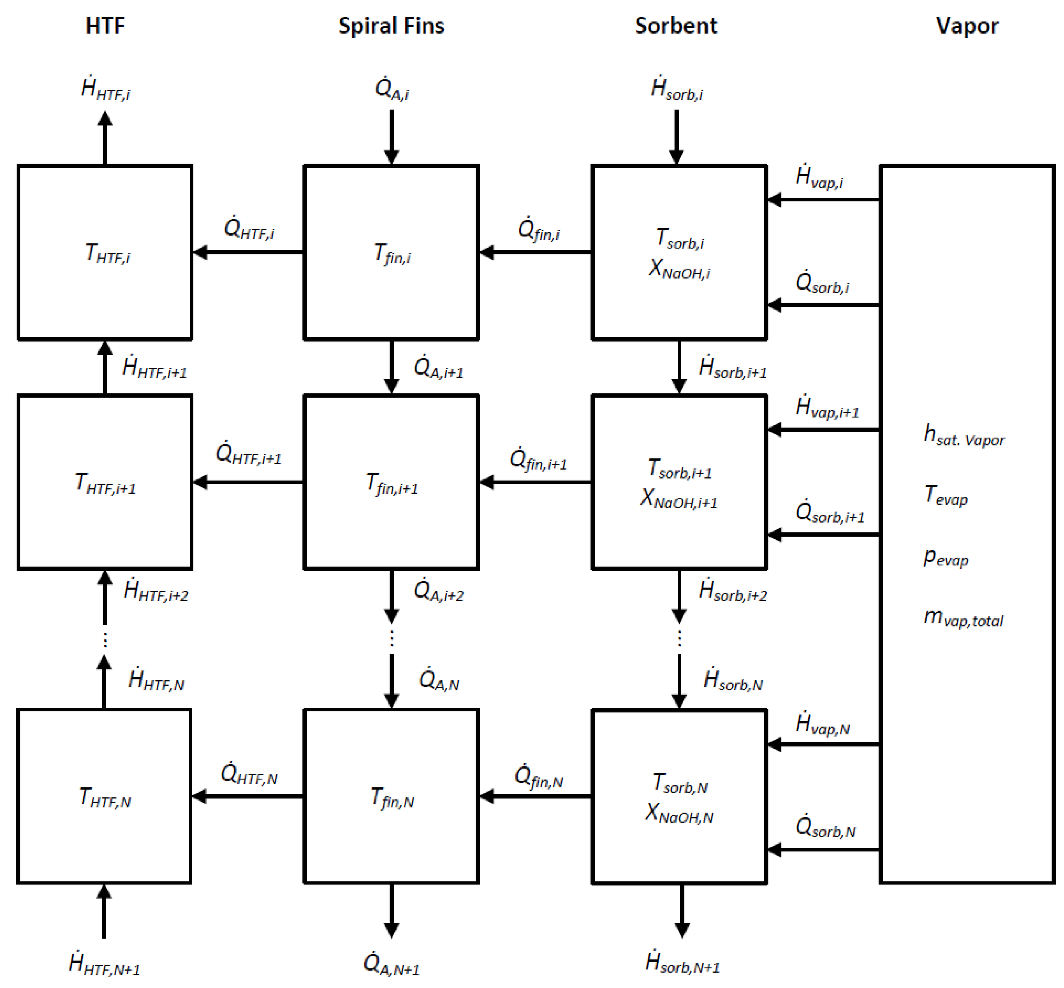


Sorption cycle in isosteric diagram

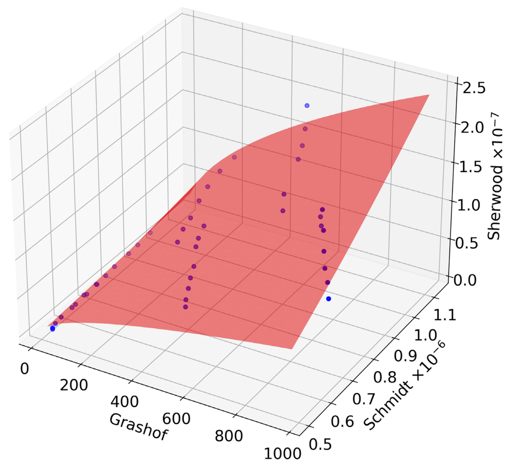
Spiral-finned tubes

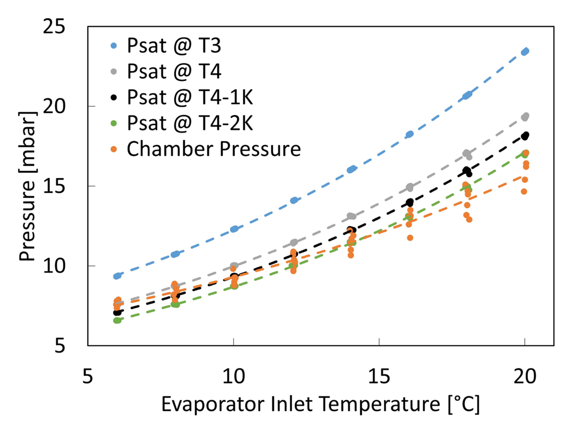


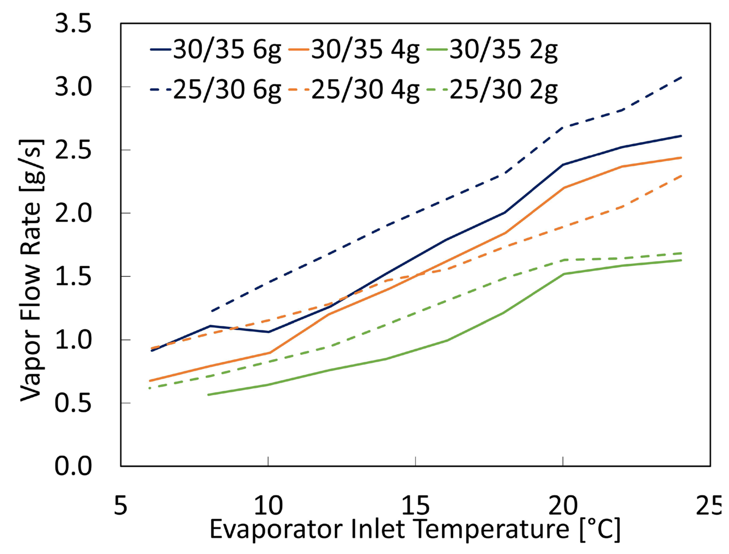
Simplified fluid flow shape.



1D, steady state model of absorber/desorber.







Problem Description

Switzerland is undergoing significant changes in the energy sector, brought on by local and global shifts in economics, technology, and politics. This change is significant in areas with cold winters where energy demand peaks due to heating needs. The renewable energy available, like solar power, is not enough to meet this high demand, which brings attention to the need for innovative and efficient seasonal energy storage solutions. Sorption heat storage stands out as a promising solution here. This method, extensively researched at EMPA and HSLU, uses sodium hydroxide to create compact and efficient systems that do not lose energy over time, operating as chemically driven heat pumps that charge in the summer and release heat in the winter with minimal electricity use. However, there is a notable gap in this field of research: the need for a reliable method to assess the system's performance within a broader energy system.

Solution

The main objective of this master's thesis is to develop a sorption heat storage component that can be utilized in Dymola. The sorption component will model the physical behavior of the heat storage system, including its heat and mass transfer dynamics in sorption and desorption cycles under various operating conditions.

Results

Correlations are defined to model the vapor flow and heat transfer dynamics among crucial components of the system: the evaporator, absorber, desorber, and condenser. These correlations are crucial for understanding the system's dynamics and the sorption processes occurring in the system. The study's novelty lies in its dual approach to vapor flow: experimental data with theoretical correlations that consider the unique flow regime of the sorption heat storage system. Central to this research are several critical assumptions and simplifications.

The research also underlines the necessity of further experimental validation and model refinement. These developments are crucial as this technology progresses from pilot projects to commercial-scale applications, emphasizing the need for efficiency and reliability in real-world implementations.

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MASTER OF SCIENCE IN ENGINEERING