Karlsruher Institut für Technologie

Institute for Thermal Energy Technology and Safety

Two-dimensional modelling of a fixed-bed heat storage with liquid metals

Master's thesis (theoretical)

Start: as soon as possible

Chemical engineering/process engineering, mechanical engineering

Subject:

Due to their excellent heat transfer properties, liquid metals are suitable as heat transfer fluids in a wide temperature range. The KArlsruhe Liquid metal LAboratory (KALLA) is conducting research into their use in packed-bed heat storage systems (see figure 1). As a component of so-called Carnot batteries, the heat storage systems can make an important contribution to the success of the energy transition.

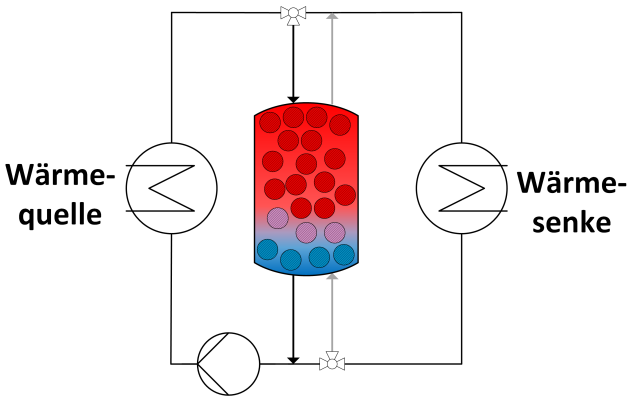

Figure 1: packed-bed heat storage

A heterogeneous, one-dimensional model already exists in Matlab for simulating the heat storage tank. The necessary differential equations are solved numerically using the finite volume method. However, it is known from experiments that a clear radial temperature profile forms in the storage tank. A two-dimensional modelling of the heat storage is therefore necessary for further investigations. Specifically, the following tasks are to be addressed in this thesis:

- Literature research on two-dimensional modelling of packed bed heat storages and familiarization with the existing model
- Extension of the 1D model so that a two-dimensional simulation is possible
- Validation of the 2D model with existing experimental data and performance of a sensitivity analysis
- Comparison of the computational time and accuracy of the 2D model with the 1D model

Prior knowledge of using MATLAB is advantageous but not a requirement. A personal conversation to present the topic is possible at any time. The exact assignment of the work can be adapted to the individual interests.

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