University of Stuttgart
Institute of Nuclear Technology and Energy Systems

Prof. Dr.-Ing. Jörg Starflinger
Chair of Nuclear Technology and Reactor Safety

Bachelor / Master Thesis, Student Project

Optimization of internal design of potassium heat pipe for micro modular reactor applications using COMSOL Multiphysics

Objective:
The task of the work involves modelling of High Temperature Potassium Heat Pipe with varying internal structures in COMSOL Multiphysics.

Background:
High-temperature potassium heat pipes are being explored as passive primary cooling systems for micro modular reactors. To ensure reliable operation with sufficient safety margins, design optimization is essential. Wick properties such as porosity, permeability, width, and pore size significantly impact performance, making internal design optimization challenging. The SiFeKo project explores additive manufacturing (AM) as a viable method for producing tailored wick structures. However, before AM fabrication, a numerical optimization of the internal design is necessary to enhance efficiency and feasibility.

Procedure:

- Introduction to the Finite Element Analysis (FEA) software COMSOL Multiphysics.
- Development of a computational model for a high-temperature heat pipe, incorporating appropriate physical phenomena and boundary conditions.
- Validation of the numerical model by comparing the simulation results with existing experimental data.
- Investigation of various wick structures and properties within the model to determine the optimal internal.
- Generating of a comprehensive dataset of high-temperature heat pipe design parameters, to be utilized in the SiFeKo project for additive manufacturing.

Requirements:

- Bachelor student in mechanical engineering or similar.
- Interest in numerical/simulation work.

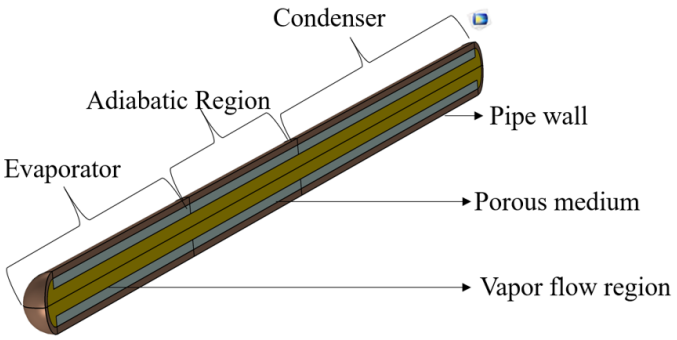

Figure: Heat Pipe model in COMSOL.

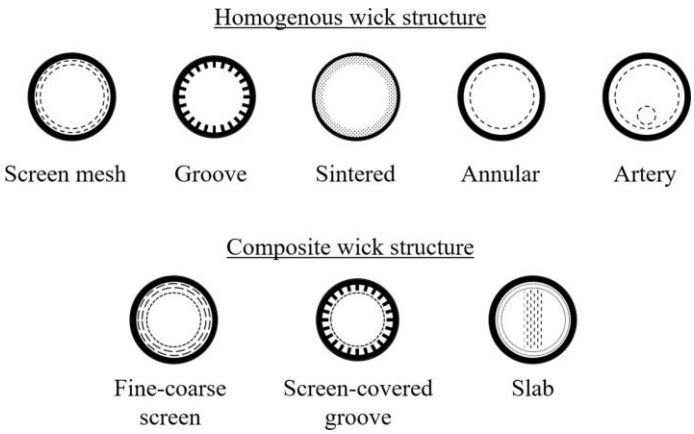

Figure: Wick structures to be explored using the model.

Start: As early as possible.

Contact: M. Sc. Sushanta Biswas
Pfaffenwaldring 31 • Raum 3.305
D-70569 Stuttgart
sushanta.biswas@ike.uni-stuttgart.de
0711 685 62415

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