Masterthesis

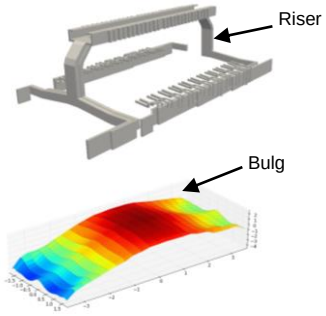
11.10.2020

Optimization and investigation of the riser design of an aluminum electrolysis with and without magnetic shielding

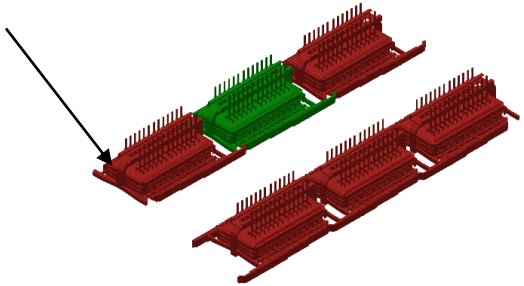
Background

Due to the high currents in the production of aluminum by Hall-Héroult process in combination with internal and external magnetic fields, strong Lorentz forces are generated. The fluid phase consisting of aluminum and cryolite (electrolyte) is set in motion by the Lorentz forces and the interface between aluminum and cryolite begins to bulge. In the worst case a bulging of the interface can lead to a short circuit, which must be prevented. The external magnetic field can be influenced by changing the riser or by shielding it with a ferromagnetic material (steel plate).

Your task will start by validating a numerical method, implemented in the open source code OpenFOAM, for the calculation of ferromagnetic material and perform sensitivity studies (Mesh independence study, Scheme Study etc.). Subsequently, simulations of different riser designs (created automatically or manually) will be performed and the influence on the Lorentz force and thus on the bulging of the interface will be investigated. Finally, an evaluation of the investigated designs will take place.



Arrangement of the 6 Hall-Héroult cells



Key Points

- Literature research
- Performance of a sensitivity study for the numerical solution method for the calculation of ferromagnetic materials
- Validation of the solution process
- Development of different riser designs
- Implementation of the simulations and evaluation of the results

Requirements

- high self-motivation
- Understanding of fluid mechanics
- Interest in numerical work
- Structured, independent work
- Practiced handling with CAD software (Catia, Inventor etc.)
- Experience with OpenFOAM or other CFD-Tools desirable
- First experiences with mesh generation (Hypermesh, Pointwise, BlockMesh etc.)

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