

## Bachelor or Master Thesis on Modelling of Cement Recycling Processes

*“Evaluation of electrical heating and heat recovery options through further development of process flow sheet models using Aspen Software”*

### Background:

In recent years, the usage of cement has increased significantly and therefore the CO<sub>2</sub> emission related to the production of ordinary Portland cement (OPC) clinker. On the other hand, increasing large quantities of construction and demolition waste are generated every year by the construction sector. Continued attempts are being made to explore new techniques to reduce these emissions by recycling cementitious wastes.

We, at the Institute for Technical Chemistry (ITC), are working on the chemical recycling of cementitious wastes, e.g. post demolition autoclaved aerated concrete or cementitious fines from crushing of waste concrete, by a new process, which yields recycled cement clinker as a substitute for OPC clinker. The synthesis process is based on the formation of the clinker mineral Belite at temperatures below those of OPC clinker generation, 1000°C instead of 1450°C. The complete process includes a series of mechanical and chemical process steps like raw material preparation, heat transfer to the raw material in an electrically heated kiln, the initial endothermic limestone decomposition, the exothermic clinker formation, and finally quenching. In particular, the production of Belite cement reduces energy demand as well as CO<sub>2</sub> emissions compared to OPC. To optimize the process and to support scale-up, we are working on process modelling of Belite using flowsheet simulation.

### Scope of the work:

We currently have a basic flow sheet model for the Belite process that includes the unit operations described above. In this work, different heating and heat recovery options oxyfuel, direct and indirect electrical heating options should be selected and developed within the model. Finally, in the thesis, you will evaluate the options in terms of energy efficiency, energy demand, and complexity of the approaches. The scope of the work for the bachelor's thesis will be limited to energy efficiency evaluation.

### Tasks:

- Familiarization with the Aspen simulation tool and Belite processing
- Understanding and working with existing models
- Improvement/development of flowsheet simulation models for Belite production
- Summarizing the work by comparing and evaluating the developed flow sheet models, identifying the limitations and conditions under which they can be used

### Personal qualifications:

- Bachelor's or Master's student in chemical/process engineering or similar disciplines
- Interest in interdisciplinary topics, research, and simulations

**Language:** English and German

**Start of work:** According to the arrangement

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