

MASTER'S THESIS

Techno-Economic Analysis and Optimization of Hybrid Absorption Processes for CO₂ Capture from Lime and Cement Plants



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Background

Process and combustion CO₂ from lime-based industries accounts for around 8% of the global fossil CO₂ emissions. The process emissions associated with the calcination cannot be avoided without carbon capture, utilization, and storage (CCUS). At the Institute for Energy Systems and Technology (EST), a promising CO₂ capture process, the Indirectly Heated Carbonate Looping (IHCaL), is being developed for integration into lime and cement plants, to reduce the associated CO₂ emissions. Combining IHCaL with other capture methods, such as absorption with monoethanolamine (MEA), could further reduce the specific energy consumption (SPECCA) and the cost of the entire system. Some hybrid solutions have been proposed, but a process optimization considering techno-economics is still required to assess the potential.



Dyckerhoff cement plant Göllheim: the raw meal from this plant is being investigated for its usability in the Indirectly Heated Carbonate Looping process. Source: Dyckerhoff.

Aim and Method

The aim of the thesis is to optimize hybrid carbon capture concepts for lime and cement plants that combine IHCaL with other CO₂ capture method, e.g. MEA. To analyse these concepts, techno-economic models in MATLAB/excel will be further developed, and process modelling with Aspen Plus will be carried out. The results will be used to optimize the hybrid processes. Finally, an optimized hybrid process will be presented and compared with the IHCaL process.

Proposed Work Structure

The following tasks are proposed for the development of the thesis:

- Initial review of relevant literature, and determination of reference key performance indicators.
- Development of a detailed techno-economic model for absorption processes
- Simulation of hybrid absorption CO₂ capture processes with ASPEN Plus
- Calculation of technologic and economic key performance indicators: CAPEX, OPEX, SPECCA, etc.
- Discussion of results, and reporting

Information for the Application

The thesis can be submitted in English or in German.

For applications and further information, please contact:

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