Student Research/Bachelor Thesis

For students in environmental engineering, mechanical engineering, process engineering WASTE or similar study programs

Calcium based processes for carbon capture

Background:
Carbon dioxide (CO$_2$) is an important contributor to global climate change. This greenhouse gas is mainly emitted through anthropogenic sources linked to energy generation and other energy intensive industrial processes, such as cement or steal production. In order to mitigate climate change, carbon capture and storage/utilization (CCS/CCU) technologies are developed. Promising CCS technologies for both post- and pre-combustion capture are based on cyclic calcination and carbonation of the natural and cheap sorbent limestone (CaCO$_3$).
At high temperatures, CaCO$_3$ decomposes to CaO and CO$_2$ (calcination/sorbent regeneration). The formed CaO can (re)bind CO$_2$ at lower temperatures (carbonation/CO$_2$ separation). The repeating sequence of these reactions enables a continuous CO$_2$ capture. Advantages of Ca-based CCS techniques are the cheap and widely available sorbent, the high energy level enabling efficient heat recuperation and its versatile application potential. Besides the production of a CO$_2$ rich gas stream for storage or utilization it is also possible to use the generated solid byproducts (e.g. cement industry). By means of the sorption enhanced gasification (SEG), limestone can be used to adapt the syngas composition.

Aims:
The objective of this work is to perform a research study about current limestone based processes. During the research/thesis, the pre-combustion and post-combustion CO$_2$ capture for energy intensive industries using a Ca-based sorbent shall be evaluated. The focus will be on the investigation of the current state of research for the main technologies. The potential of Ca-based processes regarding climate change mitigation shall be assessed.

Approach and Tasks:
- Literature review
- Critical discussion
- Report writing

Requirements:
- Good methodological skills
- Good knowledge of English
- Ability to work independently

Start date: immediately

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