Master's Thesis project proposal

Rigorous technoeconomic assessment of the production costs of phase-change solvents for CO_2 capture.

Background

Innovative phase change solvents can significantly reduce the energy consumption of solvent based post combustion CO2 capture compared to the reference MEA based process. These solvents exhibit triple phase equilibrium (vapor-liquid-liquid) under absorption and/or stripping conditions in the presence of water and CO2, which facilitates recycling of big amounts of the water-rich phase before solvent regeneration, thus reducing the corresponding reboiler consumption by 50% or more. However, these solvents have a more complex molecular structure compared to MEA and are thus more expensive to produce. It is therefore important to examine how big is the cost benefit from a system perspective, including the energy saved and solvent consumption during the CO2 capture process together with the solvent production costs. Because the corresponding molecules are only produced in low volumes (e.g., experimental testing), the available cost data are not representative of full-scale production: there are only some indicative production costs based on correlations with other molecules.

Aim

The aim of this project is to perform rigorous technoeconomic assessment at early stages of process design to produce a few, innovative, phase-change solvent molecules which are proven to be efficient for CO2 capture. Principal flowsheets for production of these molecules are available (e.g., in Aspen Plus®), which may need to be refined during the project. Moreover, the performance of the investigated molecules at CO2 capture is already evaluated, and thus the corresponding consumption rates of these molecules are known. Moreover, a full technoeconomic assessment of the CO2 capture plant is available. Thus, the estimated solvent production costs will be combined with these studies to assess their relative impact from a system perspective. Thus, the main project tasks are:

- Fine tuning (e.g., process parameter settings, heat integration, etc.) of developed flowsheets for the production of 3-4 main phase-change solvents of interest.
- Rigorous technoeconomic assessment of the final process designs.
- Analysis of the results (i.e., solvent production costs) with respect to the overall CO_2 capture and storage costs.

Additional information

The Master's thesis is a follow-up work of the project ROLINCAP (http://www.rolincap-project.eu/). The project can be carried out by one or two students. The work corresponds to 30 ECTS credits (approximately 20 weeks).

Prerequisites

The students are expected to have a background in chemical, process or energy engineering (e.g., from, but not limited to, master programs Sustainable Energy Systems or Innovative and

Sustainable Chemical Engineering). The students are also expected to have some basic knowledge and/or interest in cost engineering and sustainability.

Supervisors and Contact information

The project supervisor will be Associate Professor Stavros Papadokonstantakis.
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