Utilization of captured CO_2: Enhanced esterification reactions using membrane reactor

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Introduction and background:

The highest amount of greenhouse gas emissions come from carbon dioxide (CO_2) in the world. A variety of techniques and methods can be used to reduce CO_2 emissions. One way is to capture CO_2 after combustion processes and utilize it to produce useful products. Among the methods being explored to utilize captured CO_2 is the ester formation. Typically, membrane separation can be used to improve ester conversion, and its implementation for ester formation from CO_2 is currently being explored.

This thesis is a part of a newly funded project 'ALCOhol-based PrOcess for Production of carbonic acid diesters from CO_2 (ALCOPOP)' by The Research Council of Norway that focuses on finding a new process concept for the synthesis of ethylene carbonate from CO_2 and biomass sourced ethylene glycol via amine pre-activation of CO_2. Using CO_2 captured by a capture unit as feedstock, the project will aim to enhance carbonate ester yield and reduce the energy needed to capture CO_2.

Problem description and objective:

This project aims to observe the ethyl acetate synthesis esterification reaction as a model equilibrium reaction. Removal of the by-product, water, would increase the rate of the forward reaction and improve the ester formation. A membrane separator will be setup to remove water from the system and water separation will be studied. Following tasks will be carried out during this project.

- Literature study on esterification reaction, pervaporation (membrane) technology.
- Setting up the membrane reactor with help from supervisors and fit for purpose test.
- Testing of esterification reactions and study of different membranes.
- Discussion/recommendation on improvement to the system.

Even though the objectives were set as mentioned above, due complications arose, experiment plans had to be revised accordingly to observe membrane separation from water-ethanol liquid mixtures where water separation could be studied.

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