Characterization of structured packings and solvents for CO_2 absorption from air

The use of direct air capture (DAC) systems to separate CO_2 from the ambient air is becoming increasingly important. One challenge with liquid-based systems is to maximize the contact area between the gas and liquid phases for good mass transport while at the same time minimizing the pressure loss to enable a low energy demand. One approach to soving this is the use of advanced structured packings. Furthermore, the choice of "green solvents" as absorption lliquids is becoming more and more of a focus of interest, as they cause less environmental pollution.

Current challenges

For liquid-based separation of atmospheric CO_2, only commercially available structured packings are currently used on a large scale. However, these do not have optimal properties for application in direct air capture, as they have not been optimized for the specific application. Absorbents currently used include sodium or potassium hydroxide, ethanol amines (e.g. mono ethanolamine). The research focus for new solvents in the context of DAC is to find a solvent that has high effectiveness and selectivity despite low input concentrations, can be regenerated easily and with little energy, and has as little negative environmental impact as possible.

Figure 1. Absorption-Test-Rig for structured packings for liquid-phase DAC.

Solution

IMVT operates a test bench for characterizing packings for CO_2 absorption. Ambient air can be passed through the absorber in co-current or counter-current operation. An aqueous L-Arginine solution is typically used as the absorption liquid, but other solvents can also be evaluated. Based on integrated gas and liquid phase analyses, important mass transfer parameters such as the absorption rate or the CO_2 absorption efficiency can be determined. Furthermore, the dry and wet pressure loss can be determined.

Advantages

The advantages of this test bench are the simple and quick characterization of new, innovative packings or random packings. These packings can be quickly and easily manufactured on site using 3D printing and tested directly. Furthermore, new solvents can be tested for their performance in combination with new packings or with commercial packings.

Options for companies

The test bench can be made available to interested companies in order to investigate new solvents as well as to test specially developed structures.

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