Capture and Storage Projects at IVC-SEP

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CO₂ capture and storage projects at IVC-SEP

DTU Chemical Engineering

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**Why CO₂ Capture and Storage (CCS)?**

CO₂ is a greenhouse gas and during 2007 the Intergovernmental Panel on Climate Change (IPCC) concluded that the major contribution to the global warming is CO₂. Electricity produced solely by renewable energy-sources like wind, solar, or wave power is not possible yet, since the full scale infrastructure and knowledge is not available. In the meantime while these expertise are being developed the existing proven state-of-the-art know-how must be taken into use in order to lower the emission of CO₂. Figure 1 shows a principle sketch of the CO₂ flow in electricity production. The capture of CO₂ is performed at the plant and storage of CO₂ in nearby underground aquifers or in oil reservoirs, which as a side effect may enhance oil production. Figure 2 shows the known solvent-based CO₂ capture process studied at IVC-SEP.

**Capture**

The solvent used in the equipment of figure 2 consists typically of an amine component. It binds and removes the CO₂ from the flue gas in the absorber. The CO₂ rich solvent is heated in the stripper and pure CO₂ is released which is transported for on or off-shore storage. In IVC-SEP the phase equilibria are studied in order to improve current technology. The technology is extended for simultaneous capture of CO₂ and H₂S in order to lower the cost.

**Improved Design of CO₂ Capture**

A model of the thermodynamic properties of amines is being created by Leila Faramarzi in order to improve column calculations.

**Solvent Design & Selection**

The amine solvent may not be the most optimal solvent for CO₂ capture. Several interesting alternative solvents are being studied in IVC-SEP.

**Amino Acids**

Recently the PhD project by Benedicte M. Lerche was initialised in order to study the process improvements of using amino acid solvents. The benefit of these solvents are low toxicity, low volatility, high stability to oxidative degradation, leading to low solvent loss.

**Ionic Liquids**

Ionic liquids (IL) are liquid salts. They have similar benefits to amino acids and may be used for combined capture of CO₂ and SO₂. IVC-SEP just received a large grant in collaboration with DTU Chemistry for developing new IL solvents. Muhammad W Arshad is finishing his master on this topic.

**Aqueous and Chilled Ammonia**

Victor Darde is involved in the thermodynamic model development of the electrolytic CO₂-NH₃-H₂O system.

**Mathematical Column Models**

Philip L. Fosbol, Martin P. Breil and Leila Faramarzi are involved in the creation of software packages (CAPE-OPEN) for the calculation of heat and energy balances for the figure 2 columns as sketched in figure 3.

**Experimental absorber pilot**

Several master students have been, and are, involved in building an absorption column as shown in figure 4. This is done in order to test packings and solvents. Lars Kierboe and Nicolas von Solms are supervising these projects.

**Experimental equilibrium and injection tests**

Two types of storage experiments are performed in IVC-SEP. CO₂-Chalk interaction test as shown in figure 5 by Ben Niu and CO₂ solubility in brine as shown by figure 6 performed by Wei Yan and students.

**Model of CO₂ Injection**

The aim of the studies by Ben Niu is to build a CO₂ reservoir injection model in order to predict the experimental findings from the CT-scanner. Figure 7 shows the planned modelling methodology.