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of Technology in Scandinavia

Development of Low-Cost Ionic Liquid Based Technology for CO_2 Separation

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Introduction

- **CO_2 separation technologies**
  - Generally expensive
    - Amine Absorption (Commercial technology)
      - High cost: $50 to $100 per ton CO_2
      - Environmental effect: volatility (amine goes to environment)
    - Pressure Swing Adsorption (stability and cost)
    - Membrane (multistage process, permeability, selectivity)
    - New technology: ionic liquids

- **Advantages**
  - Negligible vapor pressure
  - Designable
  - High solubility, selectivity (CO_2)
  - Potential: decrease the cost down to $20 per ton CO_2

- **Limitation of conventional ILs:**
  - High viscosity (low kinetic rate), cost
  - Thermal and chemical stabilities (long-term utilization)

- **Solution:**
  - Novel low price ionic liquid, co-solvent

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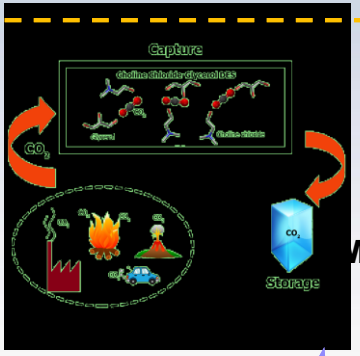
Project plan: develop and test low-cost IL-based solvents for CO_2 separation

Systematicly study of IL-based process

35 DESs
4 Novel ILs

Synthesis → **Lab test**

Gas solubility
Viscosity
Absorption rate



Modeling and Simulation

aspentech

Aspen plus

Analysis and Evaluation

Pilot test

Future work

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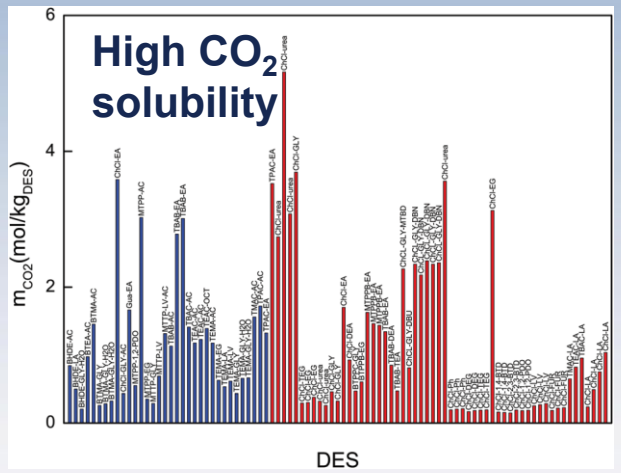
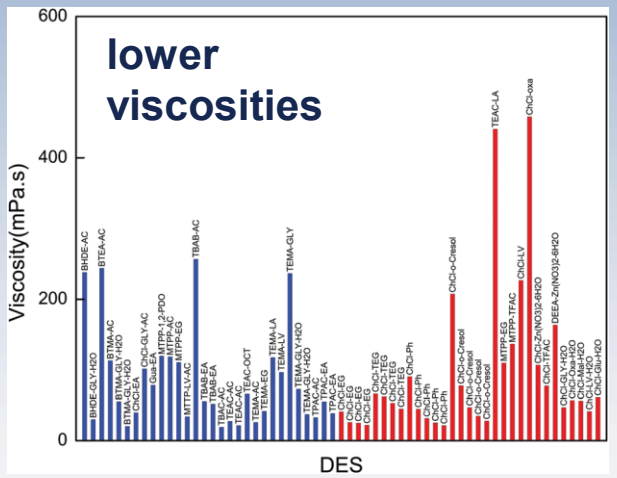
Novel Ionic Liquids synthesis and testing

- 35 (deep eutectic solvents, DESs)
  - Easily-synthesis-process
  - low price of raw materials





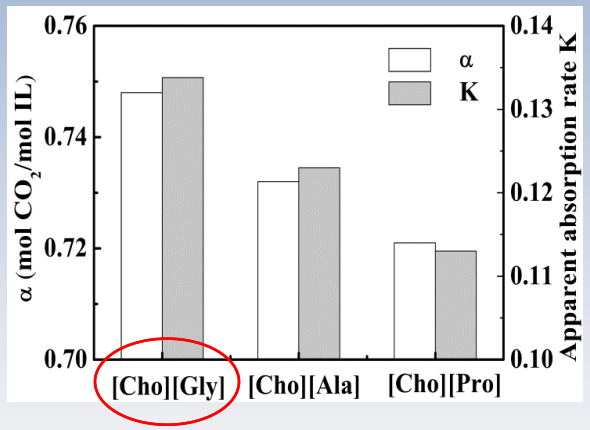
- 15 promising DESs
  - Solubility >1 mol/kg IL
  - Viscosity <200 mPa·s

- Future work
  - Functional DESs
  - Co-solvents (water)
  - Solubility of N_2, CH_4

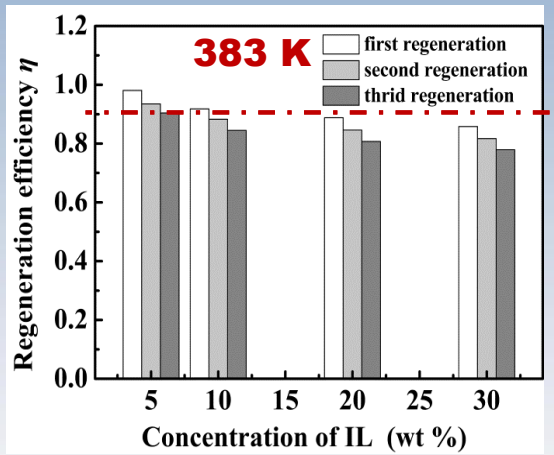
New J. Chem., 2017,41, 290-299

Novel Ionic Liquids synthesis and testing

- 3 (functional cholinium amino acid ILs)
  - Non-toxic
  - biodegradable



CO_2 absorption in 5 wt. % [Cho][AA]s



Regeneration efficiency

- 1 promising aqueous IL: 5 wt.% [Cho][Gly]
  - High solubility and absorption rate
  - Regeneration efficiency>90%
  - Viscosity <1 mPa·s

- Future work
  - Co-solvents (decrease T_{de})
  - Solubility of N_2, CH_4
  - Process simulation

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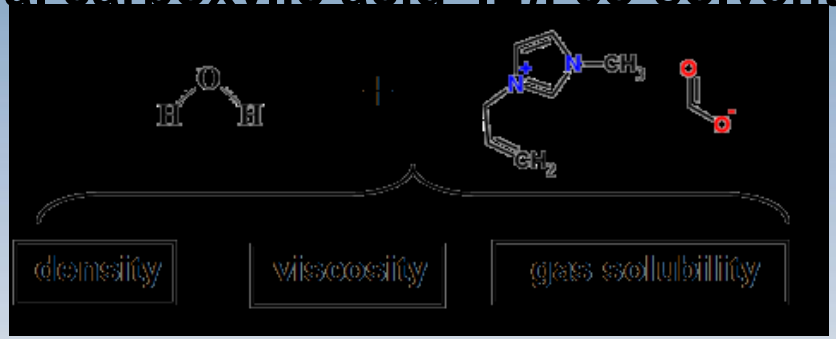
Novel Ionic Liquids synthesis and testing

- 1 (functional carboxylic acid_IL): co-solvent testing (ongoing)



CO_2, CH_4, N_2

Future work in summary

- Functionalize 15 promising DESs and lab-test
- Effect of co-solvent (lab-test)
- Process simulation using screened solvents based on Aspen plus
- Tech-economic analysis and evaluation