About Deep Eutectic Solvents (DESs)

**DES:** mixture of a hydrogen bond donor (HBD) and a hydrogen bond acceptor (HBA)

Formation of an **eutectic**

Freezing point of urea : choline chloride mixtures as a function of composition.

Until recently only hydrophilic DESs

The constituents of the currently produced DESs all promote the preparation of hydrophilic DESs

Due to the high amount of hydrogen bond donating and accepting groups

**Hydrogen Bond Donors (HBDs)**

- oxalic acid
- Malic acid
- Lactic acid
- Urea
- Glycolic acid

**Hydrogen Bond Acceptors (HBAs)**

- Choline chloride
- Tetrabutylammonium bromide
- Proline
- Betaine
- Glycine
Extraction of volatile fatty acids

Removal of metal ions from water

Removal of metal ions from water
**Capture of CO₂**

- Important from an environmental point of view

- What do the numbers tell us?

<table>
<thead>
<tr>
<th>Solvent</th>
<th>298.15 K</th>
<th>H₂₁ / Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>DecA : N₈₈₈₈‒Br (2:1)</td>
<td>6.26 ± 0.07</td>
<td>7.15 ± 0.01</td>
</tr>
<tr>
<td>DecA : N₈₈₈₈‒Cl (1.5:1)</td>
<td>5.90 ± 0.09</td>
<td>6.55 ± 0.07</td>
</tr>
<tr>
<td>Urea : Choline Chloride (2:1)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Lactic acid : N₄₄₄₄‒Cl (2:1)</td>
<td>NA</td>
<td>14.46</td>
</tr>
<tr>
<td>[C₄mim][BF₄]</td>
<td>5.90 ± 0.26</td>
<td>NA</td>
</tr>
<tr>
<td>[C₄mim][Tf₂N]</td>
<td>3.3 ± 0.03</td>
<td>NA</td>
</tr>
<tr>
<td>Selexol</td>
<td>3.57</td>
<td>NA</td>
</tr>
</tbody>
</table>

Hydrophobic DES in water emulsions

- Small droplets of our hydrophobic phase in water
  - Produced by the addition of a surfactant (a soap)

Dannie J.G.P. van Osch, Nicole van der Heijden, Jaap van Spronsen, A. C. C. (Catarina) Esteves, Remco Tuinier and Mark Vis, in preparation
Conclusions

• Hydrophobic DESs have been produced

• Hydrophobic DESs have already been applied for the:
  • Removal of fatty acids from water
  • Removal of metal ions from water
  • Capture of CO$_2$
  • Production of hydrophobic DES in water emulsions
Acknowledgement

This project has received funding from the Bio-Based Industries Joint Undertaking under the European Union’s Horizon 2020 research and innovation programme (Grant Agreement No. 668970).