QUEEN'S UNIVERSITY BELFAST

QUEEN'S UNIVERSITY IONIC LIQUID LABORATORIES

QUILL

Hydrophobic low melting mixtures for biogas upgrading

J. Mark Young, Sam H. McCalmont, John D. Holbrey, Sophie Fourmentin, and Leila Moura

QUILL Research Centre, School of Chemistry and Chemical Engineering, Queen's University Belfast

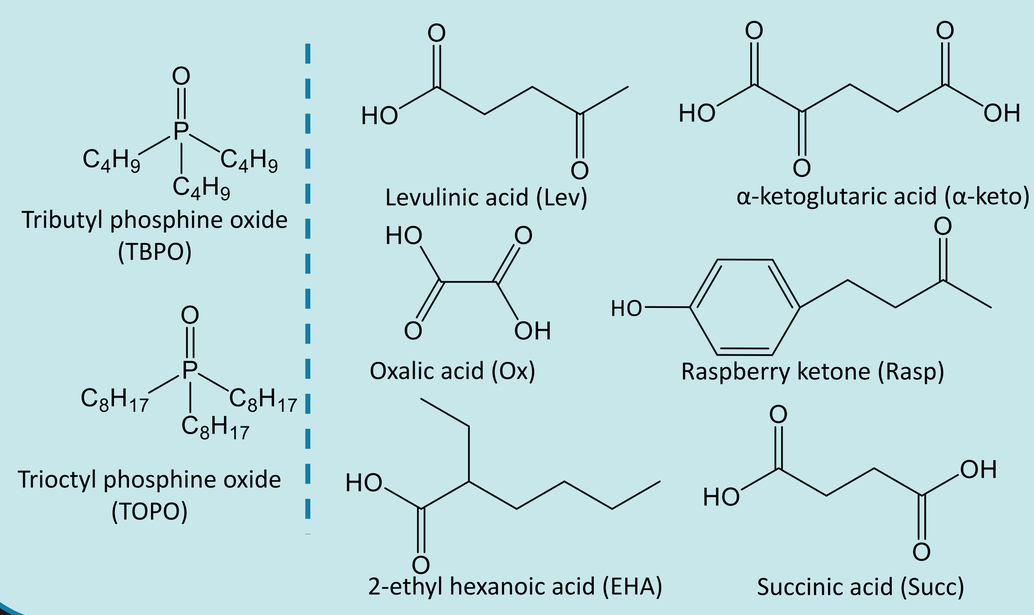
Email: **jyoung34@qub.ac.uk**

The problem

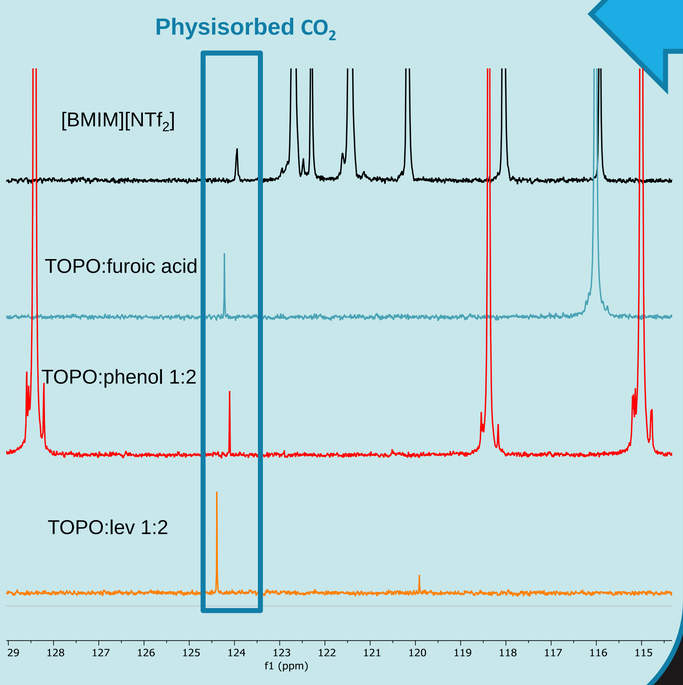
- Biogas is a natural product of anaerobic digestion of organic material
- Multi component mixture; predominantly CO_2/CH_4 with other impurities such as water, H_2S, VOCs and siloxanes
- Liquid amines are predominantly used for CO_2/CH_4 separation these have several main issues:
  - **High regeneration cost of 85 kJ mol^{-1}CO$_2$**
  - **High volatility**
  - **Corrosivity**
- We seek to find high capacity physisorbant materials with lower regeneration energies, low volatility and low corrosivity
- Phosphine oxide based low melting mixtures have the potential to have high CO_2 capacity, selectivity and desirable physico-chemical properties

*Phys. Chem. Chem. Phys., 2020, **22**, 24744–24763.* *Can. J. Chem. Eng., 1995, **73**, 140-147*
*ACS Sustain. Chem. Eng., 2018, **6**, 17323–17332.*

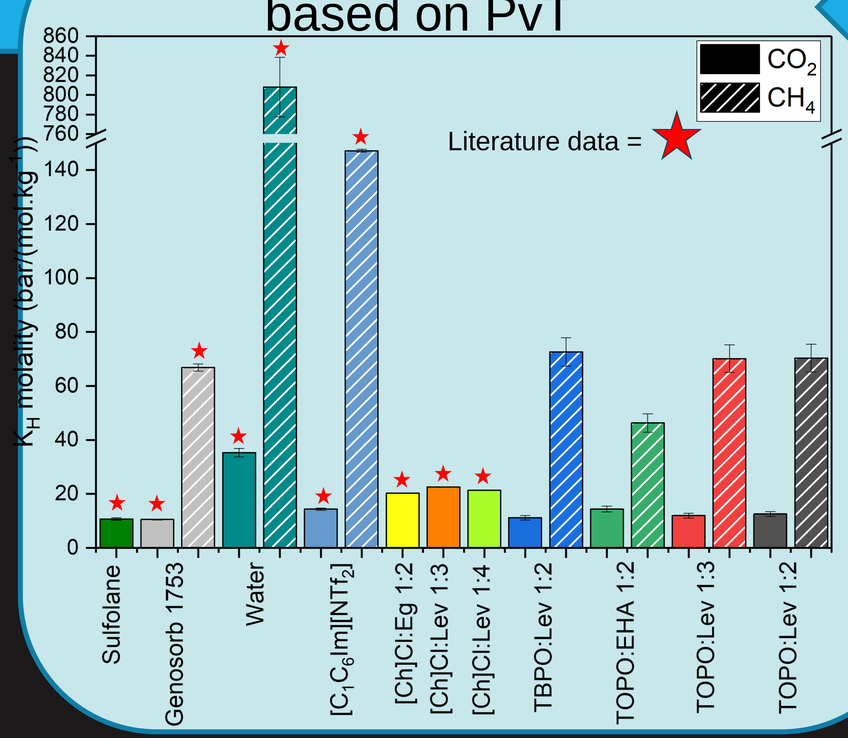
Components of LMMs



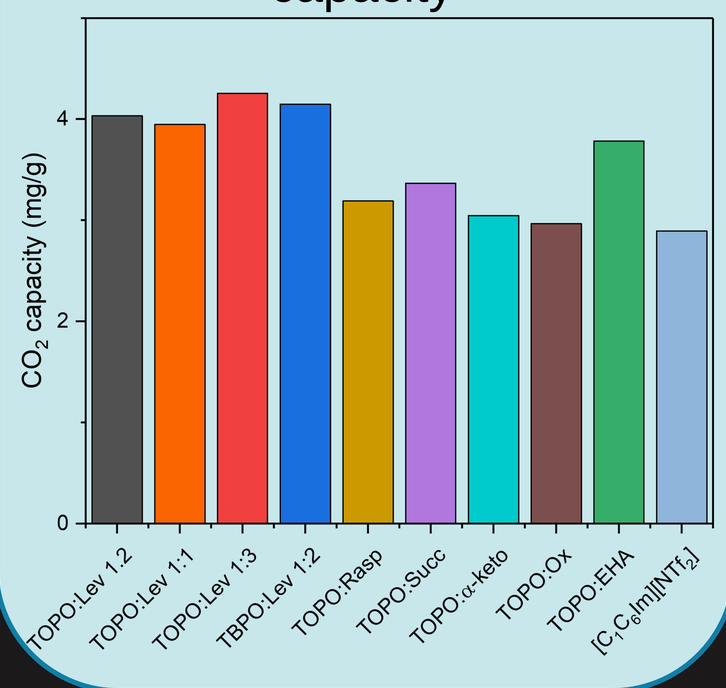
Absorption mechanism



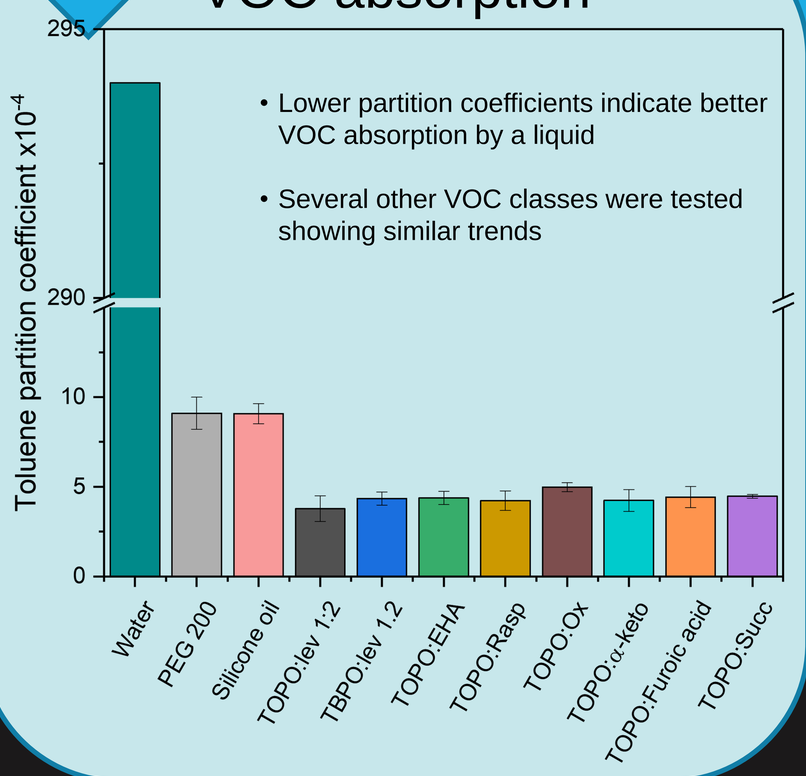
Isochoric saturation method based on PvT



Screening CO_2 uptake capacity

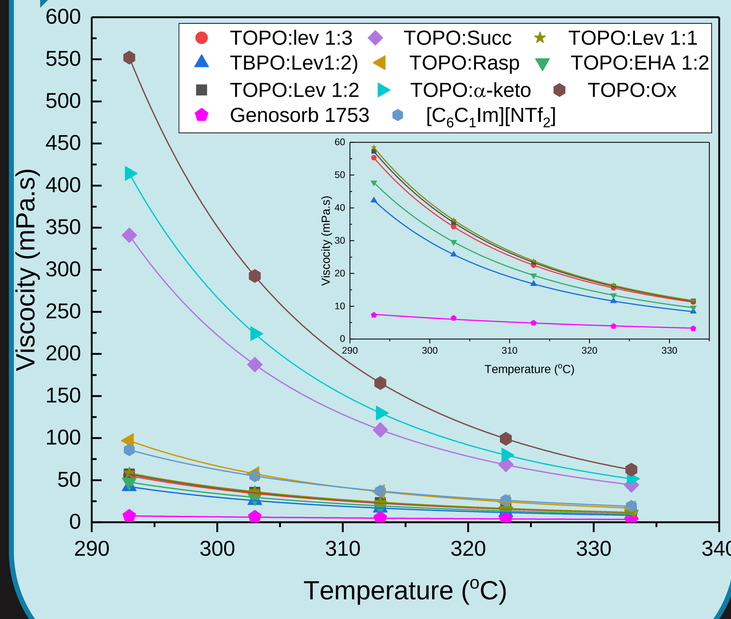


VOC absorption



- Lower partition coefficients indicate better VOC absorption by a liquid
- Several other VOC classes were tested showing similar trends

Viscosity



Our solution

- By first screening materials we can narrow down the overall experimental time
- TOPO based LMMs have CO_2 uptake capacities comparable to that of the best physisorbant ILs
- TOPO based materials show good potential VOC removal from gas streams
- These materials have potential to be a “one pot” biogas purification technology

FUNDED BY A PARTNERSHIP GRANT FROM THE ROYAL SOCIETY

UKRI Engineering and Physical Sciences Research Council

ROYAL SOCIETY OF CHEMISTRY

Royal Academy of Engineering