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QUEEN'S UNIVERSITY IONIC LIQUID LABORATORIES

QUILL

Waste Plastic Valorisation Using Acidic Ionic Liquids

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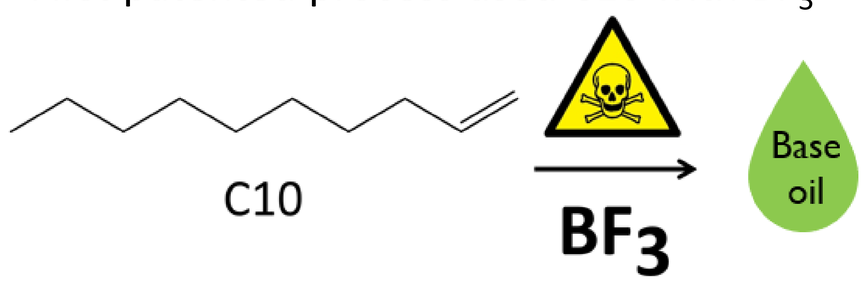
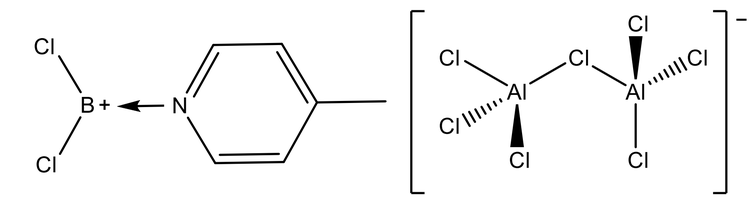
1. Introduction

- Waste polyalphaolefin plastic is processed by pyrolysis to produce a distribution of alphaolefins/paraffins.
- Recycling polyolefin plastic is particularly challenging due to the $C(sp^3)$-$C(sp^3)$ bond which is more difficult to break than other plastics

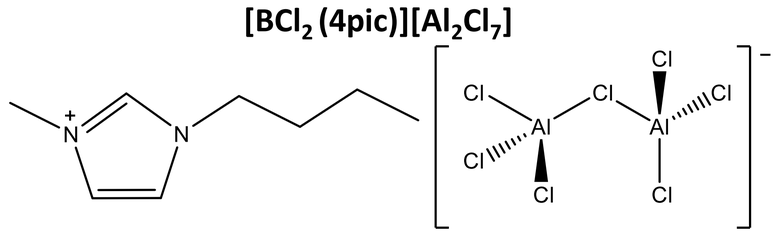
- First patented process used C10 with BF_3



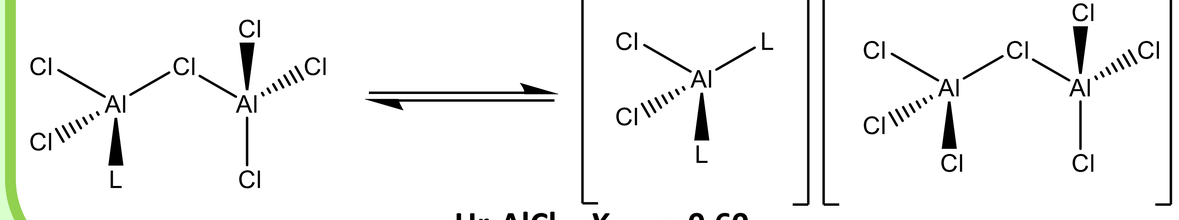
2. Ionic liquid catalysts



$[BCl_2(4pic)][Al_2Cl_7]$

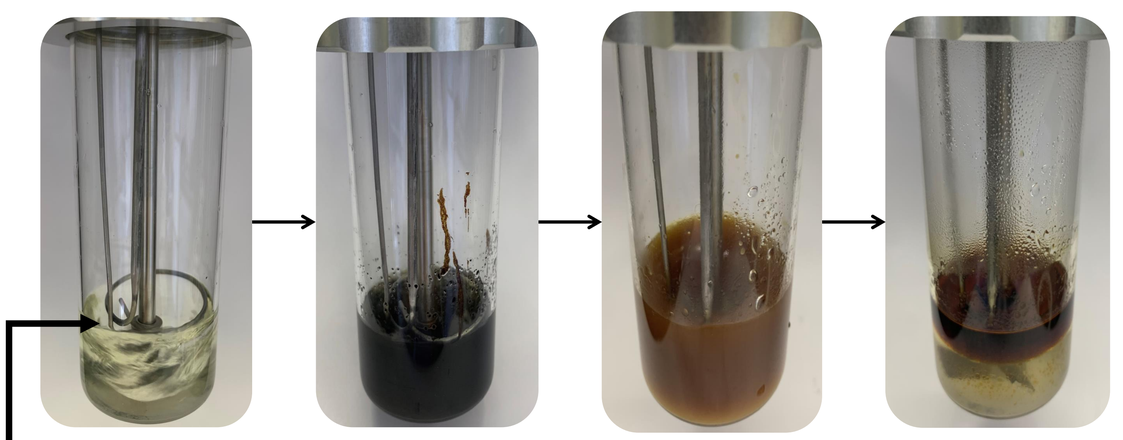


$[Bmim][Al_2Cl_7]$



$Ur\text{-}AlCl_3$ $X_{AlCl3} = 0.60$

3.Method



Recycled feedstock

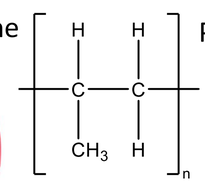
Addition of catalyst: exothermic reaction

Reaction quenched with water

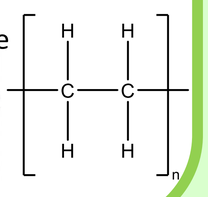
Removal of aqueous layer

1.Pyrolysis
2.Reaction with ionic liquids

Polyethylene

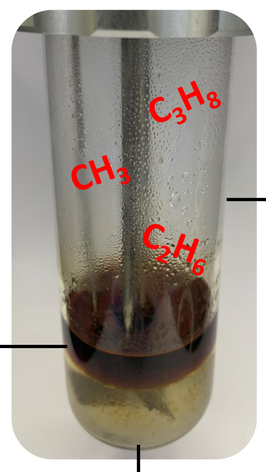


Polypropylene



4.Analysis

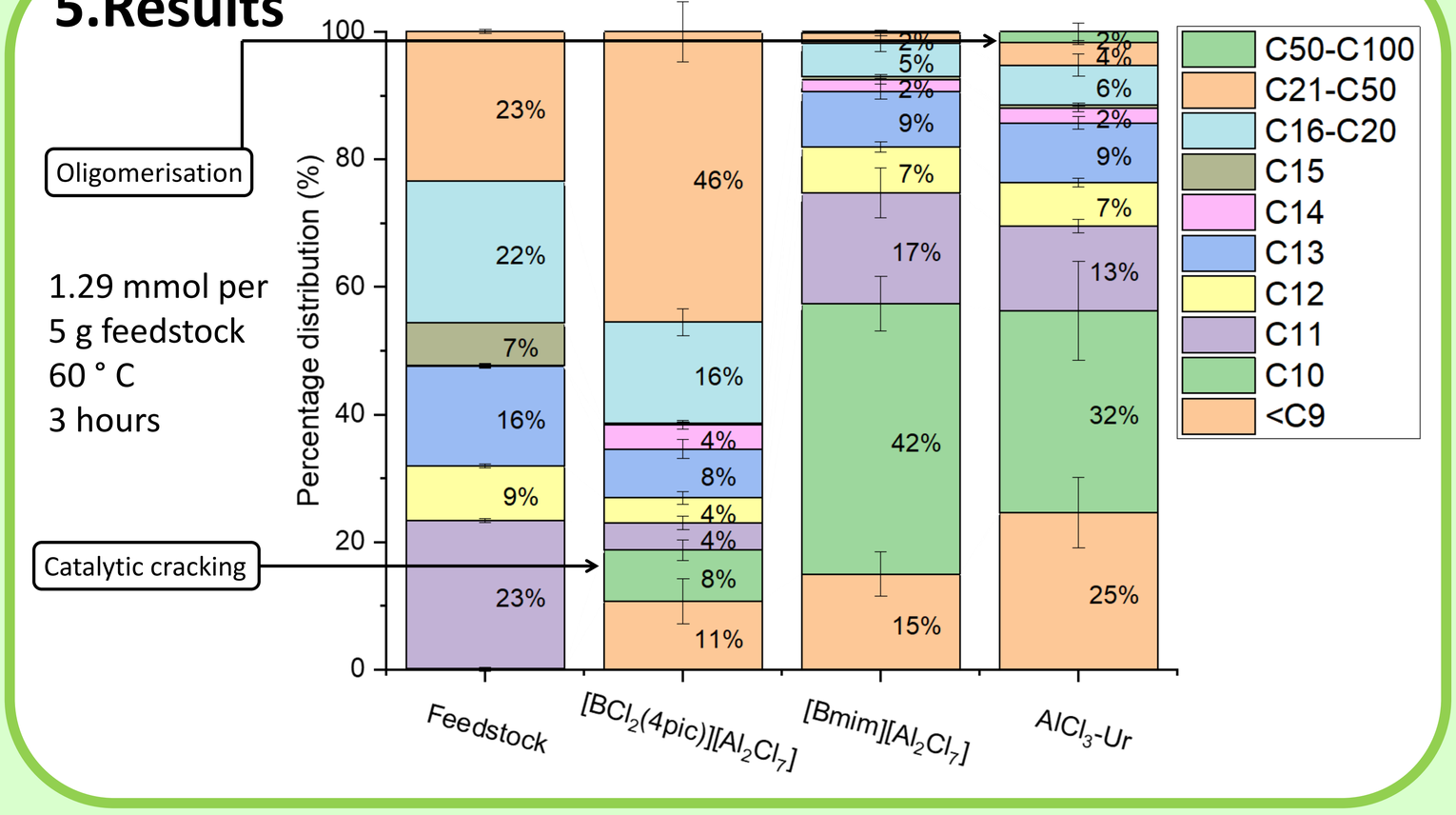
Product is separated and analysed by SimDist GC, ^1H & ^{13}C NMR, GC-MS, and mass balance



Loss of mass due to the catalytic cracking to volatile hydrocarbons

Aqueous layer is separated, and ionic liquid is quenched

5.Results



6.Conclusion

- Competition between cracking and oligomerisation reaction
- Endothermic C-C cleavage vs exothermic reaction
- Oligomerisation of feedstock to lubricant base oil range
- Cracking feedstock toward fuel range
- High sensitivity towards feedstock, catalyst and reaction parameters

7.References

1. *Green Chem.*, 2015, **17**, 1831
2. *ACS Sustain. Chem. Eng.*, 2019, **7**, 15044
3. US Patent Office, 3382291, 1968

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