Light naphtha alkanes from (ligno)cellulose: A chemocatalytic approach

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General introduction

Petrorefinery

Biorefinery

Introduction – One pot hydrodeoxygenation – Influence of the substrate – C&H neutrality – Conclusion
Perspective for bio-based alkanes

2020

2050

Introduction – One pot hydrodeoxygenation – Influence of the substrate – C&H neutrality – Conclusion
Chemocatalytic tool box

Heavy products e.g. Lubricants

Fatty acid (Glycerides)

Diesel

Kerosene

Gasoline

Light naphtha

Monomer - Dimer (Lignin)

C_{5-6} Sugar ((Hemi)cellulose)

TOOL BOX
- Hydrogenation
- Oxygen removal
- Cracking
- Coupling
- Branching

Heavy products e.g. Lubricants

Diesel

Kerosene

Gasoline

Light naphtha

Fatty acid (Glycerides)

Monomer - Dimer (Lignin)

C_{5-6} Sugar ((Hemi)cellulose)

Deneyer et al., Current Opinion in Chemical Biology, 2015

Introduction – One pot hydrodeoxygenation – Influence of the substrate – C&H neutrality – Conclusion
Hydrodeoxygenation of cellulose

Op de Beeck et al., Energy and Environmental Science, 2015

Introduction – One pot hydrodeoxygenation – Influence of the substrate – C&H neutrality – Conclusion
Properties of cellulose

- **Crystallinity** (CrI\%) (XRD)
- **Particle size** (\(\mu\)m) (LD, SEM)
- **Degree of polymerization** (# units) (Viscosity)
Particle size (µm)

Sieving: < 125 µm

67 mol% C

Sieving: > 125 µm

70 mol% C

62 mol% C

Introduction – One pot hydrodeoxygenation – Influence of the substrate – C&H neutrality – Conclusion
Particle size (µm)

Introduction – One pot hydrodeoxygenation – Influence of the substrate – C&H neutrality – Conclusion
Introduction – One pot hydrodeoxygenation – **Influence of the substrate** – C&H neutrality – Conclusion
Comparison with fast-hydropyrolysis

H₂Bioil

Mild catalytic

≈ 0.05 g H₂/g feed

* Venkatakrishnan et al., Green Chemistry, 2015
100% renewable Carbon and Hydrogen

Introduction – One pot hydrodeoxygenation – Influence of the substrate – C&H neutrality – Conclusion
Toward real (ligno)cellulosic feedstocks

Whatman filter 4

α-cellulose

Wheat straw organosolv

Yield = big cellulose spheres

70 mol% C
Toward real (ligno)cellulosic feedstocks

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- Cellulose $\rightarrow$ C₆ alkanes = Efficiency
- Hemicellulose & Lignin Degradation
Mildly refined, large and fibrous raw cellulose

One-pot hydrodeoxygenation of cellulose

$\Rightarrow$ 100% renewable C & H

Light naphtha

Perspective for bio-based alkanes

Conclusion
Thanks to …

- Thijs Ennaert
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