

Marine and jet biofuel production via hydrotreating of Triacylglycerides

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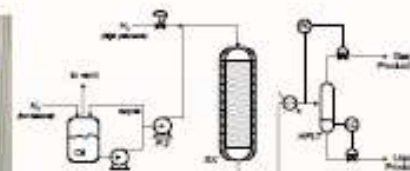
Introduction

The aim of the current research is focused:

- On the upgrading of bio-based triacylglycerides (TAGs) via hydroprocessing to marine and jet bio-fuels.
- Biogenic residues and wastes were gasified and the syngas was fermented to produce bio-based triacylglycerides (TAGs).
- All Hydrotreating experiments performed in a TRL 3 continuous flow, pilot-scale hydroprocessing plant VBD1 of the Chemical Process & Energy Resources Institute (CPERI) of the Center for Research and Technology Hellas (CERTH) (Picture 1&2).
- A commercial hydrotreating catalyst was employed.
- The effect of hydrotreating operating parameters was investigated (Table 1)



Picture 1: TRL 3 Hydrotreating unit



Parameters	Units	Cond. 1	Cond. 2	Cond. 3
Temperature	°C	350	360	375
Pressure	psi	1450	1450	1450
H2/Oil ratio	scfb	5900	5900	5900
LHSV	hr ⁻¹	1	1	1

Table 1: Operating testing window

Results & Discussion

Feed:

For the purpose of the current investigation, biogenic residues and wastes were gasified and the syngas was fermented to produce bio-based triacylglycerides (TAGs). However, due to the limited availability of the feedstock, the TAGs were simulated via a model compound.

The fatty acid composition of the TAGs was analyzed and a model compound was developed simulating their composition via a blend of four commercial vegetable oils (Palm oil, Flaxseed oil, Olive oil and Pumpkin oil). Model compound can simulate the fatty acid composition of TAGs by ~80% (Figure 1)



Figure 1: Fatty acid composition from TAGs & model compound

Products:

- Hydrotreating increased the hydrogen content in all products increasing in that way the energy content of the produced fuels (Figure 2)



Figure 2: H and C elemental composition on dry basis of feeds and products after hydrotreatment

Marine diesel and jet fuel range hydrocarbons were produced via hydrotreating of TAGs (Figure 3)

- Cond. 1: 41 wt% Jet-fuel & 59 wt% Marine diesel fuel
- Cond. 2: 35 wt% Jet-fuel & 65 wt% Marine diesel fuel
- Cond. 3: 56 wt% Jet-fuel & 42 wt% Marine diesel fuel

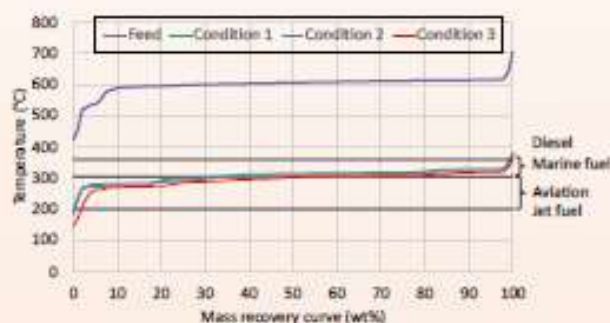


Figure 3: Feed & product mass recovery curve

- An increase of temperature favor hydrodeoxygenation reactions leading to a less oxygenate product but with higher H₂ consumption during the process (Figure 4)

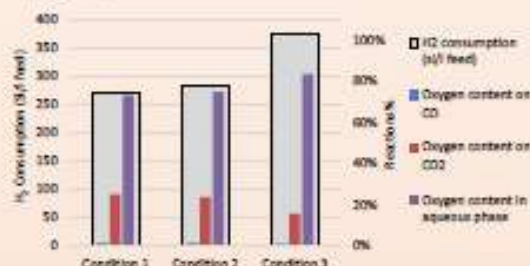


Figure 4: Oxygen distribution in gas and liquid products

Conclusions

- TAGs were simulated via a blend of various commercial vegetable oils with an accuracy of ~80%
- Hydrotreating of the model compound has led to ~56 wt% jet fuel and ~42 wt% marine diesel range hydrocarbons
- Operating hydrotreating window influence the mass product yields and oxygen removal reaction pathway
- Optimum condition No. 3, higher jet and marine fuel yields while the oxygen is removed mostly via hydrodeoxygenation instead of decarbonylation and decarboxylation reactions

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