Triacylglycerides to marine and jet biofuel via hydrotreating

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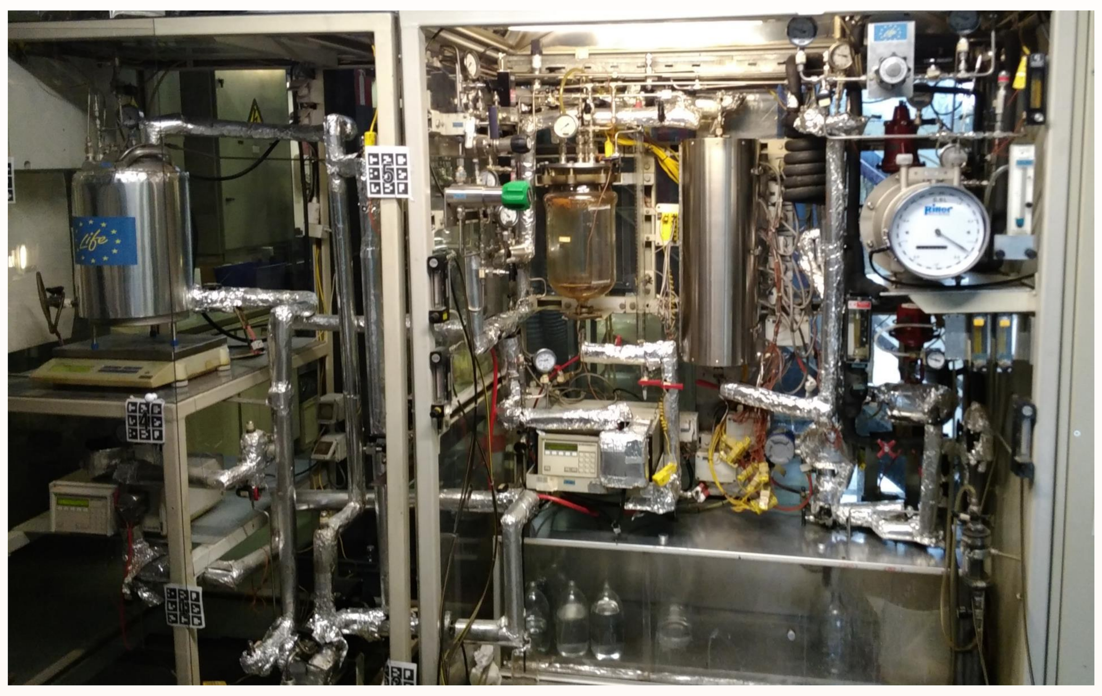
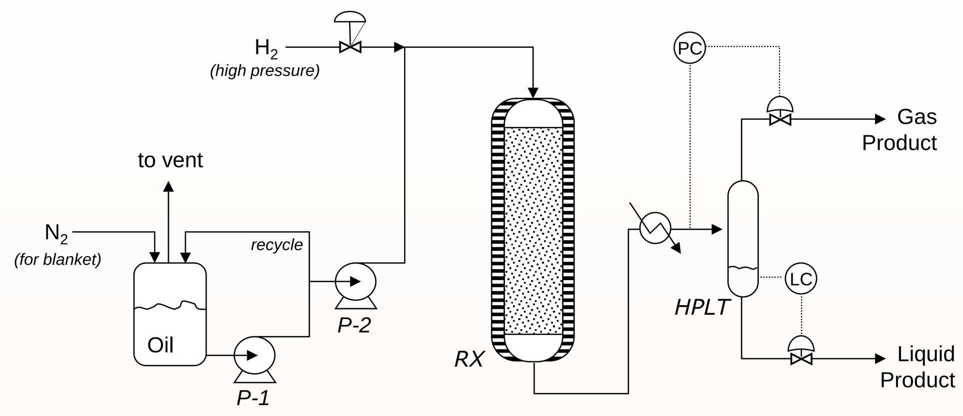
Introduction

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 VB01 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	5930	5930	5930
LHSV	hr^{-1}	1	1	1

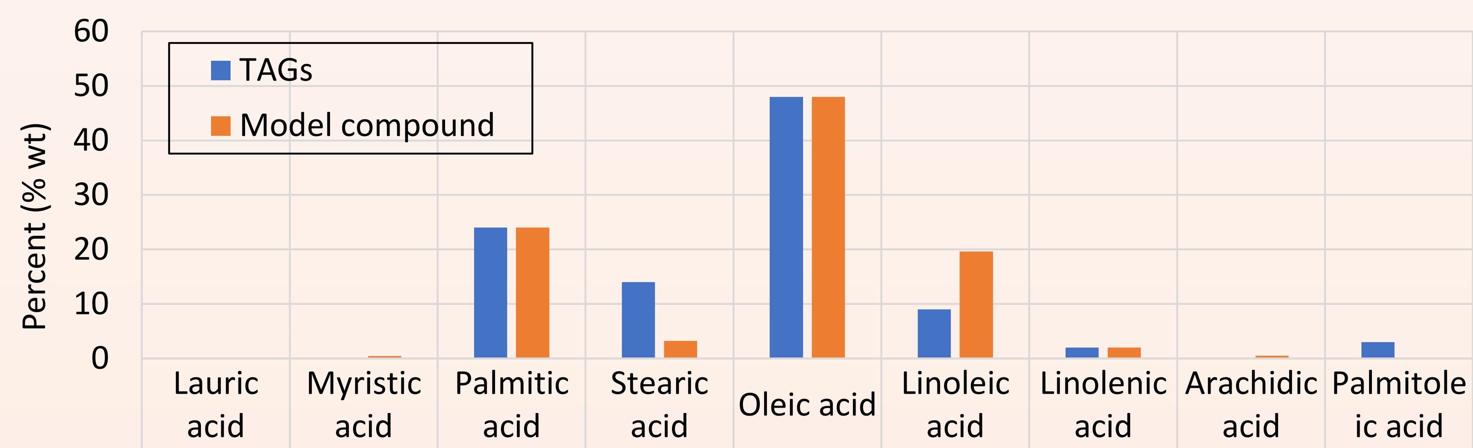
Table 1: Operating testing window

Results & Discussion

Feed:

Biogenic residues and wastes were gasified and the syngas was fermented to produce bio-based triacylglycerides (TAGs).
Due to the limited availability of the feedstock, the TAGs were simulated via a model compound.

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



	Lauric acid	Myristic acid	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid	Arachidic acid	Palmitoleic acid
TAGs	0.00	0.00	24.00	14.00	48.00	9.00	2.00	0.00	3.00
Model compound	0.09	0.43	24.00	3.25	48.00	19.61	2.00	0.51	0.00

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)

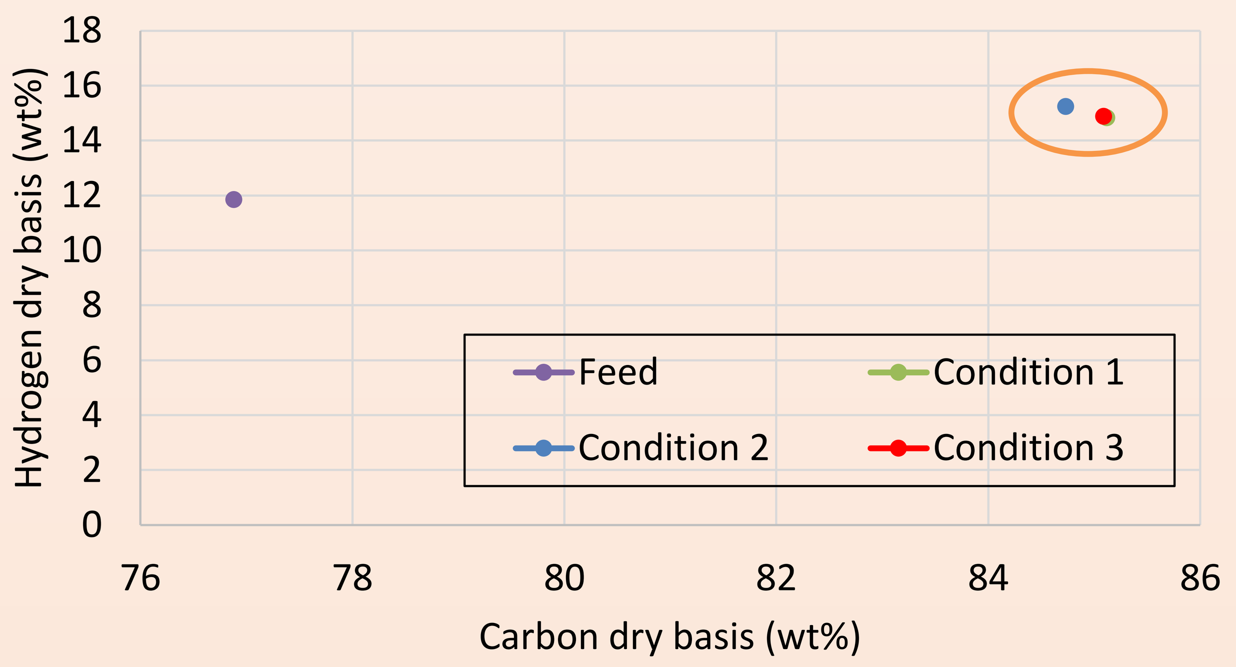


Figure 2: H and C elemental composition on dry basis of feeds and products after hydrotreatment

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

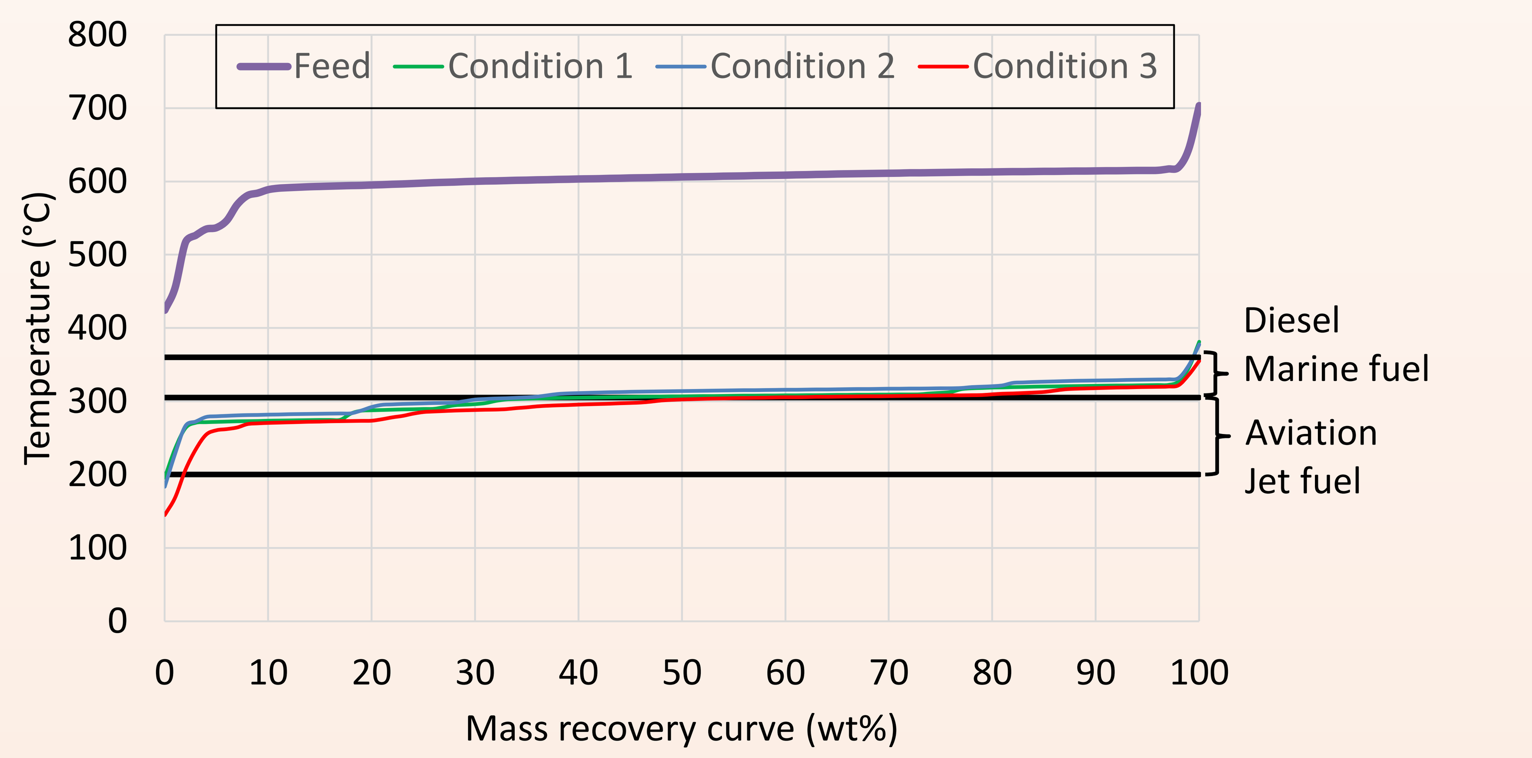


Figure 3: Feed & product mass recovery curve

- Increase of temperature favor hydrodeoxygenation reactions leading to a less oxygenate product but with higher H_2 consumption during the process (Figure 4)

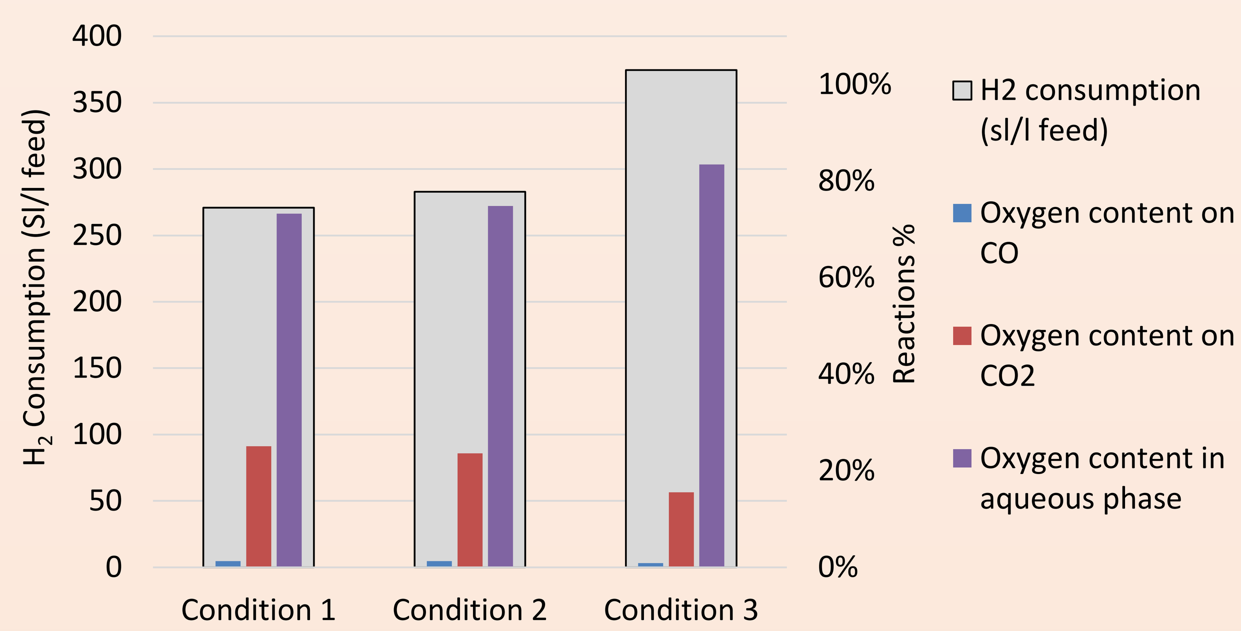


Figure 4: Oxygen distribution in gas and liquid products

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
- The oxygen was removed mostly via hydrodeoxygenation instead of decarbonylation a& decarboxylation reactions

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