# UPGRADING OF BIO-LIQUIDS FOR CO-PROCESSING IN STANDARD REFINERY UNITS

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## Introduction

The **BIOCOUP** project aims at the development of a **strategy** to allow biomass feedstocks to be co-fed to a conventional oil refinery. In this way, **bio-fuels** can be introduced into the market gradually and economically. The BIOCOUP project is divided into 6 sub-projects (SP's), each of them dedicated to different aspects of the process. SP2 is committed to the **upgrading of bio-liquids** and, at the current stage of the project, one of the processes considered is hydrodexoygenation (HDO) of pyrolysis oil.

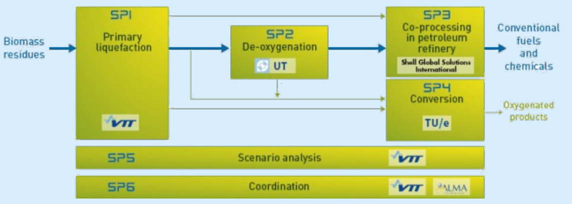


Figure 1: BIOCOUP sub-project structure.

## Hydrodeoxygenation of pyrolysis oil

Some properties of pyrolysis oil (mainly oxygen and water content) make its direct co-processing in standard refineries impossible. HDO is a process that reduces the oxygen content of pyrolysis oil and the resulting product might be co-fed to conventional refineries. HDO requires high temperatures and $H_2$ pressures and the presence of a catalyst. The SP2 partners study different aspects of the process, from catalyst development to scaling-up of the process.

### Catalyst development

(Boreskov Institute of Catalysis, BIC)

Development of a heterogeneous catalyst which is active and stable for HDO. Cheaper transition metal catalysts are preferred to noble metal catalysts.

Transition metal vs. Noble metal

### Catalyst screening on pyrolysis oil

(University of Groningen, RUG)

Batch testing of catalysts, both transition metal (TM) and noble metal (NM) based, with real pyrolysis oil. Evaluation of deoxygenation activity and physical properties of product.

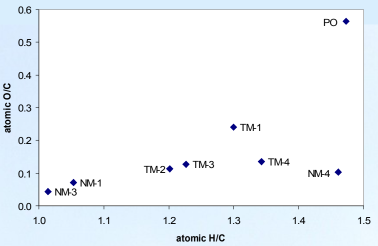


Figure 3: Van Krevelen diagram of HDO oils using different catalysts.

### Operation in a continuous set-up

(Biomass Technology Group, BTG)

Larger-scale sample production using a continuous HDO set-up. Miscibility test showed that HDO oil is miscible with fossil fuels. HDO oils are also tested for co-processing in lab scale refinery units.

Production of large samples

### Catalyst screening on model compounds

(Helsinki University of technology, TKK)

Testing of commercial and tailor-made catalysts (prepared by BIC and TKK) using model components. The deoxygenation kinetics of selected catalysts are determined.

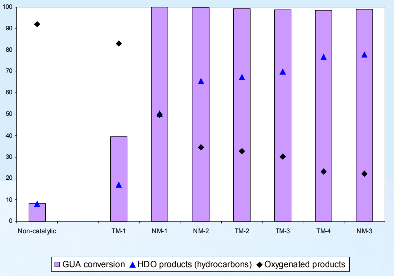


Figure 2: HDO batch experiments. Guaiacol conversion and selectivity towards hydrocarbons. TM – transition metal, NM - noble metal based catalysts.

### Pre-processing of pyrolysis oil

(University of Twente, T)

Development of a process to pre-treat pyrolysis oil reducing its oxygen content before HDO. High pressure thermal treatment (HPTT) is investigated. The oil obtained has a lower oxygen content.

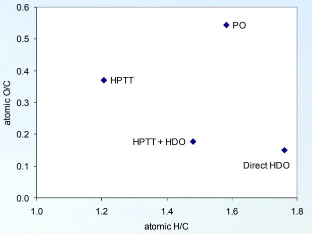


Figure 4: Van Krevelen diagram of direct HDO oil and HPTT + HDO oil. The de-oxygenation degree is similar.

## Conclusions

- Active HDO catalysts based on TM have been developed.
- These low-cost catalysts gave similar deoxygenation activity when compared to more expensive noble-metal catalysts, using both model compounds and pyrolysis oil.
- A pre-process to reduce the $H_2$ consumption during HDO is under development.
- Implementation of the fundamental findings in a larger scale set-up has been achieved.
- The advances achieved have been possible thanks to close collaboration between the partners involved in the project and the combined use of their individual expertise.

### Acknowledgement

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