BioMates

Public Summary of Deliverable D2.03: Report on the electrochemical hydrogen compressor and purifier performance during validation testing

Version 01

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Responsible author:	Wouter Dalhuijsen
Co- author(s):	Martijn Mulder
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1. Introducing BioMates

1.1. The BioMates Project

The BioMates project aspires in combining innovative 2nd generation biomass conversion technologies for the cost-effective production of *bio*-based inter*medi**ates* (BioMates) that can be further upgraded in existing oil refineries as renewable and reliable co-feedstocks. The resulting approach will allow minimisation of fossil energy requirements and therefore operating expense, minimization of capital expense as it will partially rely on underlying refinery conversion capacity, and increased bio-content of final transportation fuels.

The BioMates approach encompasses innovative non-food/non-feed biomass conversion technologies, including **ablative fast pyrolysis (AFP)** and single-stage **mild catalytic hydroprocessing (mild-HDT)** as main processes. Fast pyrolysis in-line-catalysis and fine-tuning of BioMates-properties are additional innovative steps that improve the conversion efficiency and cost of BioMates technology, as well as its quality, reliability and competitiveness. Incorporating **electrochemical H_2-compression** and the state-of-the-art **renewable H_2-production** technology as well as **optimal energy integration** completes the sustainable technical approach leading to improved sustainability and decreased fossil energy dependency. The overall BioMates-Concept is illustrated in Figure 1.

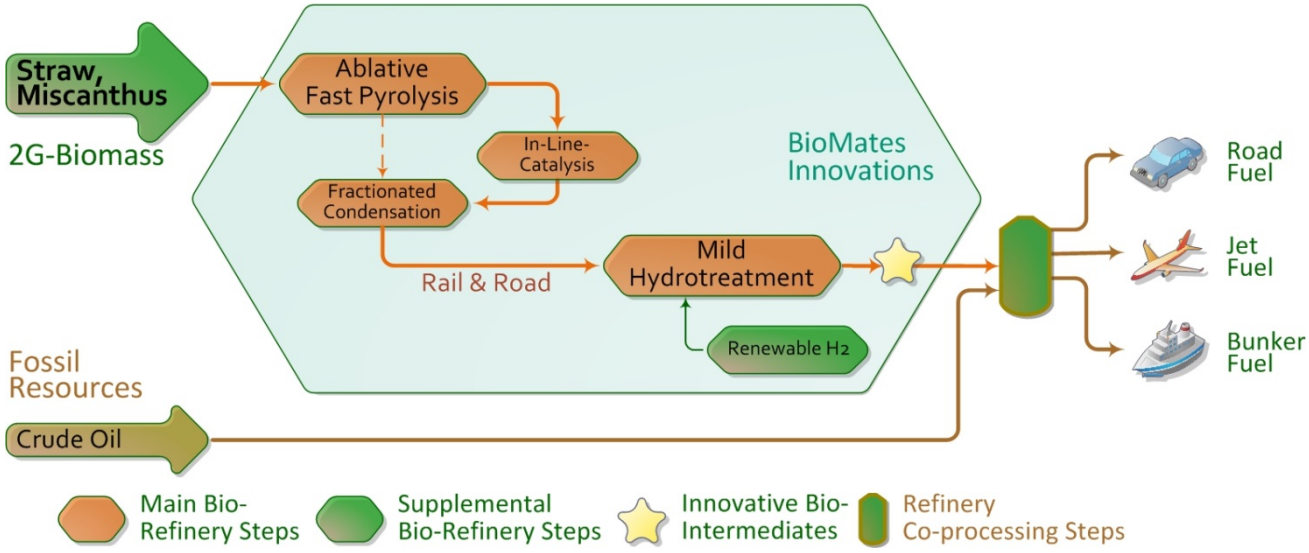

Figure 1: The BioMates-concept

The proposed technology aims to effectively convert residues and non-food/feed plants or commonly referred to as 2nd Generation (straw and short rotating coppice like miscanthus) biomass into high-quality bio-based intermediates (BioMates), of compatible characteristics with conventional refinery conversion units, allowing their direct and risk-free integration to any refinery towards the production of hybrid fuels.

1.2. European Commission support

The current framework strategy for a Resilient Energy European Union demands energy security and solidarity, a decarbonized economy and a fully-integrated and competitive pan-European energy market, intending to meet the ambitious 2020 and 2030 energy and climate targets /EC-2014a, EC-2014b/. Towards this goal, the European Commission is supporting the BioMates project for validating the proposed innovative technological pathway, in line with the objectives of the LCE-08-2016-2017 call /EC-2015/. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727463.

1.3. The BioMates team

The BioMates team comprises eight partners from industry, academia and research centres:

- Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT, Germany (Project Coordination) - *www.umsicht.fraunhofer.de*
- Centre for Research & Technology Hellas / CERTH - Chemical Process & Energy Resources Institute / CPERI, Greece - *http://www.cperi.certh.gr/*
- University of Chemistry and Technology Prague, Czech Republic - *http://www.vscht.cz*
- Imperial College London, United Kingdom *www.imperial.ac.uk*
- Institut für Energie und Umweltforschung Heidelberg GmbH / ifeu, Germany - *www.ifeu.de*
- Hydrogen Efficiency Technologies B.V. / HyET, Netherlands - *www.hyet.nl*
- RANIDO, s.r.o., Czech Republic *http://www.ranido.cz/*
- BP Europa SE, Germany www.bp.com/en/bp-europa-se.html

For additional information and contact details, please visit *www.biomates.eu*.

2. Disclaimer

This Deliverable report reflects only the authors' view; the European Commission and its responsible executive agency INEA are not responsible for any use that may be made of the information it contains.

3. Preface

The Deliverable summarised in this report comprises (a) the development and assembly of an innovative renewable H_2 system, and (b) its testing.

Developing and assembling the system had been done well in time and the corresponding Milestone MS06 "Innovative Renewable H_2 System Developed" had been reached one month ahead of the schedule, delivering the electrochemical H_2-compressor needed by the partners in overall WP2.

Anyhow, test runs were still ongoing at the end of November 2017, and we consented with the Project Officer to rather delay submission of this deliverable by one month than to omit valuable test results.

4. Public summary

For the project BioMates, HyET has developed an electrochemical hydrogen purification and compression system that can compress and recover hydrogen for the hydro-treatment of bio-oils, which is to be tested at the facilities of the Centre of Energy Research Thessaloniki (CERTH). This pilot scale test (25 NL/h) can be considered as an exploration of the EHC system integration in preparation for the full scale (180 NL/h) validation test later on.

A dedicated mobile test system was built to provide the required Balance of Plant for controlling process conditions for the newly developed EHC stack (see Figure 2).

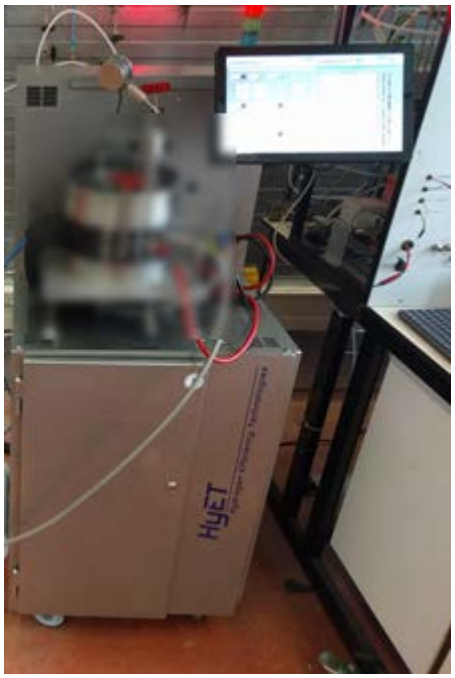

Figure 2: The newly developed EHC stack

The system can be operated by means of a touch screen connected to a PC, interfacing with the software and hardware process controller. Automated process sequences can be programmed in the control software. It has the capability to control both voltage and current of the EHC stack. The feed gas humidity can also be carefully controlled, which is critical for good EHC membrane performance.

Third party operability has been proven by a consortium partner of HyET in another R&D project.

The EHC platform HCS100 has shown compression to 210 and 410 bar, which is well above BioMates target.

The HCS100 platform applied as a purifier shows that recovery of >80 % of the hydrogen is possible at 95 %H_2/N_2-mixtures at the cost of a slightly higher driving voltage compared to pure H_2.

Further testing to combine purification and compression to 150 bar is ongoing, allowing for proper energy mapping at different current densities.

5. Literature

EC-2014a European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - A policy framework for climate and energy in the period from 2020 to 2030, COM(2014) 15 final, Brussels, 22.1.2014, http://www.europarl.europa.eu/meetdocs/2009_2014/documents/nest /dv/depa_20140212_06/depa_20140212_06en.pdf; *http://bit.ly/1LUcJKL*

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