BioMates

Public Summary of Deliverable D3.5:

Integrated process modelling, used for optimization

Version 01

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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.

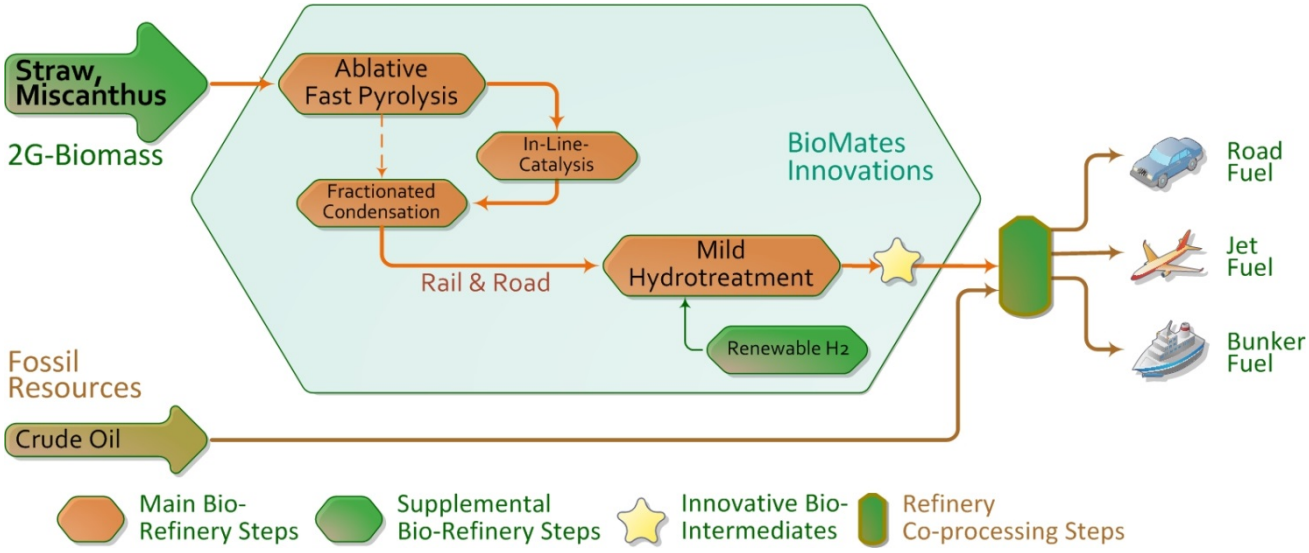

Figure 1: The BioMates-concept

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 [1,2]. 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 [3]. 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 nine 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*
- HyET Hydrogen B.V. / HyET, The 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
- Research Institutes of Sweden AB, Sweden - https://www.ri.se/en
- For additional information and contact details, please visit *www.biomates.eu*.

2. Preface

The Deliverable 3.5 "Integrated Process Model, used for optimization" provides an overview of the modelling efforts conducted for each section of the BioMates biorefinery concept. It is part of Task 3.4 "Consolidation and Validation of the simulation model" of Work Package 3. The scope of this deliverable is to present the individual process models of each section and incorporate each model into an overall process flowsheet as well as detect and investigate crucial operating parameters that affect the overall efficiency. The current document is the Public Summary of Deliverable 3.5. It presents an overview of the work done within Task 3.4 and summarizes the key points of this investigation.

3. Overview

The Deliverable 3.5 "Integrated Process Model, used for optimization" presents the modelling methodology of the overall BioMates biorefinery scheme. The proposed biorefinery consists of five major subsystems: pyrolysis, hydrotreating, gas conditioning (CO Methanation and H_2S Adsorption), hydrogen recirculation (electrochemical hydrogen compression) and renewable hydrogen production (water electrolysis). Modelling of each section has been conducted in AspenPlus™ in combination with calculators that incorporate the characteristics and specifications of each system section. The ultimate analysis of the initial biomass feedstock, as well as of the subsequent bio-products, serves as the basis for each calculation in the pyrolysis and hydrotreatment sections. The gas cleaning reactors are both simulated using an equilibrium approach, whereas the electrolysis section takes into consideration the basic aspects of the process. In addition, the developed electrochemical compression model incorporates the crucial phenomena occurring inside the electrochemical system (such as the individual over-voltages, hydrogen back diffusion, water management etc.) for the accurate simulation of the overall operation. The individual process models are consolidated into an overall process flowsheet and crucial parameters that affect the overall operation and efficiency are identified and investigated. Finally, the operation of the subsystems is validated by experimental tests and the overall results are presented for wheat/barley straw biomass as a starting point.

4. 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.

5. Literature

[1] 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*

[2] European Commission, Energy Union Package - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions and the European Investment Bank - A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy, COM(2015) 80 final, Brussels, 22.1.2014,http://eur-lex.europa.eu/resource.html?uri=cellar:1bd46c90-bdd4-11e4-bbe1-01aa75ed71a1.0001.03/DOC_1&format=PDF, *http://bit.ly/198SAUf*

[3] European Commission, LCE-08-2016-2017 "Development of next generation biofuel technologies", Publication date: 14 October 2015, https://ec.europa.eu/research/participants/portal/desktop/en/ opportunities/h2020/topics/lce-08-2016-2017.html, *http://bit.ly/2ndtvPc*