BioMates

RELIABLE BIO-BASED REFINERY INTERMEDIATES – BioMates

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TECHNICAL DEVELOPMENT AMBITION

Co-feeding lignocellulosic-biomass-derived intermediates into conventional refineries is a promising option to decarbonise automotive, aviation and bunker fuels and to reduce import-dependence of mobility. Of course, this strictly requires compatibility of bio-based intermediates with the refining process and especially consistency of the intermediates' properties. The ultimate goal of this approach is the production of fuels of high-quality abiding by the standards, with no intermediate-caused off-spec batches lowering the refineries' yields.

This defines the idea behind the BioMates-concept (Figure 1) consisting of two successive steps. The first step involves the ablative fast pyrolysis (AFP) for converting lignocellulosic feedstock (i.e. straw and miscanthus) to bio-oil with an innovative in-line-catalysis system integrated in the AFP-reactor that already optimises the bio-oil with respect to the later refinery application. The second step (optionally at another location) is mild hydrotreatment for upgrading the bio-oil into bio-based intermediates with compatible-to-refinery properties to be co-fed without any risk. This step is improved by applying solar-generated renewable make-up hydrogen and electrochemical compression of the hydrotreating recycled gas, lowering the upgrading costs and carbon footprint. Moreover, using the AFP technology enables a near-the-acre-operation of the first conversion step, reducing the bulk volume from straw to bio-oil by a factor of 10. This serves for a high transportation-efficiency and promotes rural job creation, while still enabling a near-refinery-operation of the second conversion step. Catalyst development, serving the specific needs of the BioMates process, will complete the project set-up.

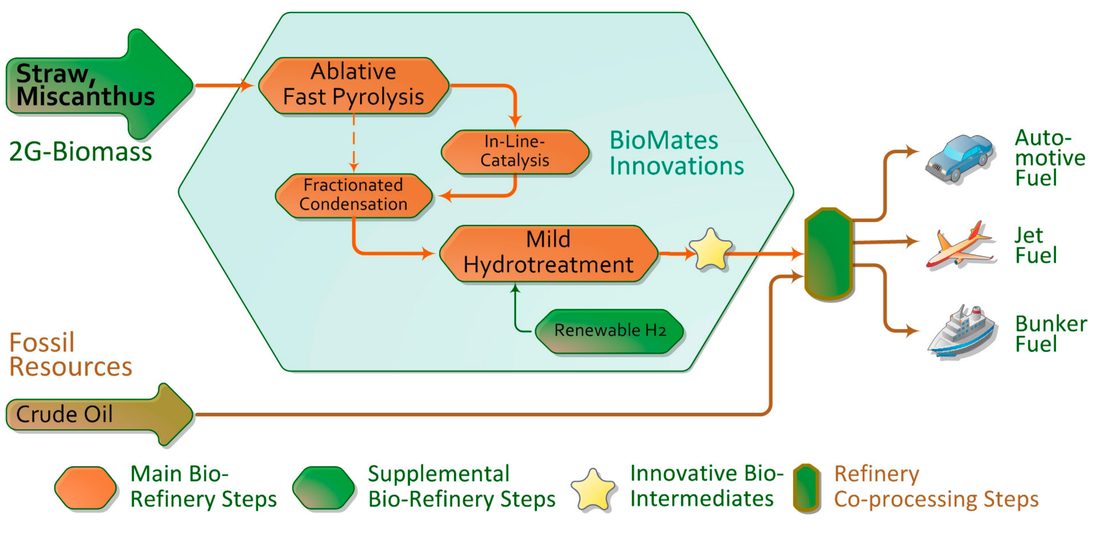

Fig. 1: Schematic illustration of the BioMates concept to produce bio-based intermediates for co-feeding in conventional refineries.

SUPPORTING ACTIVITIES

Various surveys concerning sustainability, economics, possible business plans and technical applicability of the generated intermediates within the refinery will prepare the later industrial-scale implementation. These surveys' results will be used for various feedback-loops to the technical R&D in order to rule out later industrial-scale-obstacles even before they really arise.

FIRST RESULTS

A sample of bio-oil produced from straw at Fraunhofer UMSICHT was used by UCTP for a series of hydrotreatment test runs with varying reaction temperature from 200 °C to 360 °C. A commercial hydrotreatment catalyst was used. Figure 2 shows the reduction in acid number with increasing reaction temperature but also an increasing amount of carbon-containing compounds in the gas exhaust from the reactor (indicating loss of carbon to gaseous species). At lower temperatures the organic phase still has higher density than water (staying below the water phase as shown for 300 °C), while at higher temperatures the density of organic product is below water density (organic phase above water, as for 360 °C).

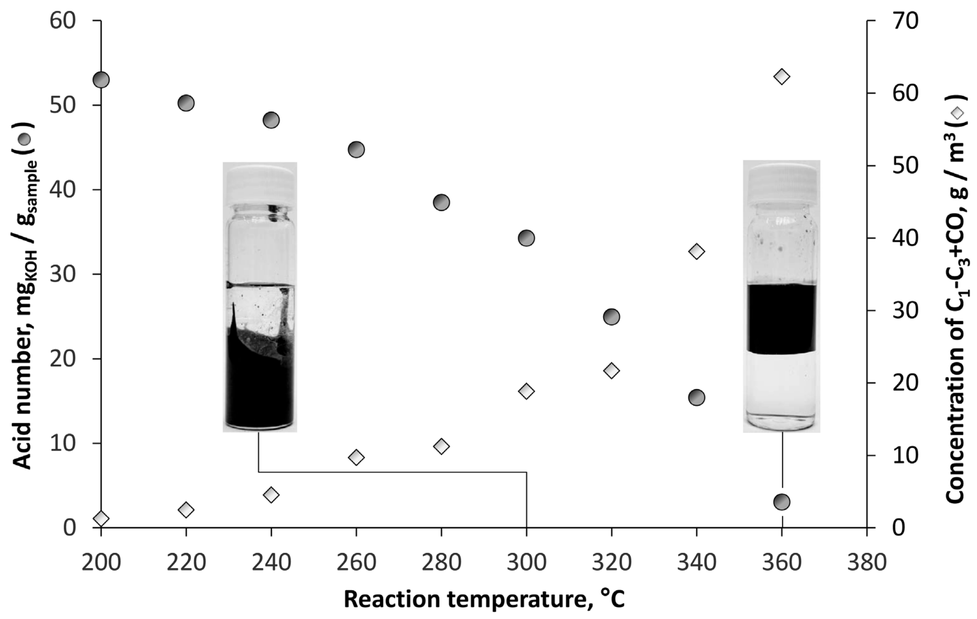

Fig. 2: Acid number of the treated bio-oil and gas-phase-concentration of CO + C_1-C_3-alkanes/olefins for increasing reaction temperatures of mild-HDT.

SUMMARY

The technical results achieved so far since the start of the project in October 2016 indicate that pyrolysis condensates can be produced from agricultural residues (straw) and energy crops (miscanthus) and that they can be processed with hydrogen atmosphere to give less acidic and less oxygen containing liquid products, which still have to prove their suitability for refinery co-feed in the remaining period of the project BioMates.

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