Aalto University
School of Chemical
Technology

CATALYTIC AQUEOUS-PHASE REFORMING OF BIOREFINERY WATER FRACTIONS

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The transition from fossil to sustainable and bio- based economy requires novel production processes for chemicals, energy and fuels. Switching from fossil to biomass sources as raw material has been the main difference between oil refineries and biorefinery plants. New feedstock with complex composition requires challenging adaptations of current processes which results in higher investment costs. Thus, product efficiency and value of all streams should be maximized in order to develop economically competitive processes.

Biorefineries are processes that produce chemicals, fuels, power and heat from biomass by thermochemical routes including gasification, pyrolysis and catalytic routes, or by biotechnical routes such as fermentation. Biomass-based fast pyrolysis and Fischer-Tropsch reactions have been extensively studied as promising processes for fuels and chemicals production from renewable biomass (Figure 1). In spite of the sustainable character of these technologies, the target products are accompanied by large water fractions with organic residues considered as waste streams. The organic compounds included in water fractions are contaminants and harmful substances for the environment. The disposal of those compounds reduces the efficiency of the processes, due to costly conditioning treatments in addition to upgradeable-products loss. In order to increase the product efficiency, the value of all streams should be maximized.

Currently, there is no efficient technology able to convert the diluted organic compounds in the water fractions of fast pyrolysis and Fischer-Tropsch processes. Catalytic aqueous-phase reforming (APR) of organic compounds is a highly potential route to obtain H_2 and CH_4 from these water fractions since no evaporation of water is needed. However, intrinsic challenges of the process, such as mass transfer limitations and low concentrations of the reactants as well as performance and stability of catalysts require significant research effort.

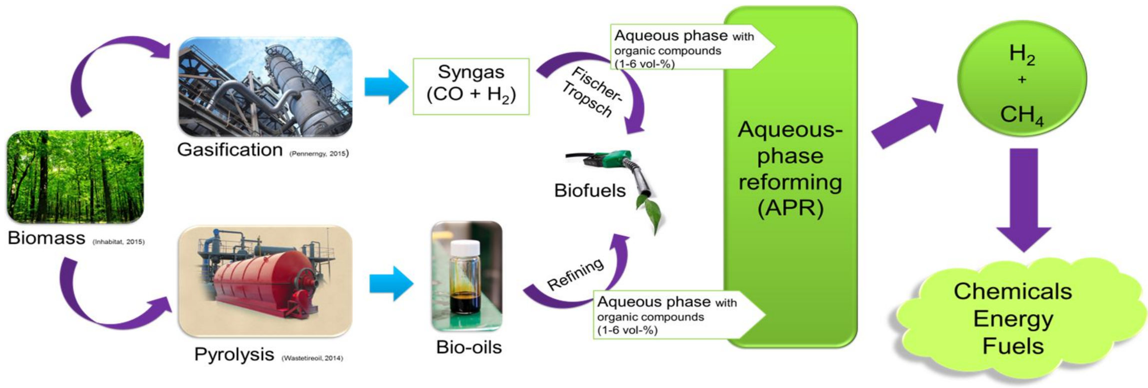

Figure 1. Biomass to chemicals, energy and fuels concept.

Catalyst preparation and characterization, aqueous phase-reforming experiments, and modelling and concept development are the main work packages of the project. These packages pursue development and screening of catalysts to reveal the effects of active metals, supports and promoters on catalyst performance to determine the optimal catalyst composition for APR. Furthermore, the project aims to design an intensified reactor as well as feasible process concept and process integration for APR.

International co-operation is a highlighted of AQUACAT. The scientific advisory board consist of professors from top level European universities where the postdoctoral researcher and the postgraduate student will perform part of their research (University of Twente and Imperial College London respectively). Moreover, the postgraduate student will perform part of the experimental work in Universidad de Zaragoza (Spain) through transactional access granted by BRISK.

Figure 2. Kick-off meeting. Board members in Imperial College London.