30 YEARS OF HYDROPROCESSING AT UCT PRAGUE: THE TRANSITION FROM PETROLEUM FEEDSTOCKS TO BIO-OILS FROM HTL AND PYROLYSIS

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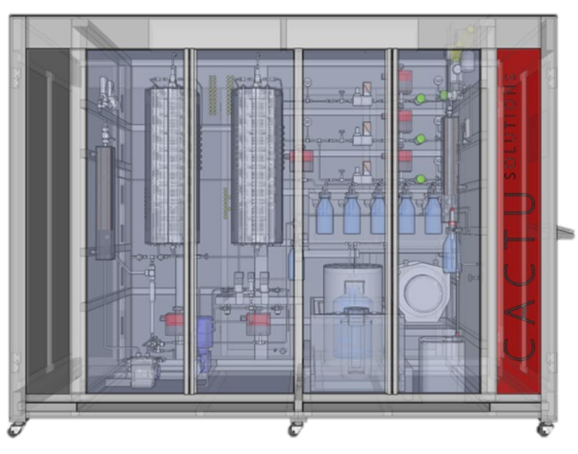
Hydroprocessing including hydrotreating and hydrocracking is a key refinery process commonly used for the upgrading of various petroleum fractions to produce transportation fuels or feedstocks for other processes. In this process, solid-state catalysts commonly based on sulfides of transition metals supported by alumina and/or aluminosilicate are applied. As most of the industrial-scale hydroprocessing units are operated in the flow reactor, the testing of catalyst activity or various feedstocks processing in the lab-scale fixed-bed continuous flow catalytic unit can perfectly simulate the industrial process, in contrast to batch-stirred autoclaves.
Our Department of Petroleum Technology and Alternative Fuels at the University of Chemistry and Technology, Prague investigates hydroprocessing for more than 30 years. We started with the hydrotreating (mainly HDS) of petroleum middle distillates and successfully solved all challenges connected with decreasing the limits of sulfur content in diesel fuel [1]. The transition to biofeedstocks started more than 15 years ago when we focused on vegetable oils and animal fats HDO [2] to hydrocarbon-based fuels. It is more than 7 years since we had to push our abilities to a new level starting with the study of hydrotreating (mostly HDO) of bio-based feedstocks like bio-oils derived from the ablative pyrolysis of straw or miscanthus [3]. It is almost two years since we started a collaboration with Aarhus university and deal with the upgrading of HTL biocrudes derived from cow manure and straw [4]. Since that time, we processed by hydrotreatment the HTL biocrudes from various feedstocks like waste cotton and textile, water treatment sludge and pyrolysis oils from waste tires and plastics [5]. We cooperate on this research with several refineries like Crossbridge Energy, BayernOil and Orlen Unipetrol. As each feedstock differs significantly, we had to make a corresponding modification of the catalytic unit.
In the meantime, the need for the hydrocracking of bio-based feedstocks at high pressures of up to 200 bar arose and the new hydrocracking unit was, therefore, built. The unit was equipped with a 6-heating zones furnace and 14 thermocouples in a catalyst bed for the perfect temperature control and monitoring and allowed to test the hydrotreating and hydrocracking catalyst bed in the same reactor. It was designed with respect to the processing of feedstocks which are solid at room temperature (e.g. paraffinic types). The unit was used e.g. for the hydrocracking of Fischer-Tropsch wax with a melting point of around 120 °C [6], isomerization of durene-based feedstock and high-pressure hydrotreating of biocrudes derived from water treatment sludge.



As new challenges are coming and we know that hydrotreating unit should be even more versatile and autonomous, we designed a new generation of catalytic unit (see figure) that should solve all your problems. At present we are building the demonstration two-reactor fully automated lab-scale unit equipped with an on-line GC for the analyzing of off-gas composition and continuous mixing and filtration of the feedstock. Each reactor is placed in an 8-zone furnace allowing perfect temperature control. The processing of viscous, high melting point and even unfiltered feedstocks at a wide range of flow rates 15-300 $g.h^{-1}$ will be possible. For more information about the unit, check our team (**CACTU Solutions)** website (www.cactu.eu). The poster presentation at the PyroliqII conference will monitor whole our journey.

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