LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 125, 9052 Gent, Belgium

Coach	**Supervisor(s)**	**Funding**
Ir. César Pernalete Dr. Pieter Janssens	Prof. Dr. Ir. Joris Thybaut	-

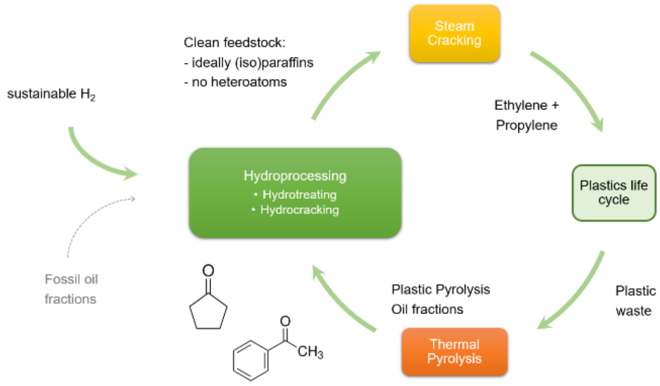
Experimental study of the hydroprocessing of non-aromatic and aromatic ketones

Aim

Investigate the kinetics of the hydroprocessing of non-aromatic and aromatic ketones via an experimental campaign in a CSTR type reactor.

Justification

The hydrocarbon industry will be facing important changes in the coming years. The inclusion of plastics and renewables in the hydrocarbon processing scenario will be managed by combining these circular feeds with fossil fractions in conventional processes such as hydroprocessing. Mixing pyrolysis oil from recycled plastic or biomass with fossil fractions as feed for hydrotreating/hydrocracking opens an opportunity to close the loop in the plastic production process. As described in the figure, in this scenario the hydroprocessing step ensures a clean feed for the steam cracker where ethylene and propylene are produced and later used to produce plastics.



The proportion of plastics and renewables derived feeds in the combined mixture is, in principle, limited because of potential negative impacts on the downstream processing. In particular, high concentration of oxygenated compounds that have been identified in pyrolysis oil can be detrimental in downstream processes. Aromatic and non-aromatic ketones such as cyclopentanone and acetophenone are some of these molecules identified in Pyrolysis Oil that are not present in fossil fractions and should be converted to ensure a clean feed for steam cracker.

Using an available set up at the LCT that combines a CSTR reactor with an on-line 1D GC, the goal of this thesis is to perform an experimental campaign to treat a Synthetic Pyrolysis Oil mixture including aromatic and non-aromatic ketones. Employed operating conditions need to allow the understanding the underlying kinetics present in the hydroprocessing of these compounds. The obtained results can later be used to propose a model that enables getting a more detailed understanding of the involved mechanism.

Program

1. Perform a literature review about the hydroprocessing of oxygenated compounds.
2. Plan the experiments to be execute in the Robinson Mahoney set-up.
3. Perform the experimental campaign.
4. Analyze feed and product samples using 1D chromatographic analysis.
5. Calculate the mass balance for each of the experiment.
6. Propose potential mechanisms describing the hydroprocessing of the studied compounds
7. (Optional) Develop and compare different kinetic models implementing the suggested mechanisms.

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