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The inhibition impact of aromatic admixture on alkane hydrocracking

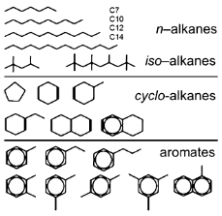
Aim

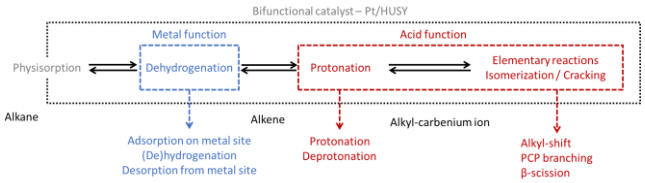
Understanding of the impact of aromatic admixture on alkane hydrocracking and comparison with cycloalkane admixture effect.

Justification

Hydrocarbon upgrading consists in converting heavy feedstock into lighter cuts that could be used to produce fuels or petro-chemical intermediates. The development of catalytic upgrading processes is required to fulfill contemporary techno-economic and environmental requirements by improving energy efficiency, increasing the selectivity in valuable products or integrating biomass as feedstock.

Hydrocracking represents one of the conventional conversion processes for upgrading the oil streams for their use as fuels. To do so, the hydrocarbon structure is rearranged in a hydrogen atmosphere either by isomerization or by cracking of the molecule. The reaction is catalysed by a bifunctional catalyst, containing a metal and an acid function.





The real industrial hydrocarbon feeds are, in general, complex mixtures of alkanes, cycloalkanes, aromatic and heterocyclic components, etc. This standard feed is hydrotreated prior the hydrocracking, resulting in presence of only some refractory aromatic components. However, most of the research done on hydrocracking assessed the reaction mechanism by single model alkane molecule feed or by feeds containing alkanes and cycloalkanes. Building further upon this, the present challenge is to investigate further impact of refractory aromatic components. The addition of aromatics is expected to have a preferential impact on metal active sites, due to saturation reactions. This effect is very likely much more prominent than the impact caused by cycloalkanes of comparable size. The particular focus of this thesis will be on experimental quantification of the impact of aromatic admixture on alkane hydrocracking and analysis of impacted phenomena related to both active sites.

Program

1 – Literature review : Introduction to the hydrocracking reaction, to the principle of ideal hydrocracking, and to cycloalkane admixture impact on alkane hydrocracking;

2 – Experimental campaign on high-throughput setup : The goal is to observe determine the impact of aromatic admixture on n-alkane hydrocracking. Experiments are to be planned systematically to meet the goals of the study.

3 – Analysis of the results, determination of the aromatic admixture impact on alkane hydrocracking and comparison with cycloalkane admixture effect.

Recommended literature

Weitkamp,J., *Catalytic Hydrocracking – Mechanisms and Versatility of the Process*, ChemCatChem 2012, 4, 292-306

Thybaut,J.W., Marin,G.B., Baron,G.V., Jacobs,P.A., Martens,J.A., Alkene Protonation Enthalpy Determination from Fundamental Kinetic Modeling of Alkane Hydroconversion on Pt/H-(US)Y-Zeolite, J.Catal. 2001, 202, 324-339

Guisnet,M., Fouche,V., *Isomerization of n-hexane on platinum dealuminated mordenite catalysts III. Influence of hydrocarbon impurities*, Appl.Catal, 1991. 71(2), 307-317

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