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A study of the catalytic hydrodenitrogenation of nitrogen-rich bio-oils using propylamine and propionitrile model reactants and supported nickel phosphide catalyst

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General overview

- The biomass raw material of second generation biofuel is either lignocellulosic material (carbohydrite polymer) or animal by-products (mainly protein, amino acid polymer)
- The first step of biomass processing is destruction of the polymer chain either in hydrolitic (acid, base, enzime) and/or thermal destruction.
- A preferable technology of thermal destruction is pyrolysis.

General overview

- Approximately 20 million tons/year animal by-products, meat and bone meal (MBM) in the EU 27 countries, 300 thousand tons/year in Hungary. Since 2001 its use as animal food additive is forbidden (BSE), MBM is considered as specific risk material that requires heat treatment prior to disposal or must be eliminated by co-combustion. Pyrolysis of MBM at 400-550°C gives biochar (~35 wt %), pyro-oil (~55 wt %) and gaseous products (~10 wt %).

Goal of the project

- Establishing scientific bases to the catalytic hydroconversion of pyro-oil obtained by pyrolysis of animal by-products, to hydrocabon liquid and ammonia.
- To clarify the hydrodenitrogenation (HDN) reaction network of aliphatic amines and nitriles over silica-supported nickel phosphide catalysts.

Conclusions

- It is possible to obtain high yields of hydrocarbon and ammonia product from N-containing organic compounds, such as pyro-oil from animal by-products by catalytic HDN.

- The Ni_2P/silica is active catalyst of the process. The reaction proceeds through secondary and tertiary amine intermediates.

- In contact with the reaction mixture the supported Ni_2P particles lose their defected structure and convert to more ordered crystals. The particles of defected and ordered structure have about the same size.

- The results obtained with the model reactants propylamine and propionitrile suggest that formation of dipropylamine by-product can be suppressed and high conversion to propane and ammonia can be achieved at 350-400 ^oC reaction temperature and moderate ($\leq$ 30 bar) H_2 partial pressures over Ni_2P/silica catalysts.

THANK YOU FOR YOUR ATTENTION

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