**Hydrodeoxygenation of bio-oil model compounds over the nickel phosphide catalysts**

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**Highlights**

* Detailed analysis of gas and liquid product of hydrodeoxygenation of model compounds
* Hydrodeoxygenation of model compounds
* Effect of temperature on hydrodeoxygenation of model compounds

**1. Introduction**

Multifarious efforts have been focused on the production of renewable and clean biofuels and chemicals to meet growing energy demand and environmental and sociopolitical concerns arising from a current heavy global dependence on fossil fuels. Biomass is considered as sustainable and abundant feedstock which can be effectively converted into liquid fuels via fast pyrolysis technologies. Unfortunately, although fast pyrolysis is a promising method to obtain bio-oil, the high content of oxygenated molecules (ketones, aldehydes, organic acids, furans, phenolic derivatives and lignin-derived oligomers) decrease its chemical and thermal instability [1]. It is unsuitable for direct use as a transportation fuel (or as a fuel additive) because of its low heating value and high corrosiveness caused by the presence of significant oxygenated compounds. These organic compounds are highly reactive, promoting the formation of ethers, acetals, hemiacetals and heavier organics through condensation reactions, resulting in some problem in bio-oil application, for example, coke formation. Therefore, it requires the investigators to improve the pyrolysis bio-oil to obtain an upgraded liquid fuel or some useful chemicals with proper properties which can be suitable for the global transport infrastructure.

In this paper, hydrodeoxygenation (HDO) experiments of the bio-oils model compounds upgrading reaction over the Ni2P/HZSM-5 and Ni2P/SiO2 will be studied. Here presents an experimental study of influence of different reaction parameters, such as feedstock state, residence time, reaction temperature and reaction pressure (H2 partial pressure) etc.

**2. Methods**

Supported nickel phosphide catalysts (Ni2P/HZSM-5 and Ni2P/SiO2) were prepared by incipient wetness impregnation and a temperature programmed reduction (TPR). The XRD and elemental analyzer was used to characterize the catalysts. The model compounds feedstock (acetic acid, 4-Ethylguaiacol) vapor phase was introduced into a continuous fix-bed reactor under the high hydrogen pressure. The liquid phase feedstock had been conducted in a batch reactor. The gas chromatography-mass spectrometer (GC-MS) and GC/FID will be used to analyzed the gas and liquid products to compare the results between different types of reaction.

**3. Results and discussion**

Figure 1 shows the main oxygenated compounds (CO, H2O) content in the gas and liquid products of acetic acid HDO reaction. It indicated that the CO content in the gas products was decreased with the reaction pressure increasing. This can be explained by the promotion of the reaction CO and H2 given that the H2 partial pressure was increased. In addition, figure 1 also shows that the moisture content increase due to the increasing of reaction pressure. It means that more oxygen was removed by the hydrogenation reaction.



**Figure 1.** The CO content in gas products and moisture content in the liquid products under different reaction pressure.

**4. Conclusions**

In this work, the HDO reaction of different model compounds where studied in different experimental conditions (temperature, contact time and pressure) and catalysts. Results show that the pressure of hydrogen has a conspicuous influence on the HDO reaction. It had a promoted effect on the hydrogenation. The liquid products moisture was higher using the Ni2P/HZSM-5 catalysts and relative lower using the Ni2P/SiO2 catalysts. It was possible that the conversion and products selectivity were higher when the HDO reaction took place in the continuous fix-bed reactor with the vapor phase hydrodeoxygenation of model compounds.

**References**

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