Study of the influence of zeolite and lignin type on the lignin pyrolysis products

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Introduction

The bio-oils obtained from lignin pyrolysis generally contain a large amount of oxygen-containing products and small amount of aromatic compounds. Accordingly, such bio-oils are corrosive, viscous and unstable and require further upgrading. Zeolites ZSM-5, BETA and Y have been reported as promising for softwood pyrolysis since they decrease the yield of oxygen-containing products and increase the yield of desirable aromatic compounds [1]. The present investigation was aimed to study NiO-containing zeolites (H-ZSM-5, H-BETA and H-Y) in the catalytic pyrolysis of Eucalyptus (EUC) and Hardwood lignin (HL).

Experimental

NiO/H-ZSM-5, NiO/H-BETA and NiO/H-Y were prepared by mechanochemical dry milling (MCDM) method [2]. The pyrolysis of EUC and HL were examined at 500 °C under N_2. GC and GC-MS were used to characterize pyrolysis products.

Results and Discussion

All studied catalysts increased the yield of aromatics and decreased the yield of oxygenates as compared to non-catalytic experiment for both lignin types. However, the catalytic activities are affected by zeolite structural features and by lignin type. The highest liquid and gas yield, and lowest coke was obtained with NiO/H-Y which also increased the amounts of desirable and decreased undesirable pyrolysis products. NiO/H-ZSM-5 gave the bio-oil with the highest amount of aromatics and the lowest amounts of oxygenates but it exhibits a low selectivity towards PAHs. A high yield of hydrogen was obtained with NiO/H-Y indicating a synergetic catalytic activity of NiO particles and H-Y.

Conclusions

The NiO-containing catalysts (H-ZSM-5, H-BETA and H-Y) prepared by MCDM method exhibit large specific surface areas and the presence of mainly Brönsted acid sites. The products obtained by an intermediate fast pyrolysis showed a dependence on both zeolite structural features and lignin origins suggesting HL as a more suitable feedstock.

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References

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