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Lignin-derived Propylphenols to Phenol and Propylene over Acidic Zeolites: Activity, Selectivity, and Stability

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PURPOSE OF THE ABSTRACT

The (hemi)cellulose fraction of lignocellulose has been comprehensively investigated to produce bulk chemicals. However, lignin, a heterogeneous alkyl-aromatic polymer, is usually left as a waste, which is underutilized to manufacture bulk chemicals. It was recently reported that reductive catalytic fractionation of lignocellulose can selectively obtain monomers (methoxylated propylphenols) with high yield.1 The monomers can be selectively converted into propylphenols (PPs) via hydrodeoxygenation. Although such an abundant of PPs can be yielded, the applications of them are limited up to now. Hence, in this work, we study the dealkylation of PPs to two bulk chemicals (i.e. phenol and propylene) using acidic zeolites.

4-n-propylphenol is selected as a prime substrate to study within this research. The thermodynamics of dealkylation is studied first to understand the reaction outcome. The nature of the active sites for dealkylation of PPs is investigated by using oxides with distinct surface properties. Kinetic studies are used to understand the activity of different active sites. Besides, the influence of the acid properties and porosity of zeolites on the activity of PPs dealkylation and the selectivity to phenol and propylene were comprehensive studied (Figure 1).2 The different catalytic performance of the tested zeolites can be attributed to the result of shape selective catalysis. Most importantly, the presence of steam in the stream is of crucial importance to maintain the activity of ZSM-5, which is investigated from kinetic and adsorption aspects. The deactivation mechanism of ZSM-5 and the reaction mechanism of dealkylation of PPs over acidic zeolites are explored. These results enable the design of acid catalyzed dealkylation catalysis and its process conditions, highlighting the challenges and opportunities that processing of second generation lignocellulosic biomass may offer.

FIGURES

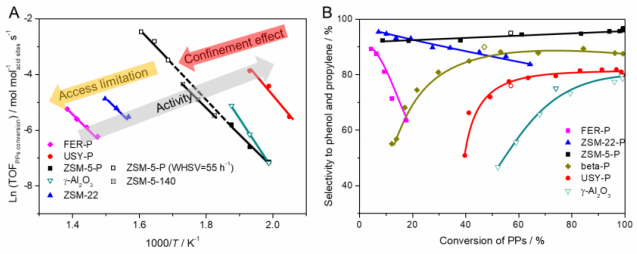

FIGURE 1

Figure 1

(A) The activity of different acidic zeolites (Si/Al=40); (B) The selectivity to phenol and propylene in dealkylation of propylphenols over acidic zeolites (Si/Al=140). WHSV=3.7 h-1. Water/PPs=6.

FIGURE 2

KEYWORDS

lignin | zeolite | shape selective | phenol

BIBLIOGRAPHY

[1] W. Schutyser, T. Renders, S. Van den Bosch, S. F. Koelewijn, G. T. Beckham and B. F. Sels, Chem. Soc. Rev. 47, 852-908,2018.

[2] Y. Liao, R. Zhong, E. Makshina, M. d'Halluin, Y. van Limbergen, D. Verboekend and B. F. Sels, ACS Catal., 8, 7861-7878, 2018.