Liquefaction of Lignosulfonate in Supercritical Ethanol Using Alumina-Supported NiMo Catalyst

Lignosulfonate was subjected to a reductive catalytic degradation in ethanol medium at 310 °C in the presence of alumina supported NiMo catalysts and H2. The liquid and solid products were analyzed with size exclusion chromatography (SEC), gas chromatography mass spectrometry (GC–MS), two-dimensional gas chromatography (GC × GC), heteronuclear single quantum coherence nuclear magnetic resonance (HSQC NMR) and elemental analysis. The highest oil yield and the lowest char yield obtained was 88 and 15 wt %, respectively. The liquefied species were mainly dimers and oligomers with minor yields of monomers. The catalyst was important for stabilization of reactive intermediates either by hydrogenation or coupling with ethanol. Simultaneous deoxygenation and desulfurization reactions took place in the presence of the catalyst; the oxygen and sulfur content in the oil fraction obtained after 4 h reaction time were 11.2 and 0.1 wt %, indicating considerable deoxygenation and desulfurization compared to the lignosulfonate feedstock (O, 30.8 wt %; S, 3.1 wt %). The effect of the reaction parameters such as temperature, reaction time and catalyst mass was studied. It was observed that by increasing the temperature from 260 to 310 °C the degradation increased, however, the SEC analysis showed that the degradation progressed only to a certain size range dimers to oligomers in the reaction temperatures studied. Investigating the effect of reaction time of 1, 2, 3, and 4 h indicated that degradation, deoxygenation, desulfurization and alkylation reactions progressed over time. The reusability of the catalyst without any pretreatment was confirmed by an almost constant oil yield in three repeated experiments with the same catalyst batch. The results show that alumina supported NiMo catalysts are very promising catalysts for conversion of lignosulfonate to liquid products.

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