Upgrading of Napier grass pyrolytic oil using microporous and hierarchical mesoporous zeolites: products distribution, composition and reaction pathways

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Figure 1: Schematic diagram of experimental set-up of pyrolytic oil deoxygenation
(a) Intensity (A.U) vs. 2θ (degree) for ZSM-5, 0.2HZSM-5, and 0.3HZSM-5.

(b) Volume (cm³/g STP) vs. Relative pressure (p/p₀) for ZSM-5, 0.2HZSM-5, and 0.3HZSM-5.
Figure 2: Characteristics of ZSM-5 and Modified ZSM-5. (a) XRD diffractogram, (b) Isotherms of N\textsubscript{2} adsorption/desorption, (c) BJH Pore size distribution (d) NH\textsubscript{3}-TPD temperature-programmed desorption curves analysis
Figure 3: SEM-EDX images of (a) ZSM-5, (b) 0.2HZSM-5 and (c) 0.3HZSM-5
Figure 4: Effect of catalyst on deoxygenation of bio-oil at 400°C. Feed: 30 g pyrolytic oil, catalyst loading: 2.0 wt%. Solid: char and tar. Values are the means (n = 3)
Figure 5: Simulated distillation using TGA. (a) Premium motor spirit-PMS, kerosene and diesel (b) Raw and upgraded organic phase pyrolytic oil. DFET, KFET and PMSFET: diesel, kerosene and PMS final evaporation temperature.
Figure 6: Selectivity of olefins and aromatic hydrocarbons
Figure 7: Summary of material, heating value and degree of deoxygenation.
Figure 8: Possible reaction pathways of thermal and catalytic ex-situ upgrading of pyrolytic oil. Component in the raw pyrolytic oil, intermediate products, desired products, undesired products.
Figure 9: Reusability of 0.3HZSM-5 on deoxygenation of pyrolytic oil at 400 °C. Catalyst loading (catalyst/pyrolytic oil): 4.0 wt%
Figure 10: Characteristics of 0.3HZSM-5 catalyst. SEM-EDX (a) fresh catalyst, (b) spent catalyst, (c) regenerated catalyst after 4 cycle, (d) diffractogram of fresh and regenerated sample.