

Conversion of Lignocelluloses using Solid Catalysts

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Lignocellulosics, a plant derived non-edible biomass is made up of cellulose (35-55%), hemicelluloses (25-35%) and lignin (15-25%). Thus far efforts are made into conversion of starch, cellulose and hemicellulose using homogeneous acids and enzymes.^{1,2} However, it was also shown that heterogeneous catalysts could convert cellulose.³ In the latest work from our group for the first time it was shown that selectively hemicelluloses can be converted to C5 sugars and furfural directly from bagasse (lignocellulosics, without separation of cellulose, hemicelluloses and lignin) using solid acid catalysts such as, zeolites and clays.⁴ It has been also shown that lignin can also be converted to aromatic monomers using solid acid catalysts. However, detailed characterization of the catalysts revealed that zeolites undergo structural change.⁵ Hence the objective of the work was to synthesize the stable catalysts.

For the conversion of hemicelluloses (scheme 1) tungsten, gallium or molybdenum incorporated silica catalysts with acidity are synthesized either by impregnation or sol-gel method. The catalysts were calcined at 500-800°C.

Scheme 1.: Hydrolysis of hemicellulose using solid acids.

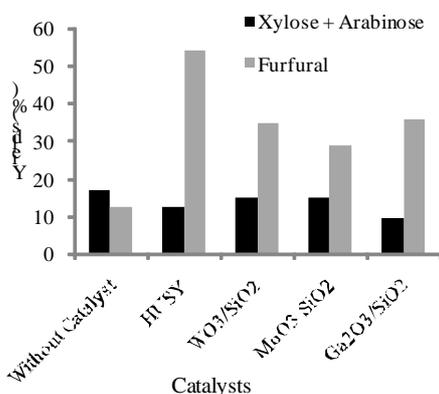


Fig. 1.: conversion of hemicellulose into C5 sugars and furfural. 170°C, 6 h, N₂ 20 bar

have found few of the stable catalysts. The catalysts are characterized with XRD, TPD-NH₃, and ICP. More discussions will be done during the presentation.

In a typical reaction, hemicellulose, solid acid catalyst, and solvent were charged in an autoclave and the reactions were performed at 170°C for varied time. The tungsten-silica and gallium-silica catalysts gave ca. 36% furfural yield after 6 h with ca. 90% conversion. Though molybdenum catalyst showed less activity than other catalysts but still it was active. The prepared catalysts showed activity less than the structured catalysts such as zeolites (Figure 1) however, the catalysts showed similar activity up to 6 recycles.

Conversion of hemicellulose and lignin using other solid acid catalysts is also carried out and we

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