Innovative alternatives in organosolv pulping process for better valorization of lignin under mild conditions

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Abstract (300 word limit)

Lignin is a plant-derived, amorphous, aromatic polymer and a potential source of carbon feedstock for generation of fuels and bulk chemicals. Nonetheless, the commercial use of lignin has not been favourably brought to the market due to its difficult processing as a raw material. Organosolv treatments are among the most effective pulping methods for lignin recovery. Most emphasis is usually given to the solvolysis of polysaccharide-lignin bonds. Hereby, we contributed to the catalytic hydrodeoxygenation of lignin model molecules to obtain functional aromatics. Reductive methods for the fractionations are game-changing only if the cost issues of hydrogen are resolved. This problem can be addressed through a mechanism of transfer of hydrogen coming from a cheap hydrogen-donor source. The study is aimed to understanding the level of pre-hydrogenation of lignin achievable in organosolv treatments. Beyond contributing to extraction and depolymerization of lignin, hydrogen transfer can reduce the hydrogen requirement in the more severe process of pyrolysis-hydrogenation of lignin to bio-oil. On synthesized lignin model molecules, the hydrodeoxygenation reaction was carried out under mild conditions in the presence of (Ni-Cu-Fe based) mixed oxides catalysts obtained by the thermal decomposition of layered double hydroxide (LDH). We observed that MeOH, as an efficient H-donor solvent can successfully cleave α-O-4 linkage, causing Meerwein–Ponndorf–Verley reduction and selective hydrodeoxygenation of the lignin model under mild condition, consequently generating products of solvolysis and successive hydrogenation. The catalytic activity was strongly dependent on the presence of copper in the system but the presence of nickel induces significant variations in the product distribution. The doping of CuO and NiO by iron undoubtedly affects the activity of the catalysts. The relative effectiveness of MPV hydrogenation and hydrogenolysis of phenylether bonds can orient the choice of the catalyst in a lignin organosolv environment to obtain products with different level of functionalisation.

Image

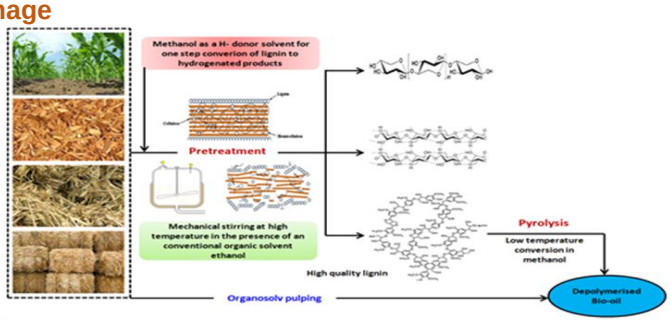


Figure 1 H-transfer pre-treatment from lignin for bio-oil

Recent Publications (minimum 5)

1. Awan IZ, Tanchoux N, Quignard F, Albonetti S, Cavani F, Di Renzo F (2019) Heterogeneous catalysis as a tool for production of functional aromatic compounds from lignin, in Albonetti S, Perathoner S, Quadrelli EA (Eds.), Horizons in Sustainable Industrial Chemistry and Catalysis, Elsevier, 178, Amsterdam (2019) 257-275.
2. Awan IZ, Khan AQ (2019) Recovery, Recrystallization, and grain-Growth. Journal of the Chemical Society of Pakistan. 41: 1-42.
3. Awan IZ, Khan AQ (2018) Corrosion-Occurrence and Prevention. Journal of the Chemical Society of Pakistan. 40: 602-655.
4. Awan IZ, Khan AQ (2018) Shape Memory Alloys. Journal of the Chemical Society of Pakistan. 40: 1-23.
5. Awan IZ, Khan AQ (2017) Precipitation from Solid Solutions. Journal of the Chemical Society of Pakistan. 39: 319-336.



Biography (150 word limit)

Dr. Iqra Zubair Awan has recently earned her PhD in Industrial Chemistry under an Erasmus Mundus Joint Doctorate programme in the group of Prof. Fabrizio Cavani at University of Bologna (Italy) and with Prof. Francesco Di Renzo at the Ecole Nationale Superieure de Chimie de Montpellier (France). Currently, she is working as an Assistant Professor in the department of Polymer Engineering and Technology, University of the Punjab, Lahore, Pakistan. Her PhD project was about the development of heterogeneous catalysis for the depolymerization of lignin to produce functional aromatics. To date, Iqra has 10 publications to her credit dedicated to material science and heterogeneous catalysis. She has presented her work at many national and international conferences. Her research interests include synthesis of materials for green chemistry, heterogeneous catalysis for sustainable energy and water purification technologies.

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Notes/Comments:

This research work is still in progress and the presentation may contain some new results that have not been described in the abstract.