THERMO-CHEMICAL CONVERSIONS OF BIOMASS – NEW TRENDS

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ABSTRACT

This contribution is based on the monograph entitled "Recent Advances in Thermochemical Conversion of Biomass", covering both general items as well as the primary processes, like fast pyrolysis, gasification, hydrothermal liquefaction, carbonization and secondary processes, like co-processing of bio-oil in fluidized catalytic cracking (FCC), Fischer-Tropsch synthesis and valorization of lignin[1].

Keywords: Biomass, Thermo-Chemical Conversion, New Trends

INTRODUCTION

The biorefinery concept with focus on thermo-chemical conversion will be discussed with respect to the advantages, and methods. Analytics regarding the reaction mechanisms will be presented along with new trends within artificial neural networks, plasma and catalytic pyrolysis of lignin-fractions, hydrothermal liquefaction as well as supercritical fluids for the catalytic thermo-chemical conversion of biomass. Finally, co-processing of upgraded bio oil in fluidized catalytic cracking (FCC) will be highlighted.

METHODS

Methods of the thermo-chemical conversion of biomass will be highlighted with focus on the formation of solid, liquid or gaseous components. which can be upgraded subsequently to valuable products. Examples to be discussed are: pyrolysis, gasification, combustion, torrefaction, hydrothermal liquefaction. In addition, upgrading via hydroprocessing, cracking, steam reforming, Fischer-Tropsch synthesis, hydropyrolysis, methanation and hydrothermal upgrading (HTU) will be addressed.

NEW TRENDS TO BE ADDRESSED

1. The use of artifical neural network models to predict the producer gas composition and the gas yield from biomass composition with only few operating parameters (like thermodynamic equilibrium models), while avoiding the high complexity of kinetic models, has been recognized as a very suitable tool.
2. Plasma pyrolysis as a process of reacting carbonaceous solids with limited amounts of oxygen at high temperatures using a high voltage electrical field in order to produce gas and solid products is regarded as an alternative process to the conventional pyrolysis.
3. The recirculation of pyrolysis non-condensible gases (NCGs) leads to an increase of the bio oil yield and reduction of the oxygen content.
4. Use of porous materials as pyrolysis catalysts for the production of bio oil from lignin fractions represents a new technology.

5. Hydrothermal liquefaction is a promising process for the valorization of biomass, especially high-moisture containing biomass.
6. The catalytic transformation of lignocellulosic biomass and their components over supported metal catalysts in supercritical water or supercritical carbon dioxide solvent is very effective.
7. Co-processing of upgraded bio oil in fluidized catalytic cracking (FCC): Catalysts specifically designed both for a more efficient upgrading of bio-oils and tuning existing FCC catalysts to adapt them to the co-processing requirements - hierarchical porous catalysts are promising candidates which are supposed to meet those requirements.

CONCLUSIONS

Challenges related to the thermo-chemical conversion of biomass are addressed with respect to innovations in catalyst design, process conditions, mechanistic understanding of the thermo-chemical conversion of biomass as well as the design of reactors for the high-throughput evaluation of suitable catalysts and advanced spectroscopic methods for monitoring ultra-fast catalytic processes dedicated to the thermo-chemical conversion of biomass.

REFERENCES

[1] A. Pandey, T. Bhaskar, M. Stöcker, R. K. Sukumaran (Eds.), *Recent Advances in Thermochemical Conversion of Biomass*, Elsevier, Amsterdam, **2015**.