

From Waste to Advanced Biofuels. Experiences and Challenges

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Abstract

The presentation tries to give an overview of the R&D experience on the development of thermochemical research projects, based on pyrolysis and gasification processes. The projects consider different types of residues, i.e., lignocellulosic, RDF from MSW, black liquor from a pulp a paper mill, meat and bone meal, sewage sludge and textile.

The drivers, during four decades, have been the generation of renewable energy and to obtain high value bio-based molecules and products. To achieve these objectives different synergetic processes have been designed to address the processes pathways to the interest of the market and to achieve environmental, sustainable and economic real plants.

The processes have followed a scaling up strategy, from TRL 3-4 up to 7. Participation of national and international industrial companies has been essential during the scale up of the installations. For this reason, the technological challenges will be analyzed from an engineering point of view in order to achieve a stable and continuous run-up of the plants.

The presentation will also pay attention to the scientific results on obtaining products from pyrolytic lignin. More specifically, the bio-oil obtained from biomass pyrolysis has great potential for several applications after being upgraded and refined, for example to generate additives to blending biodiesel and biokerosene to get a biofuel for the heavy transport.

At the present the research developed at the Thermochemical Process Group is focused on establishing a method for separating bio-oil into different fractions based on polarity and molecular size to extract phenolic and polyphenolic compounds with antioxidant properties. The fractions are analyzed using various spectroscopic and chromatographic techniques, such as GC/MS, FTIR, UV-vis, SEC, DOSY-NMR, ¹³C-NMR, and ³¹P-NMR. The antioxidant properties of these fractions are being tested by examining their ability to improve the oxidative stability of biodiesel.



Saccharide derived products remained in water-soluble/dichloromethane insoluble fractions. Pyrolysis lignin remained in the water-insoluble/dichloromethane insoluble fractions that showed good antioxidant potential despite its low solubility in biodiesel. Dichloromethane efficiently extracted phenolic compounds from the raw bio-oil, which are efficiently fractionated by semi-preparative Size Exclusion Chromatography. The subfractions with higher masses did not show good antioxidant abilities, which was related to the low hydroxy group content. Fractions with lower molecular weight (in the order of monomers and dimers) outperformed the greatest solubility and antioxidant potential of the crude bio-oil for biodiesel.