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In-situ upgrading of *Eucalyptus* woodchips fast-pyrolysis bio-oil using metal oxide/h-ZSM-5 catalysts

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The viability, sustainability, and overall commercial readiness of biofuels are still a matter of intense debate. While the potential benefits of replacing fossil fuels by liquids from renewable sources are obvious, substantial barriers for implementation must still be overcome. Biomass forestry and agricultural residues can be thermally decomposed via fast-pyrolysis to maximize the production of bio-oil. This bio-oil offers advantages in terms of storage, transport and flexibility in applications like fuels for transportation. Nevertheless, this application is still in a relatively early stage of development, and fundamental understanding of the thermal decomposition behavior of biomass during fast-pyrolysis is crucial to control the end-product composition. Bio-oil obtained by conventional no-catalytic fast-pyrolysis is formed by complex mixtures of species derived from the fragmentation of the three main components of the biomass (cellulose, hemicellulose and lignin), and it contains a high oxygen concentration (35-40 wt.%), acid pH and water contents between 20-50% wt. Catalytic fast-pyrolysis can promote partial deoxygenation reactions that could proceed by different pathways: Dehydration, decarbonylation and decarboxylation, leading to the H_2O, CO and CO_2 formation, respectively. In this work, catalytic and no-catalytic fast-pyrolysis of Eucalyptus woodchips has been carried out at a lab-scale setup. For catalytic tests, nanostructured materials having mild acidic properties and a high accessibility, such as, h-ZSM5 zeolite, have been employed. The catalytic properties of these materials for biomass catalytic pyrolysis have been also modified and adjusted by incorporation of different metal oxides. Likewise, Pd-containing h-ZSM5 zeolite has been tested. The catalysts activity has been analyzed in terms of their properties for bio-oil deoxygenation in comparison with those results obtained for no-catalytic tests. For that purpose, several parameters like: mass products yield (gas, char, coke and bio-oil (bio-oil+H_2O); gas composition (H_2, CO, CO_2 and C_1-C_3); bio-oil elemental analysis and H_2O content, among others, have been determined. The catalysts used in the present work, gave rise to an increase of the gas yield, mostly due to the higher production of both CO (from 3.5 to 6.4-10.8 wt%) and CO_2 (from 8.2 to 10.9-15.9 wt%). On the other hand, two phases can be visibly distinguished in the bio-oil fraction, organic and aqueous, as a consequence of its higher H_2O content, changing from 26.9 to 33.8-41.1 wt% when h-ZSM5 or metal/h-ZSM5 catalyst bed was installed into the reactor. All of these resulted in partially deoxygenated bio-oils, whose oxygen contents decreased from 37.3 to 27.5-32.3 wt%; but to the detriment also of the bio-oil yield, which decreased from 42.5 to 26.1-30.7 wt.%.

Biography

Patricia Pizarro completed her academic degree in Chemical Engineering in 1999 at Complutense University of Madrid. After that, she joined Rey Juan Carlos University where she received her PhD in 2005 with the Extraordinary Doctorate Award. Currently, she is working as an Associate Professor at the Chemical and Environmental Engineering Group of Rey Juan Carlos University and as an Associate Researcher at IMDEA Energy Institute (Móstoles, Madrid). Her research is mainly focused on the design of heterogeneous catalysts and materials for different chemical processes such as hydrogen production, energy storage and biofuels generation. She is co-author of 30 scientific publications; she has presented 58 communications to national and international conferences and has participated in 22 research projects.

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