Multi-valorisation of corn cob as received in the bioenergy route: Application in the Colombian Caribbean region

Rafael Gomez [1] , *Jesus Humanez*[1], *Antonio Bula*[2], *Diego Camargo-Trillos*[1]*

[1]Department of Mechanical Engineering, Universidad Pontificia Bolivariana Seccional Montería, Colombia
[2]Mechanical Engineering Department, Universidad del Norte, Colombia

*diego.camargo@upb.edu.co

Corncob is one of the most abundant agro-industrial wastes globally. It represents a bioenergy feedstock of 1500–5500 million tons per year. The shape and size of the corncob are suitable for gasification without pre-treatment (size reduction, densification, or drying) in a downdraft gasifier. At this route of bioenergy valorization, the biomass is transformed into three by-products syngas, bio-oil, and biochar. However, its volatile content (about 80% DAF), and inorganic composition (high concentration of K) represent a challenge to adopt biomass as a source of bioenergy. In the present work, we summarized the most significant advantages in a multi-valorization of corn cob gasification, focusing on three aspects: 1. Increase the hydrogen yield in the syngas 2. Measure the intrinsic kinetics of biochar gasification to model the nanoporous evolution and 3. Evaluate the nanoporous biogenic oxides' recovery from biochar.

An analysis of variance of four experimental treatments was used to determine the main statistical and interactive effects on the syngas composition, hydrogen yield (yH2), syngas lower heating value (LHVgas), and cold gas efficiency (CGE). Results reveal the highest gasification performance achieved hydrogen production yields of 310 Nml/g, an LHVgas value of 4.8 MJ/Nm3, and cold gas efficiency of 59.18% with steam and CaCO3.

The heterogeneous intrinsic kinetics of CO_2 and steam gasification of corncob biochar is measured by a methodology that develops the TGA analysis with a fitting to a multimodal porous size distribution (PSD) with random capillary. The average activation energies and pre-exponential factor obtained by parametric fitting of the model concerning the evolution of the conversion for CO_2 gasification the intrinsic kinetic parameters were ΔE=207. 28kJ/mol and A_0 =22.94 µg/m2 s while Steam revealed ΔE=113.8kJ/mol and 13.43 µg/m2 s.

Two biochar samples from different thermochemical conversions of corncob were treated by hydrochloric acid concentration between 0 to 10% w/w and subsequently oxidized at a temperature between 350-750°C. The biochar and biochar oxides' physicochemical characteristics were realized employing ultimate analysis, specific surface ABET, NLDFT pore size distribution, XRF, and SEM micrograph analysis with EDS. The biochar treatment allowed 41.2% of raw biogenic nanostructure recovery with a specific surface area up 25 m^2 g^{-1} from corncob biochar .

( ) Sistemas de producción agrícola
(x) Gestión de Recursos Naturales
( ) Gestión y Cultura Ambiental
( ) Tecnologías Electrónicas Aplicadas
(x) Charla
(x) Poster