World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Analysis of the Potential of Biomass Residues for Energy Production and Applications in New Materials

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Abstract : The generation of bioenergy is one of the oldest and simplest biomass applications and is one of the safest options for minimizing emissions of greenhouse gasses and replace the use of fossil fuels. In addition, the increasing development of technologies for energy biomass conversion parallel to the advancement of research in biotechnology and engineering has enabled new opportunities for exploitation of biomass. Agricultural residues offer great potential for energy use, and Brazil is in a prominent position in the production and export of agricultural products such as banana and rice. Despite the economic importance of the growth prospects of these activities and the increasing of the agricultural waste, they are rarely explored for energy and production of new materials. Brazil products almost 10.5 million tons/year of rice husk and 26.8 million tons/year of banana stem. Thereby, the aim of this study was to analysis the potential of biomass residues for energy production and applications in new materials. Rice husk (specify the type) and banana stem (specify the type) were characterized by physicochemical analyses using the following parameters: organic carbon, nitrogen (NTK), proximate analyses, FT-IR spectroscopy, thermogravimetric analyses (TG), calorific values and silica content. Rice husk and banana stem presented attractive superior calorific (from 11.5 to 13.7MJ/kg), and they may be compared to vegetal coal (21.25 MJ/kg). These results are due to the high organic matter content. According to the proximate analysis, biomass has high carbon content (fixed and volatile) and low moisture and ash content. In addition, data obtained by Walkley–Black method point out that most of the carbon present in the rice husk (50.5 wt%) and in banana stalk (35.5 wt%) should be understood as organic carbon (readily oxidizable). Organic matter was also detected by Kjeldahl method which gives the values of nitrogen (especially on the organic form) for both residues: 3.8 and 4.7 g/kg of rice husk and banana stem respectively. TG and DSC analyses support the previous results, as they can provide information about the thermal stability of the samples allowing a correlation between thermal behavior and chemical composition. According to the thermogravimetric curves, there were two main stages of mass-losses. The first and smaller one occurred below 100 °C, which was suitable for water losses and the second event occurred between 200 and 500 °C which indicates decomposition of the organic matter. At this broad peak, the main loss was between 250-350 °C, and it is because of sugar decomposition (components readily oxidizable). Above 350 °C, mass loss of the biomass may be associated with lignin decomposition. Spectroscopic characterization just provided qualitative information about the organic matter, but spectra have shown absorption bands around 1030 cm-1 which may be identified as species containing silicon. This result is expected for the rice husk and deserves further investigation to the stalk of banana, as it can bring a different perspective for this biomass residue.

Keywords : rice husk, banana stem, bioenergy, renewable feedstock
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020