Thermochemical conversion of Sugarcane bagasse as bioenergy resource

Leandro C. de Morais[1*], Amanda A.D. Maia[2], André H. Rosa[3]

1. PhD Assistant Professor, Institute of Science and Technology – UNESP campus de Sorocaba; leandro@sorocaba.unesp.br
2. Environmental Science PhD Student, Institute of Science and Technology – UNESP campus de Sorocaba
3. PhD Adjunct Professor, Institute of Science and Technology – UNESP campus de Sorocaba

Key words: *sugarcane bagasse, bioenergy, thermal analysis*

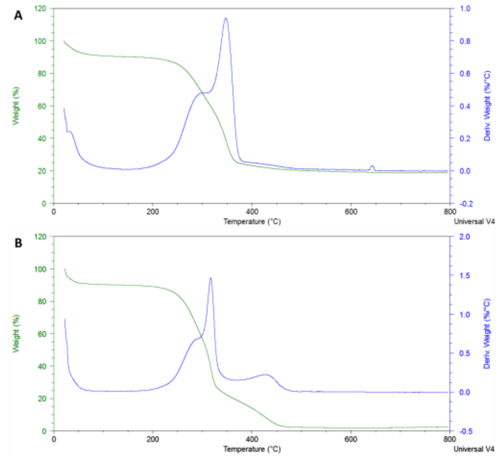
Introduction

The sugarcane bagasse (SCB) is an abundant lignocellulosic biomass[1]. Approximately, one third of global sugarcane is produced in Brazil, about 200 million tons of bagasse generated per year[2]. Bioenergy production is based in biomass uses studied[3]. The quality and quantity of bioenergy depend on the chemical composition and the reaction conditions of biomass[4]. Biomass can be converted into useful forms of energy using thermo-chemical because of high efficiency conversion to gaseous, liquid and solid products under thermal conditions[5]. The aim of this study was to determine thermal decomposition and degradation of SCB, an agro industrial residue used at bioenergy production.

Results and Discussion

Thermal analysis were carried out utilizing heating rate of 7.5 °C/min in a simultaneous DSC-TGA equipment, TA Instruments, model SDT Q600, from 25 °C to 800 °C. Air and nitrogen was used as purge gas at a 120 ml/min flow rate. About (1.5 mg) of the biomass were used in alumina pans. The DTG trends that were obtained under oxidising atmosphere were different from the pyrolysis curves showing higher reaction rates for the former. The biomass decomposition involved different stages as the water evaporation; devolatilization of thermally labile and more stable volatiles; carbonates and biochar formation. At the thermal degradation is possible to see three step weight losses as moisture evaporation, oxidative degradation and combustion of biochar. Thermal decomposition and degradation for biomass samples initiated at 236 °C, 210 °C and these variations in initial temperatures have been related to the differences in the elemental and chemical compositions in degradation and decomposition processes. The thermal degradation of sugarcane bagasse also depends on the mass ratio of its main components, as hemicellulose, cellulose and lignin. The temperature range of hemicellulose decomposition is from 190 °C to 300 °C, cellulose decomposes within the temperature range from 250 °C to 350 °C and lignin decomposition in comparison with that of hemicellulose and cellulose is broader, from 190 °C to 500 °C. The total % weight losses at the end temperature of 800 °C were 82.17% and 97.76% for the SCB at nitrogen and air atmosphere, respectively. Total weight loss was higher in those samples which have higher volatile matter and lower ash content.

Figure 1. TG and DTG curves of SCB in nitrogen (A) and air (B) atmosphere at heating rate of 7.5 °/min.



Conclusions

The behavior understanding of SCB during thermal decomposition and degradation allowed to known the thermochemical conversion of this biomass. Promoting advances at bioenergy production.

Acknowledgements

The authors acknowledge the financial support provided by Brazilian Research Agencies: FAPESP, CNPq and CAPES.

1. BIZZO, W. A. et al. The generation of residual biomass during the production of bio-ethanol from sugarcane, its characterization and its use in energy production. **Renewable and Sustainable Energy Reviews**, v. 29, p. 589–603, jan. 2014.
2. SANTOS, V. E. N. et al. Chemicals , electricity and fuels from biore fi neries processing Brazil ' s sugarcane bagasse : Production recipes and minimum selling prices. **Renewable and Sustainable Energy Reviews**, v. 53, p. 1443–1458, 2016.
3. JOENSUU, K.; SINKKO, T. Environmental sustainability and improvement options for agribiomass chains : Straw and turnip rape. **Biomass and Bioenergy**, v. 83, p. 1–7, 2015.
4. MAIA, A. A. D.; MORAIS, L. C. DE. Kinetic parameters of red pepper waste as biomass to solid biofuel. **Bioresource Technology**, v. 204, p. 157–163, 2016.
5. MUNIR, S. et al. Thermal analysis and devolatilization kinetics of cotton stalk, sugar cane bagasse and shea meal under nitrogen and air atmospheres. **Bioresource technology**, v. 100, n. 3, p. 1413–8, 2009.