Analysis of the Gaseous Emissions and the Residues Generated by the Combustion of Biomasses in a Drop Tube Furnace (DTF)

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Some of the environmental problems are caused by gaseous emissions from thermal processes, mainly by the burning of fossil fuels. Several alternatives to reduce such emissions have been discussed worldwide and the use of biofuels is a promising one. This study provides information of five lignocellulosic materials, namely pine sawdust, sugarcane bagasse, coffee and rice husks, and *tucumã* seeds to be used as biofuels in thermochemical processes. Particular attention is devoted to the residues and gaseous emissions (CO, CO_2, SO_2 and NO) generated by the biomasses combustion process in a Drop Tube Furnace (DTF). The DTF is a laboratorial reactor scale that consists of an electrically heated vertical silica tube of 400 mm length and 60 mm inner diameter. Combustion experiments were performed in triplicate for each sample and the gaseous emissions were continuously measured by a set of gases analyzer. A 1.5 L min^{-1} air upflow rate and 0.3 g min^{-1} mass flow were applied and the temperature was maintained at 1000°C. Thermogravimetry (TGA), Scanning Electron Microscopy (SEM images) and Energy Dispersive Spectroscopy (EDS analysis) were used for the physical-chemical characterization of both *in natura* biomasses and the residues generated from the combustion. The results show that CO_2 emissions ranged between 11 and 14 mg Nm^{-3} g^{-1}. Sugarcane bagasse showed the lowest limits of SO_2 and NO emissions (31 and 11 mg Nm^{-3} g^{-1}, respectively) and *tucumã* seeds provided the lowest values of CO emissions (2540 mg Nm^{-3} g^{-1}). TG/DTG curves of the solid residues aided in diagnosing the performance of the DTF combustion experiments. According to the results, the organic matter present in the residues varied from 4 to 72%, which shows the efficiency of the combustion process widely varies in function of the type of biomass used. The chemical composition of the residues showed different proportions of inorganic elements (Si, K, Na, S, Cl, P, Ca, Mg, Cu, Zn and Fe) are present in the residues, which also demonstrates that individual behavior is a consequence of the diversity of the biomass properties. The knowledge of some leading trends is important for the understanding that generalizations of processes cannot be applied when different biomasses are used.