Morphological changes on sugar cane bagasse as a consequence of dilute acid and base pretreatments

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Chemical pretreatments based on sulfuric acid (H_2SO_4) and sodium hydroxide (NaOH) solutions were applied to sugar cane bagasse and the resulting morphological changes were evaluated. Pretreatments are used to partially separate cellulose from the other cell wall components, and to improve the yield of the following hydrolysis and fermentation steps for ethanol production. Dried bagasse is first treated with a 1% H_2SO_4 solution (120°C during 1h), then rinsed with water and dried. Then, it is submitted to solutions with increasing NaOH contents (0.25, 0.5, 1.0, 2.0, 3.0 and 4.0 % w/v) at 120°C during 1h, followed by rinsing and drying in oven.

Images obtained by scanning electron microscopy revealed two main morphological features on the raw bagasse: fiber structures and pith. Both contain bundles of cellulose fibers bound together by hemicellulose and lignin. Hemicellulose major fraction (80%) is removed with the acid pretreatment, together with 15% of lignin and 7% of cellulose, as revealed by HPLC. Morphological changes are observed after this step on the fiber surfaces and on the decrease of pith total amount. Higher lignin fractions are removed with increasing NaOH contents, reaching a constant maximum limit around 88% using a 1% NaOH solution. Best results for enzymatic hydrolysis using Accelerase 1500 (Genencor, 25 FPU/g) were obtained in samples pretreated with acid and the 0.5% NaOH solution: 43% of glucose conversion, against only 12 % for the raw bagasse (both values obtained considering the initial cellulose amount on the non-treated bagasse). Under this condition, cell wall structure is significantly damaged, with fiber structures highly disjoint from the others and clearly more accessible to hydrolysis.

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