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PREDICTION OF GLUCOSE YIELD AFTER ENZYMATIC DIGESTIBILITY OF PRETREATED BIOMASS

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The aim of this research was to predict the glucose yield after enzymatic hydrolysis of pretreated plant biomass using chemical composition and the crystallinity degree of cellulose component. Biomass of various origin were used, such as poplar, switchgrass, bagasse, corn stover, corn cobs, rice and wheat straw. The biomass samples were pretreated using one and two-step pretreatments. Chemical composition of the biomasses was determined by conventional methods of chemical analysis. The pretreated biomass samples were hydrolyzed with a mixture of commercial cellulase Accelerase-1500 (DuPont/Genencor) supplemented with β–glycosidase NS-188 (Novozymes A/S). Conditions of the hydrolysis were the following: biomass loading (BL) was 50 g/L; dose of the cellulase 15 FPU/g sample; temperature 50oC; pH=4.8; duration 24 h. Concentration of glucose (G, g/L) in hydrolyzates was analyzed by HPLC-method. Yield of glucose was calculated as: Y(%) = 100% G/BL. The results showed that lignin-hemicellulose complex affected negatively on enzymatic cleavage of cellulose, whereas increased content of cellulose with decreased crystallinity degree promotes enzymatic hydrolysis. The best correlation (R2 =0.98) was discovered for the dependence of glucose yield (Y) on the combined parameter (P): Y= 0.96 P + 5; where P = 2C(1-X) – 0.5 LH, X is crystallinity degree of cellulose, C is percentage of cellulose and LH is percentage of ligno-hemicellulose complex in the pretreated biomass samples. Thus, increased content of cellulose, its reduced crystallinity, as well as decreased content of lignin and hemicelluloses in the pretreated biomass, promote enzymatic saccharification. The discovered correlation Y=f(P) permits prediction the saccharification degree of the pretreated biomass, which can be used for choice the best pretreatment method. In particular, a nitric acid/alkaline pretreatment of herbaceous plants provides the delignified biomass containing the low-crystalline cellulose having an enhanced enzymatic digestibility and maximum glucose yield.