Lignocellulose pretreatment severity – relating pH to biomatrix opening

In cellulose-to-ethanol processes a physico-chemical pretreatment of the lignocellulosic feedstock is a critical prerequisite for increasing the amenability of the cellulose to enzymatic attack. Currently published pretreatment strategies span over a wide range of reaction conditions involving different pH values, temperatures, types of catalysts, and holding times. The consequences of the pretreatment on lignocellulosic biomass are described with special emphasis on the chemical alterations of the biomass during pretreatment, especially highlighting the significance of the pretreatment pH. We present a new illustration of the pretreatment effects encompassing the differential responses to the pH and temperature. A detailed evaluation of the use of severity factor calculations for pretreatment comparisons signifies that the multiple effects of different pretreatment factors on the subsequent monosaccharide yields after enzymatic hydrolysis cannot be reliably compared by a one-dimensional severity factor, even within the same type of pretreatment strategy. However, a quantitative comparison of published data for wheat straw pretreatment illustrates that there is some correlation between the hydrolysis yields (glucose, xylose) and the pretreatment pH, but no correlation with the pretreatment temperature (90–200 °C). A better recognition and understanding of the factors affecting biomatrix opening, and use of more standardized evaluation protocols, will allow for the identification of new pretreatment strategies that improve biomass utilization and permit rational enzymatic hydrolysis of the cellulose.

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