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Corn stover saccharification with concentrated sulfuric acid: Effects of saccharification conditions on sugar recovery and by-product generation

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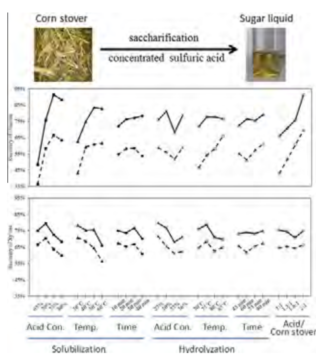
HIGHLIGHTS

- ▶ Saccharification conditions affected sugar recovery significantly.
- ▶ Glucose recovery and xylose recovery were affected differently.
- ▶ By-product generation during concentrated sulfuric acid saccharification was low.

GRAPHICAL ABSTRACT



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ABSTRACT

Although concentrated sulfuric acid saccharification is not a novel method for breaking down lignocellulosic biomass, the process by which saccharification affects biomass decomposition, sugar recovery, and by-product generation is not well studied. The present study employed Taguchi experimental design to study the effects of seven parameters on corn stover concentrated sulfuric acid saccharification. The concentration of sulfuric acid and the temperature of solubilization significantly affect corn stover decomposition. They also have significant effects on glucose and xylose recoveries. Low generation of furfural and 5-hydroxymethyl-2-furfural (5HMF) was noted and organic acids were the main by-products detected in the hydrolysate. Temperature also significantly affected the generation of levulinic acid and formic acid; however, acetic acid generation was not significantly influenced by all seven parameters. The ratio of acid to feedstock significantly affected glucose recovery, but not total sugar recovery. The corn stover hydrolysate was well fermented by both glucose- and xylose-fermenting yeast strains.

1. Introduction

Use of second-generation bioethanol, produced from lignocellulosic biomass, is a promising alternative to the use of fossil fuels in powering vehicles (Ragauskas et al., 2006). The benefits of bioethanol include, but are not limited to, value-added utilization of agricultural and forest residues, reduced emission of greenhouse gases, improved independence and security of national energy, and enhancement of the rural economy. However, hydrolyzing cellulose and hemicellulose to monosaccharides (hexose and pentose) is still one of the bottlenecks in the production of ethanol from lignocellulosic biomass, and therefore, hinders its industrial application.

Generally, pretreatment followed by enzymatic hydrolysis, dilute acid hydrolysis, and concentrated acid hydrolysis is utilized in lignocellulosic biomass saccharification. However, these methods are not developed enough to be technically or economically feasible for large-scale production (Balat, 2011; Demirbas, 2005).

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