Pretreatment and enzymatic saccharification of lignocellulose: Formation and effects of pseudolignin

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Akademisk avhandling

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Abstract
Production of advanced biofuels, green chemicals, and bio-based materials from renewable lignocellulosic biomass would contribute to decreased dependence on fossil resources and to sustainable development. The overall aim of the investigations was to explore how preprocessing and pretreatment technologies affected the chemical composition of cellulosic materials and their susceptibility to enzymatic saccharification, which is one of the major routes for biorefining of lignocellulose. Special attention was given to formation and effects of pseudolignin, an aromatic substance derived from polysaccharides. Pseudolignin is formed during dry thermal preprocessing, such as torrefaction, and during dilute-acid pretreatment, techniques that are highly relevant for biorefining of wood.

The susceptibility of seven fractions of Scots pine to dilute-acid pretreatment and enzymatic saccharification was investigated. Harsh pretreatment conditions led to slow initial conversion, which was tentatively attributed to pseudolignin. Pretreatment with ionic liquids was investigated using substrates consisting of crystalline and amorphous cellulose, hemicelluloses, and wood. The susceptibility of torrefied spruce wood to enzymatic saccharification after pretreatment with acid or ionic liquid was investigated. The results showed that the negative effects of mild torrefaction on enzymatic saccharification were possible to overcome using pretreatment with the ionic liquid. In a subsequent study, the possibility to dissolve pseudolignin with ionic liquids and conventional solvents was explored. The effects of pseudolignin on wood polysaccharides and on enzymatic saccharification were further studied using NMR, FTIR, XPS, TOF-SIMS, and SEM. The surface-sensitive analytical methods TOF-SIMS, XPS, and SEM revealed how pseudolignin formed a coat on the surface of the polysaccharide, which could explain the effects on the enzymatic saccharification.

Keywords
Pretreatment, enzymatic saccharification, ionic liquid, torrefaction, pseudolignin

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