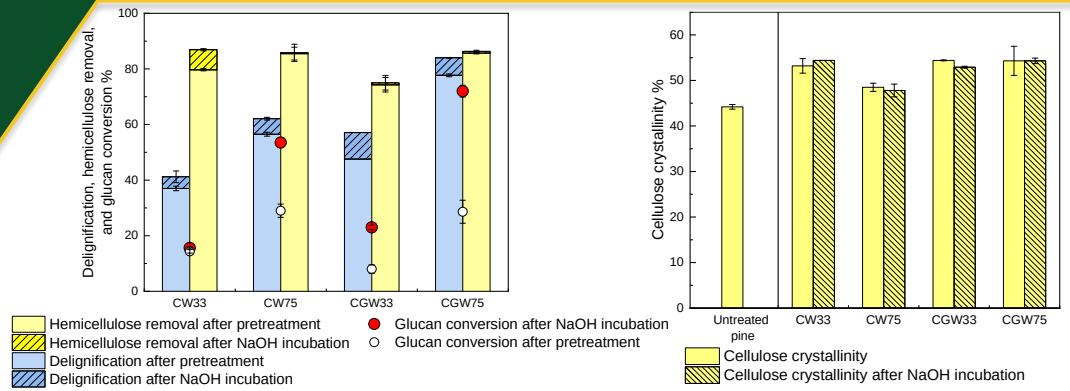
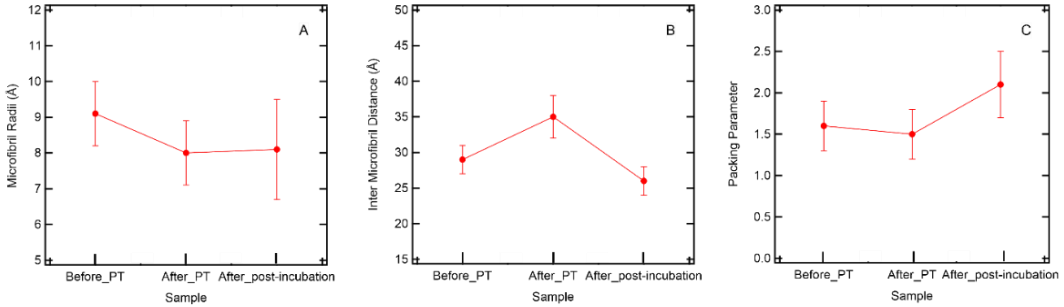
Investigation of Cyrene organosolv fractionation of softwood biomass and alkaline post-incubation



Top: Pretreatment performance (delignification, hemicellulose removal, and glucose yield) and cellulose crystallinity of pine after pretreatment using Cyrene co-solvent with different compositions and after alkaline post-incubation. **Bottom:** The trend in the fitting parameters obtained from SAXS data analysis. A: cellulose microfibril radii, B: inter-microfibril *d*-spacing, C: packing factor. untreated pine (Before_PT), Cyrene-pretreated pine (After_PT), and pine after alkaline post-incubation (After_post-incubation).



Wang et al., *Chem. Eng. J.*, 494:153046 (2024). doi:10.1016/j.cej.2024.153046

This work is supported by DOE Office of Science, Office of Biological and Environmental Research Genomic Science Program (ERKP752) and the Center for Structural Molecular Biology (ERKP291). SAXS measurements were performed at the LiX beamline of the National Synchrotron Light Source Ⅱ at BNL, a DOE Office of Science User Facility.

Scientific Achievement

We effectively fractionated recalcitrant pinewood with a Cyrene co-solvent system. Cellulose microfibril were characterized and the role of alkaline post-incubation on improving fermentable sugar yield was revealed by small-angle X-ray Scattering (SAXS) analysis

Significance and Impact

Efficient fractionation of softwood biomass is vital to the second-generation biorefinery with lignin valorization. Improvements on delignification and alkaline post-incubation are informed by integrating conventional characterization methods with SAXS.

Research Details

- A mixture of Cyrene, water, γ-valerolactone and dilute acid effectively fractionated pinewood at 120℃, leading to 78% delignification and 80% hemicellulose removal.
- After pretreatment and an alkaline post-incubation step, ~70% of glucose yield was achieved with enzymatic hydrolysis.
- Chemical composition and cellulose crystallinity did not change significantly after the post-incubation step, while SAXS analysis revealed changes in microfibrils.
- Cyrene retained on the surface of microfibrils hindered enzymatic hydrolysis which improved after removal by alkaline post-incubation.