Influence of feedstock deconstruction in enzymatic saccharification of softwoods

Ingrid C. Hoeger,[1,2] Sandeep S. Nair,[2,3] Orlando J. Rojas,[1] Junyong–FS Zhu[2]
[1]North Carolina State University, Forest Biomaterials, campus Box 8005, Raleigh, NC 27695,
[2]USDA Forest Service, Forest Products Lab, One Gifford Pinchot Dr., Madison, WI 53726
[3]Georgia Tech, Department of Chemistry, Atlanta, GA
Email: ichoeger@ncsu.edu

The past decade has witnessed a rapid progression biorefinery research; among the most important fundamental questions regarding bioconversion of biomass is the effect of size and surface area, for example, for the efficient enzymatic saccharification of wood. In this investigation we elucidate the effect of biomass deconstruction in the enzymatic hydrolysis of wood. Unbleached softwood mechanical pulps and bleached Kraft pulps were deconstructed through a continuous grinding system in a SuperMassCollider®. The mechanical deconstruction of the cell wall to the micro or nano size was followed by energy consumption and the resultant fiber morphology assessed via SEM and AFM. Samples of the process were treated with a mixture of enzymes and the generation of glucose and oligosacccharides was analyzed. It was found that almost all cellulose from the bleached softwood was converted to glucose after only 15 min of fibrillation with a cellulase loading of 5 FPU/g glucan. In the case of the unbleached samples, under same cellulase loading it took six fibrillation hours in order to reach 55% cellulose conversion. The differences are explained by the negative effect of lignin and residual cell wall components in enzymatic conversion. Overall, we will discuss the effect of cell wall deconstruction in saccharification and also in the production of value added materials, such as nanopaper.