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Session 1

Feedstocks

New Supplies and Processing

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The session on biomass feedstocks has opened the Symposium on Biotechnology for Fuels and Chemicals virtually every year. Traditionally it has focused on assessments of quantities, qualities, or pretreatment processes. This year's session was a bit unusual because for the first time we began to see the effect of biotechnology on biomass production and modification.

Advances in the genetic engineering of crops to alter lignin properties *(1–3)* has sparked interest in crating crops that are more amenable to biomass conversion. In order to carry out such genetic conversions, it is first necessary to understand how the expression of genes affects plant properties. This session includes a study by Cairney et al. that used differential display as a means to identify genes expressed at various times during development. One of the difficulties in modifying crop properties is that we do not yet fully understand how specific genes are related to overall traits. This is particularly important in disease resistance, fiber density, and strength. Advanced genetic screening techniques using random primers for the polymerase chain reaction *(4)* have enabled large-scale surveys of plant populations for genetic markers. A paper by Tuskan et al. in this session shows how such genetic information can be combined with advanced chemical and physical analytical methods to enable a systematic overview of diversity. One of the more intriguing approaches in genetic engineering for bioconversion is to express enzymes for lignocellulose degradation directly in the plant wall itself *(5)*. This session also included a presentation that examined the properties of transgenic alfalfa fibers as a feedstock for lactic acid production (*see* paper by Kogel et al.).

Pretreatment of lignocellulose continues to be a major barrier to both enzymatic saccharification and fermentation. If direct production of enzymes in the plant cell wall does become feasible, it will be necessary to develop pretreatment technologies compatible with retaining enzymatic activities in the crops. This session includes papers from three presentations on extrusion and steam explosion, two papers on acid hydrolysis, and one paper on enzymatic hydrolysis of pretreated wood. Steam explosion remains one of the most effective treatments for herbaceous materials, and this technology is progressing from batch processing to rapid extrusion technology (*see* papers by Dale et al. and Viggiano et al.). Hydrolysis research presented here included studies of peracetic (*see* Teixeira et al.) and acetic (*see* Gonçalves and Schuchardt) acids that act in part to oxidize the lignin substrate while solubilizing the cellulosic components, and one study of dilute acid hydrolysis (*see* Nguyen et al.). By keeping the concentration of acid low, it is possible to reduce the formation of toxic byproducts and increase the yield during fermentation. Inhibitors formed during hydrolysis remain a major problem, and anion exchange at pH 10 was found to be the most effective method to improve fermentability (*see* Larsson et al.). In contrast to previous hydrolysis studies that focused on fast growing hardwoods and other angiosperms, attention recently has turned to the steam explosion and enzymatic hydrolysis of softwood (*see* Wu et al.). This is becoming increasingly important as utilization of small diameter, dead, down, and diseased softwoods is beginning to be recognized as a problem in western states. Enzymatic hydrolysis of cellulose in Douglas fir is particularly difficult (*see* Schell et al.).

Although most of the emphasis in this field remains on ethanol production, the economics of other renewable products are often better. The present volume includes one paper on production of esterified vegetable oil as a lubricant (*see* Karaosmanoglu and Ozgulsun).

This symposium remains the principal forum for integrated technologies for lignocellulose bioconversion, and this year's papers have substantially expanded the topics from a biological perspective.

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