

Session 9: Advances in Bioprocessing and Related Separations Technology

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An economically viable bioprocess must use the best practices for material handling and bioconversion, coupled with optimal product separation and purification. The diversity of conversion processes and product targets which provides ample opportunities for these process unit operations will be the emphasis of this session.

The talks presented were chosen to focus on two broad areas: process and separations improvements to ethanol production and then some novel bioprocessing concepts.

The stage was set in the ethanol improvements area; Mian Li of Danisco described analysis using Genencor's whole cellulase processes and how they function under different process scenarios—batch fermentation, separate hydrolysis and fermentation, and simultaneous saccharification and fermentation. This allowed a discussion of the synergies between the cellulolytic enzymes and the fermentation. Ranil Wickramasinghe explored the use of membranes to remove inhibitors from biomass acid hydrolyzate. The membranes were used as a support for an organic extractant allowing a combination of the benefits and good removal efficiencies for both acetic acid and lignin breakdown products. L. M. Vane used membrane-assisted vapor stripping as a less energy-intensive alternative to ethanol distillation and sorptive dehydration, and estimated that the separation energy requirement to reach pure ethanol would be half of that for the current process.

The novel bioprocessing concepts included a presentation of microbial fuel cells by Abhijeet Borole. Here, a novel configuration was combined with an operational strategy to force enrichment of a much more effective mixed culture in order to produce electricity from organic acids (a potential biomass processing waste product). Mike Flickinger presented another “biofilm” concept where the biofilm is intentionally used to encapsulate thin films of active microorganisms and used to carry out catalytic transformations including photocatalytic reactions. One unique feature is the stabilization and longevity of the microbes under these conditions.

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The posters expanded on these topics. Many targeted various configurations of combined reaction and separations. Flash distillation and fermentation were considered separately for ethanol and for biobutanol, and two posters presented on supercritical reactors for biodiesel. There were more than five posters that examined continuous bioprocessing—this indicates the drive for next-generation processes that will move past the current batch and feed-batch operations for solids and liquids. The power of modeling and its result—optimization—were also a topic of multiple posters. Beyond their specific results, these show the utility of models in helping to determine targets for process improvement as well as in focusing the range for optimal operation.

While the majority of the current interest has been focused on the improvement possible in bioconversion via new biocatalysis resulting from modern biology, the talks and posters in this session demonstrate the utility, ingenuity, and impact that can result from novel or improved process configurations.