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Introduction to Session 3

Bioengineering Research

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This session deals with engineering research important to the production of bulk chemicals and fuels from renewable resources. The first paper is a review of the critical research advances necessary for the economic production of bulk chemicals by bioprocessing. These needs include research on improved biocatalysts, reactors and control procedures, and separation processes so that improved rates of reaction, yields, and product concentrations can be obtained.

This presentation is followed by two papers that deal with fluidized-bed reactors as a means to overcome a common problem in bulk chemical production—end-product inhibition. An economic analysis and experimental data indicate that extractive fermentation in a fluidized-bed bioreactor can reduce the price of butanol to $0.59 per pound, whereas synthetic butanol currently sells for $0.34 per pound. In the second application of fluidized beds, lactic acid is produced at concentrations higher than the inhibitory concentration. This occurs because the inhibitory undissociated acid is adsorbed on the supporting activated carbon as the fluidized particles move up the bed.

An analysis indicates that the economics of a wood-to-ethanol plant can be improved by the conversion of xylose to ethanol. A sensitivity analysis of the critical performance parameter on the price of ethanol indicates that the ultimate biocatalyst performance goal is 90% yield and 2.5 to 3.0% ethanol tolerance, whereas high fermentation rates have a much smaller impact on process economics.

The next two papers examine the effect of interfacial adsorption of microorganisms on mass transfer. In one study, the oxygen transfer rates from the gas to the liquid phase for a stagnant pool containing different cell concentrations indicate that *Bacillus licheniformis* accumulates at the interface and enhances the transfer rate by 60 to 240% over that expected for uniformly dispersed suspensions.

In the second paper concerned with interfacial phenomena, the location of cells of *B. amyloliquefaciens* in an aqueous two-phase system are related to changing kinetic patterns by following changes in the dynamic interfacial tension. It is found that increased polymer concentration causes cell accumulation at the interface.