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Reaction engineering studies of acetone-butanol-ethanol fermentation with *Clostridium acetobutylicum*

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Abstract:

Acetone-butanol-ethanol (ABE) fermentation by *Clostridium acetobutylicum* has been extensively studied in recent years because the organism is recognized as an excellent butanol producer. A parallel bioreactor system with 48 stirred-tank bioreactors on a 12 mL scale was evaluated for batch cultivations of the strictly anaerobic, butanol-producing *C. acetobutylicum* ATCC 824. Continuous gassing with nitrogen gas was applied to control anaerobic conditions. Process performances of ABE batch fermentations on a milliliter scale were identical to the liter-scale stirred-tank reactor if reaction conditions were identical on the different scales (e.g., initial medium, pH, temperature, specific evaporation rates, specific power input by the stirrers). The effects of varying initial ammonia concentrations (0.1 – 4.4 g L⁻¹) were studied in parallel with respect to glucose consumption and butanol production of *C. acetobutylicum* ATCC 824 as a first application example. The highest butanol yield of 33 % (mol mol⁻¹) was observed at initial ammonia concentrations of 0.5 and 1.1 g L⁻¹. This is the first report on successful application of a 48 parallel stirred-tank bioreactor system for reaction engineering studies of strictly anaerobic microorganisms at milliliter scale.

Key-words: anaerobic fermentation, acetone-butanol-ethanol fermentation, biofuel, high-throughput, milliliter bioreactor