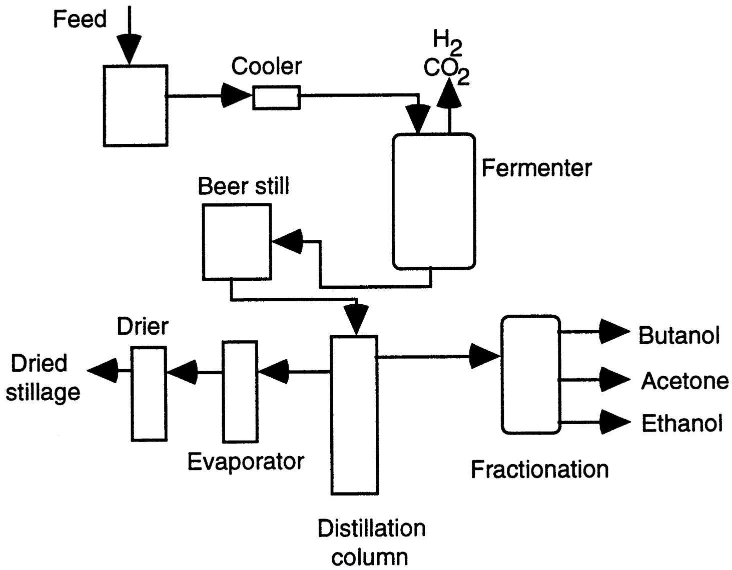

Figure A.3. Flowsheet for acetone–butanol production.

Different approaches have been developed to improve solvent yield in A/B fermentations. Phosphate limitation and addition of acetic and butyric acids improve butanol productivity. Calcium present in cheese whey complexes phosphate and also improves butanol yield. Hydrogen saturation in the medium at low agitation rates (25 rpm) and high head-space pressure improves butanol yield. Overall, butanol productivity may be improved by moderate to high agitation (300 rpm) during the acid phase followed by low agitation (25 rpm) during the solvent phase. Simultaneous removal of inhibitory products (butanol, acetone) by adsorption (activated carbon) or extraction (corn oil, paraffin oil) improves fermentation productivities. Organisms can tolerate up to 1.2% (vol/vol) of butanol.

Continuous or fed-batch operations improve solvent productivities. The possibility of controlling the growth rate and environmental and nutritional conditions improves butanol productivities (2.5 g/l h), as compared to batch cultures (0.8 g/l h). Immobilized cultures of *C. acetobutylicum* are also used for A/B fermentations with high productivities (1.2 g/l h). Biochemical and genetic manipulations of cells may further improve the solvent yield.

To recover acetone and butanol, at the end of the solvent phase the broth is transferred to a beer still that concentrates solvents (Fig. A.3). Solvents are then separated by fractionation, and the stillage is dried. Acetone and butanol prices have decreased due to a decrease in demand and excessive production capacity. It is expected that acetone demand will increase 4% per year from 2000 to 2006 to 5 million tons, while the production capacity in 2006 will be 5.3 million tons. An economic evaluation was presented for A/B