Numerical Evaluation of Immobilized Cell Contribution in Bioreactors

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Immobilized microbial cells can grow and detach from their carrier and grow independently as free ones in the liquid media. The present work proposes a numerical approach for evaluation the contribution for certain microbial conversions of immobilized cells and the free ones separately. For this purpose experimental data are required.

This approach consists in mathematical models considering the microbial growth both of the free and immobilized cells, the cell detachment from the carrier and the kinetics of substrate consumption and product formation. The mathematical models are based on ordinary differential equations for cells attached to solid supports and of partial ones for entrapped cells. The cell release into the broth is taken into account introducing a cell detachment rate factor.

Four different processes are considered: biodegradation of 1,2-dichloroethane by bacteria (*Klebsiella oxytoca*), fixed on activated carbon; the same substrate by *Xanhobacter autotrophicus*, entrapped in polyacrylamide gel; the production of cyclodextrin glucanotransferase by free and immobilized cells of *Bacillus circulans*; the lactic acid fermentation by cells of *Lactobacillus rhamnosus* immobilized in polyacrylamide gel.

The cell detachment factor for each process could be evaluated from experimental data using the proposed models in an identification procedure. It is shown that in different cases the cell detachment factor could be different and the contribution of the immobilized and the free cells may vary depending on the microbial culture.