# Mathematical Modelling of Microbial Processes in Immobilised Cell System

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Immobilised microbial cells are frequently used for practical purposes. Two main types of immobilization are used: cells entrapped into polymer beads or ones attached to solid surfaces in the so-called biofilms. In both cases the cells can growth and operate in immobilized state as well as to detach and live as free ones in the bulk. The assessment of their separate contribution to grow and produce certain product can be accomplished by appropriate mathematical models. For this purpose new quantity, named as "detachment factor" is introduced. This factor takes into account the rate of cell detachment from the particle surface to the bulk. It takes values from 0 to 1. The "zero" value corresponds to cell operation with no detachment, i.e. growth and production take place by the immobilized cells only. The other limiting case (when the detachment factor is unity) corresponds to complete cell detachment to the bulk. In this case the process is due to the free cells and the particles containing the immobilized cells serve as cell donor only. In the case of entrapped cells diffusion limitations are important for the processes of substrate supply to the cells and the product removal to the bulk. That is why the mathematical models in this case consist of system of partial differential equations with boundary condition matching the mass fluxes and the cell detachment. In the case of biofilm systems the simpler approach is to solve a system of ordinary differential equations, introducing cell detachment. In the present paper both approaches are considered. The evaluation of the detachment factor is accomplished comparing the model results with experimental data by identification procedure. The first one is demonstrated for the cases of lactic acid production by *Lactobacillus rhamnosus*, entrapped in particles of polyacrylamide. It was found out for this case that cell detachment is pre-dominant and the main fermentation process takes place in the bulk by the detached and freely growing cells. The case of microbial processes in biofilm systems is demonstrated for 1,2-dichloroethane biodegradation by *Klebsiella oxytoca* and for cyclodextrin-glucanotransferase by *Bacillus circulance*. In these cases the detachment factor is rather low, i.e. the processes are accomplished by the immobilized cells mainly with less contribution of the detached ones.