Determination of static and dynamic properties of continuous biomass cultivation in the presence of cadmium as an inhibitor

Summary

It was shown that cadmium ions cause biomass growth decrease. In order to determine the biomass growth rate the models of Monod and Esener were used. The kinetic parameters of biomass growth in a continuous flow reactor were determined, such as the maximum growth rate μ_{max}, the Monod constant K_s, the maximum yield of biomass Y_c, the intercellular respiration coefficient b_c, the maximum substrate consumption rate q_{max}, the rate constant of synthetic compartment consumption k_R, the rate constant of synthetic compartment formation from structural-genetic compartment m_G, the yield of synthetic compartment on substrate Y_{SR}, and the synthetic component conversion yield into a structural-genetic component (Y_{RG}).

A decrease of the maximum growth rate (μ_{max}) parallel to an increase of the Monod constant K_s was observed in the presence of cadmium ions. Also a decrease of the synthesis rate of synthetic component R, was observed.

On the basis of the experiments carried out, a general formula describing the biomass growth rate in the presence of cadmium, with the assumption of complexes creation which include one or two inhibitor atoms, was proposed.

The utility of proposed equations was evaluated for non-steady state conditions. In the case of the reactors response to a pulse and step changes of dilution rate, a satisfactory agreement of the experimental data with the numerical Esener model results was confirmed particularly during the first 20 hours of the experiment. A very good agreement of experimental data with numerical solutions was observed in the case of pseudo-steady state response to the rectangular wave change of dilution rate.

Analyzing the reactor response to the inhibitor concentration changes, a good concordance of experimental data with calculated values for sudden changes was observed, and a distinct disagreement in cases of pulse and step changes of the inhibitor concentration. In the reactor response to the rectangular wave change of inhibitor concentration the difference between experimental and calculated data was observed.