Mathematical Modelling of the Effect of Biosurfactants on the Surface Tension

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In this study a continuum mathematical model is developed to describe the effect of biosurfactants on the surface tension. The model includes generalized reaction-advection-diffusion equations for the concentration of the substrate, biomass and the product (biosurfactant). The reaction (bioprocess) is modeled using classical Monod kinetics for the growth of the biomass and biosurfactant. In the reaction-advection-diffusion equation for the biomass the bacterial chemotaxis is taken into account using Keller-Segel model [1].

The evolution of the concentration of biosurfactants on the surface is governed by advection-diffusion equation where the flux bulk-surface is given by Fick's low. The dependence bulk-surface concentration of biosurfactants is given by adsorption isotherm. The dependence of the surface tension on the biosurfactant concentration is modeled by the corresponding equation of state. Different nonlinear adsorption isotherms, respectively equations of state, are considered.

In the case of flat surface in the absence of fluid flow and initially uniformly distributed substrate and biomass the model can be considered as one-dimensional. In this case the evolution of the surface tension is given by a generalization of the Ward-Tordai integral equation. Numerical results for the 1D model are presented.

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References

[1] E. Keller, L. Segel, *Model for chemotaxis*, J. Theor. Biol. **30** (2) (1971) 225–234.