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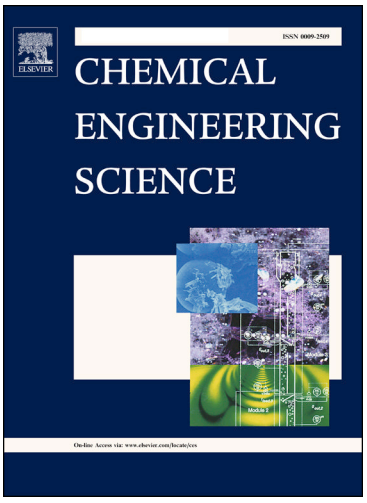


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# Model predictive control in comparison to elemental balance control in an *E. coli* fed-batch

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**Abstract**

For efficient bioprocess control it is essential to use advanced model based control strategies. Various models and control algorithms with different behaviour and peculiarities exist. The goal of this study was to compare the performance of two different model-based control strategies with respect to simultaneous set-point control of two individual substrate uptake rates (namely specific glucose and specific lactose uptake rates) by two substrate feeds within an *E. coli* fed-batch process. The compared controllers were an already established controller based on elemental balances (EBC), which was adapted for two feeds, and a model predictive controller (MPC) based on a mechanistic model, which was developed and configured for this study. MPC and EBC were compared systematically with a simulation and an experimental study. Both showed a comparable behaviour and were generally capable to fulfil their tasks. The MPC was based on a better and more flexible description of the system, whereas the EBC was easier and showed a more stable behaviour. Both suffered in case of wrongly estimated initial biomass. Summed up, for the described situation the EBC was preferable due to its simplicity. However, the potential of the MPC is clearly in its prediction power and flexibility towards objective functions. Therefore, it would be the controller of choice in case of product-related objective functions.

*Keywords:* Bioprocess, Model predictive control, Extended Kalman filter, Soft sensor, Mechanistic model, *Escherichia coli*

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