# Computational minimization of the specific energy demand of large-scale aerobic fermentation processes based on small-scale data.

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**Abstract**

During the assessment of the potential profitability and feasibility of new production routes, aerobic fermentation can turn out to be a major factor contributing to the operating expenditure of the overall process. The accurate evaluation of its energy demand is, therefore, of prime importance. To this end, a tool was developed based on established and generally accepted correlations considering relevant parameters and constraints for bioreactor operation. While the assessment is performed for large-scale reactors (10–100 $m^3$), it is based on data from small-scale experiments using the oxygen transfer rate as a scale-up criterion. Among the evaluated constraints, the flooding-loading transition of the bioreactor proved to be a crucial criterion for culture volumes of more than 20 $m^3$. Minimum energy demand for cooling, agitation, and aeration could thus be achieved at low agitation and high aeration intensity. At moderate oxygen transfer requirements, bioreactor pressurization was not found to increase energy efficiency of aerobic processes. It was, however, shown to be indispensable for processes with high oxygen demands and elevated foam formation. The tool was applied to assess itaconic acid as well as lysine fermentation processes.

Due to considerable differences in oxygen demand, average power consumption was found to be at 0.51 kW $m^{-3}$ (itaconic acid) and 2.61 kW $m^{-3}$ (lysine), thus arguing against the utilization of general rule of thumb values. The established tool, therefore, provides an efficient means to specify estimates of the energy demand in consideration of the respective process.

### Involved units

Bio Pilot Plant Miriam Agler-Rosenbaum Read more

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