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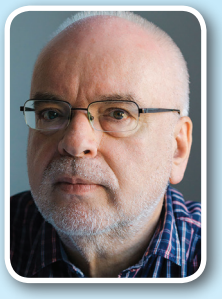

Martin Mandl
Masaryk University, Czech Republic

Defining the oxygen limitation and optimum aeration conditions in bioreactors

The intensity of aeration has multiple consequences at the biochemical, biotechnological and economical bioprocess control levels. Oxygen limitation has adverse effects on biological activities, varying with different organisms and substrates. Defining the conditions of oxygen supply and oxygen limitation is subject to the biochemical and physiological requirements of all biological systems in bioreactors.

In this study on the bioleaching bacteria Acidithiobacillus ferrooxidans, the critical values of the volumetric oxygen transfer coefficient (kLa) crit and oxygen concentration Ccrit (which is dependent on the Michaelis constant Km for oxygen) were used to define the conditions for the minimum aeration that still avoids oxygen limitation during substrate oxidation. One of the key indications of oxygen limitation is the linearity of growth and substrate oxidation. This effect has been predicted from the Monod kinetics. The Km and Ccrit values were determined in respirometric studies. Steady-state and static gassing-out techniques were used for the (kLa)crit determination. The values of the three parameters were different for the two fundamental substrates tested, ferrous iron and elemental sulfur. By comparison to elemental sulfur, the oxidation of ferrous iron required a slightly higher intensity of aeration to maintain oxygen-unlimited substrate oxidation. A continuously stirred bioreactor was used for long-term confirmation of oxygen-unlimited substrate oxidation at Ccrit. Although the results were obtained under laboratory-scale conditions, the approaches and the (kLa)crit and Ccrit values can be used universally as guidelines to develop minimum aeration criteria for pilot- and commercial-scale bioreactor processes.

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Biography:

Martin Mandl is an Associate Professor and the Head of the Department of Biochemistry, Faculty of Science, Masaryk University, Brno, Czech Republic. He is a board member of the Czech Biotechnology Society which is a member of the European Federation of Biotechnology. His teaching activities have been focused predominantly on microbial and enzyme biotechnology and applied statistics. He has published more than 60 research articles (including book chapters), 40 of which have been published in prominent journals. He was a co-editor of an Elsevier book. Most of his research activity has been related to biotechnology and biochemistry of acidophilic bacteria that are connected with biomining and environmental acidification. A part of his activity was devoted to cellulolytic fungi and industrial production of bacterial vaccines. He has dealt with several projects supported by the national and European Union science foundations.

mandl@chemi.muni