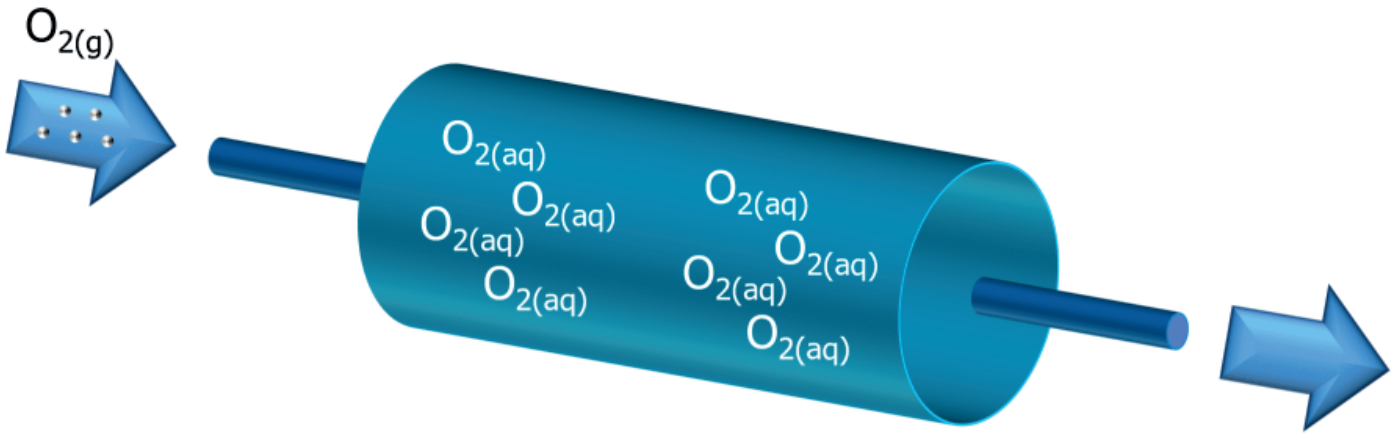
Performance Boost for Enzymatic Oxidations by means of Process Intensification and Continuous Flow Processing

O_2-dependent biotransformations are promising for chemical synthesis. Their development to the level of efficiency required in fine chemical manufacturing has proven difficult, however, due to thermodynamic and kinetic limitations when supplying O_2 to the enzymatic reaction creating a complex bottleneck on conversion efficiency using batch technology at atmospheric pressure.

Process intensification for oxidative O_2-dependent biotransformations is a promising tool using a batch-to-conti approach. In a cooperation between the Austrian Center of Industrial Biotechnology (ACIB) and Microinnova Engineering GmbH it was shown that process intensification by the application of continuous flow technology offers a comprehensive solution. A continuous flow reactor using up to 34 bars enables biotransformations to be conducted in a single liquid phase.

- Increased enzyme activity at 10 bars
- Glucose oxidase: intensification factor for enzyme activity was up to 2.5
- Amino acid oxidase: intensification factor for enzyme activity up to 6
- High product concentration: 6 to 10 times higher at 34 bars compared to atmospheric pressure



Enzyme activity	Product concentration
Up to 6x increase	6-10x increase

Pressurized single-phase flow reactor for O_2–dependent biotransformations

Reactions of glucose oxidase and amino acid oxidase were used both as soluble enzymes in liquid flow and immobilized enzymes in a packed bed as exemplary cases to demonstrate that the pressurized continuous flow reactor presents a powerful engineering tool uniquely apt to overcome restrictions inherent to the individual O_2-dependent transformation considered. The base for the performance boost when using up to 34 bars of pressure is a 34 – 170-fold increase of dissolved oxygen compared to oxygen dissolved at atmospheric pressure.