



# Intensification Boost for Enzymatic Liquid/Gas Processes by means of Continuous Flow Processing

From development to manufacturing: Process intensification of liquid/gas enzymatic reactions can be executed by implementing continuous manufacturing technology, from development to construction and start-up of a manufacturing plant.

## BACKGROUND

O<sub>2</sub> dependent biotransformation reactions have proven difficult in fine chemical manufacturing due to the mass transfer limitations of supplying O<sub>2</sub> to the enzymatic reaction, hence affecting the level of efficiency achieved. Previous research has shown that enzymatic processes involving gases have a high potential for process intensification by implementing continuous flow processing technology.

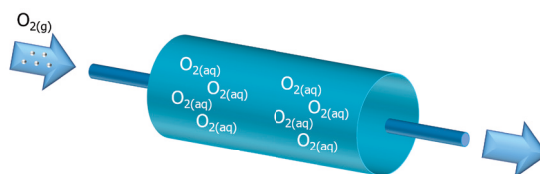
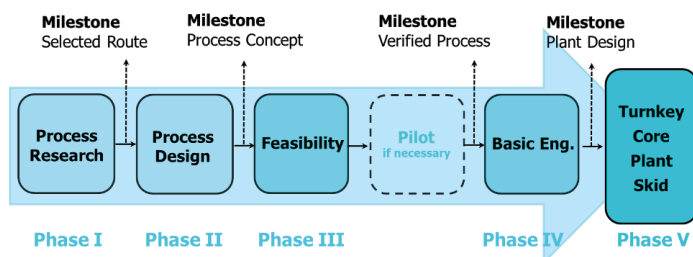
## TECHNOLOGY

In a cooperation between acib and partner Microinnova Engineering GmbH, with more than 15 years of experience in flow chemistry it has been proven that process intensification can be applied using continuous flow processing. This technology offers a comprehensive solution with a pressurized system that results in a significantly higher level of dissolved oxygen. A continuous flow reactor pressurized to 34 bar enables biotransformation to be conducted in a single liquid phase and significant increase of enzymatic activity was detected already at 10 bar. For glucose oxidase, the intensification factor for enzyme activity was up to 2.5 and amino acid oxidase showed an intensification factor up to 6 for the enzyme activity. High product concentration has been demonstrated with the concentration being 6 to 10 times higher at 34 bars compared to atmospheric pressure.

See also Bolivar J.M., Mannsberger A., Thomsen M.S., Tekautz G., Nidetzky B. (2019) *Biotechnology and Bioengineering*, 116(3), 503–514.

## OFFER

A stepwise approach for realizing an intensified enzymatic process is offered and visualized in the diagram below. This is executed starting from process research and process design. Subsequently, in phase III (feasibility phase) the process is optimized and the performance is verified. Finally the results are used to design and build a manufacturing plant to realize the continuous process on an industrial scale.



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

Pressurized single-phase flow reactor for O<sub>2</sub>-dependent biotransformations

## EXPERTS

Prof. Bernd Nidetzky  
Dr. Dirk Kirschneck

## AVAILABLE FOR

- Joint Research Project
- Contract Research
- Realization of Manufacturing

## DEVELOPMENT STATUS

Status of the project proposal – Technology Readiness Level 4-5

## IPR

Will be generated for our industrial partner

## KEYWORDS

- Liquid/Gas Enzymatic Reactions
- Flow chemistry
- O<sub>2</sub>-dependent biotransformation
- Continuous manufacturing
- Process intensification

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