process & particle engineering

Master's thesis - Design of a multistep (photo)biocatalytic process for the production of biopolymers

Photo- and biocatalysis have recently emerged in the field of organic synthesis as greener alternatives to conventional processes, since the combination of both technologies is of great interest to reduce the environmental impact of fine chemical production. However, (photo)biotransformations are limited by the low stability of many enzymes of interest (e.g. oxidoreductases) outside living cells, their cofactor dependency, as well as poor light distribution and harvesting. These disadvantages constrain the scale up of photobiocatalytic processes and their industrial application. To overcome these limitations, the utilization of continuous processes could be a solution. Flow reactors pose many advantages, especially due to their small inner dimensions and high surface area, which allow for better heat and mass transfer, as well as improved illumination efficiency.
In this project, continuous flow reactors for whole-cell photobiocatalysis will be investigated and implemented in a multistep process. The stability and activity of photoautotrophic cells as biocatalysts will be optimized by testing different process parameters. The setup will be further expanded to develop a multistep cascade for the production of highly valuable compounds, such a biopolymers, which are relevant to the pharmaceutical industry. The process can be flexible and feature different modules: reaction modules that can host packed bed reactors filled with the immobilized (bio)catalyst, as well as modules for other unit operations (e.g. mixing, quenching, extraction), as shown in **Figure 1**. The different steps will need to be optimized and tested, and the process will be improved to achieve high space-time-yield. The possible challenges include: finding an optimum light intensity that minimizes cellular photo stress; testing different reactor geometries to improve illumination efficiency; the choice of an optimal solvent compatible with multiple reaction steps; the possible interaction of byproducts within the system. To increase process understanding and efficiency, the possibility of implementing process analytical tools, such as inline sensors for real-time analyses, will be explored as well.

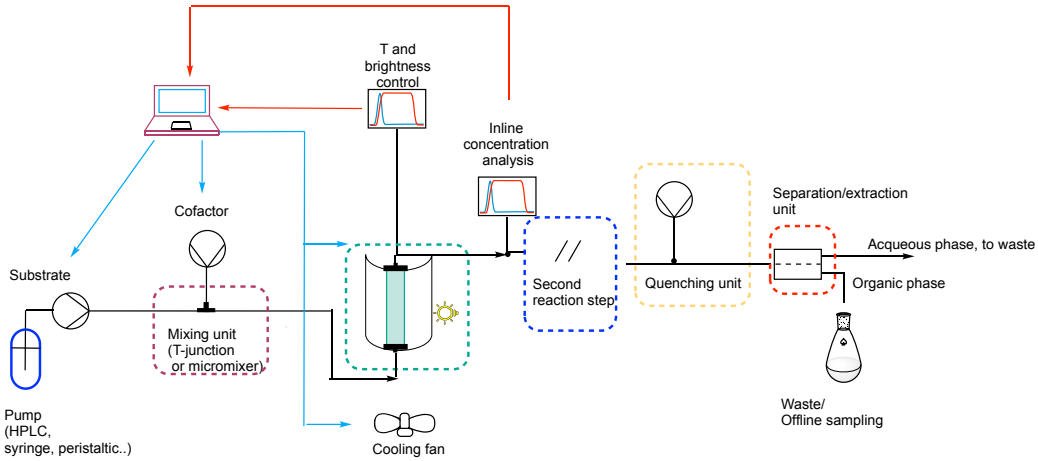

Figure 1 – Generic scheme of a multistep photo-biocatalytic reaction process.

Tasks

- Literature study on industrial photo- and biocatalysis in continuous flow and whole-cell immobilization
- Study of the single catalytic steps in batch
- Design of an adequate multistep continuous process (possibly including reactor design)
- Optimization of the reaction/process conditions
- Implementation of real-time analytics (e.g. UV-vis probes)

Requirements

• Background in chemical engineering, chemistry or biotechnology
• Interest in the above mentioned fields
• Lab work experience (master student level)

What we offer:
• Integration in an internationally leading institute (IPPE) of TU Graz
• Support from the CoSy Pro Team
• Paid master Thesis

Start
At any time

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