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Haute Ecole Spécialisée de Suisse occidentale
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Master of Science HES-SO in Life Sciences

O_2miniCSTR - A innovative Flow Process Tool for Syntheses using Oxygen

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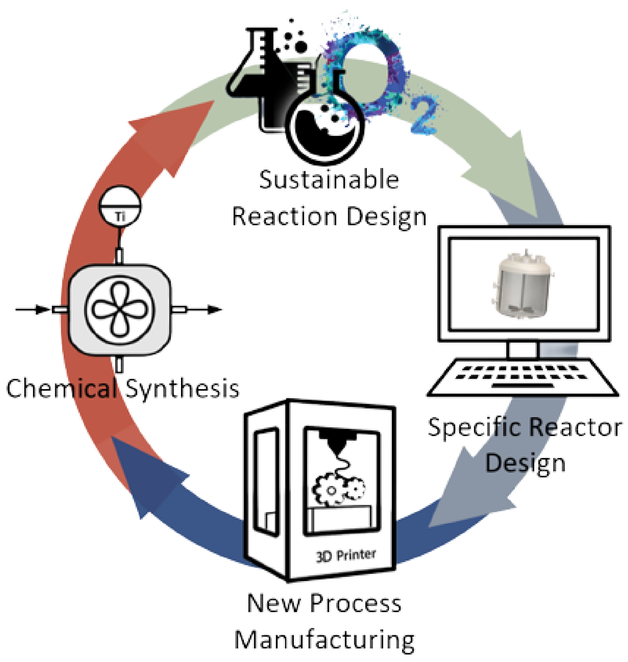
CHEMICAL DEVELOPMENT & PRODUCTION

EIA-FR

O_2 Reaction Design



Flow Chemistry as future pharmaceutical manufacturing

Due to increasing innovation pressure on new green process technologies using molecular Oxygen in chemical reaction, the **O_2miniC**ontinuous – **S**tirred **T**ank **R**eactor manufactured, having several benefits:

Real-time quality assurance
In-line analysis

Increased overall safety
Low reactor volume

Flexible manufacturing
Cascade or single module

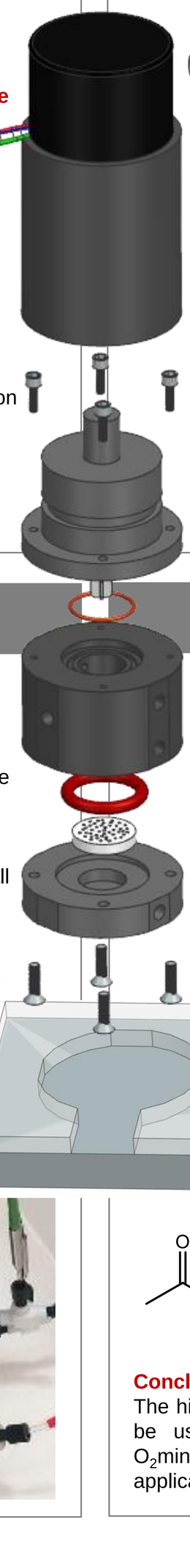
Steady-state operation
Continuous product production

Solid Handling
Constant remixing

Iterative Optimization Process Concept

By designing greener reaction syntheses with molecular oxygen, the requirements according to the chemical experiment will determine the specific design and manufacturing of the reactor device.

The experimental results can then be quickly fed back into the reaction and reactor design and lead to modification.



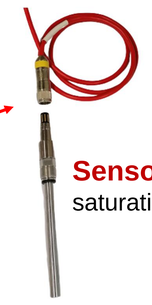
Data Recording

Parameter Recording System

The temperature, stirring speed and oxygen saturation are monitored via an interface box. The recoding is done using a custom-made Phyton Programme, integrated with an automatic storage of the measurement data in an Excel File.

Stirring Speed Regulation
- Compact design with motor on top of O_2miniCSTR

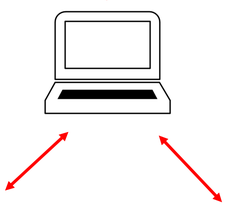
NTC Thermistors
- T-Module Adapter for Measurement



Sensor for O_2 saturation

Interface Box

Communication via RS232



Excel File

Measures_24-1-2022

Python Program

Kust

Specific Reactor Design

The new cutting-edge technology has three key elements

Overhead Stirring System

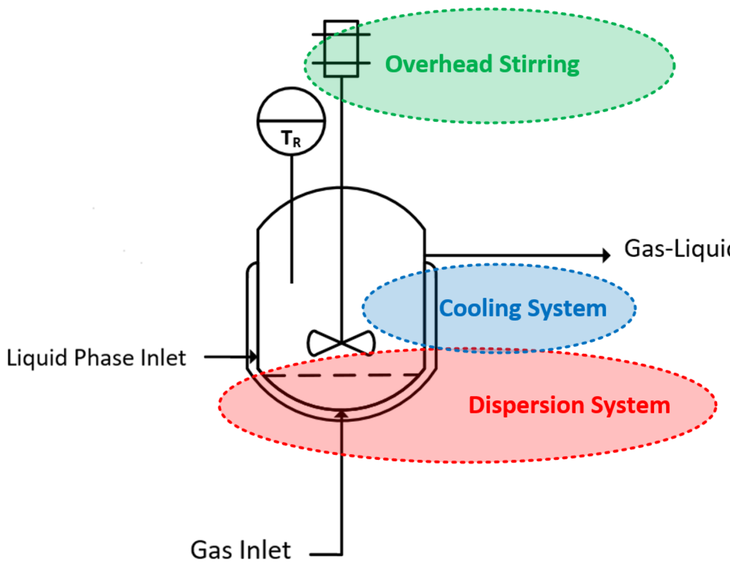
The newly integrated stirring system enables hemispherical separation between the reaction medium and the environment via a magnetic coupling stirring system.

Gas Dispersion System

Oxygen is fed into the lower part of the reactor and then dispersed in the form of small bubbles with a slight pressure difference through the borosilicate filter plate.

Integrated Cooling System

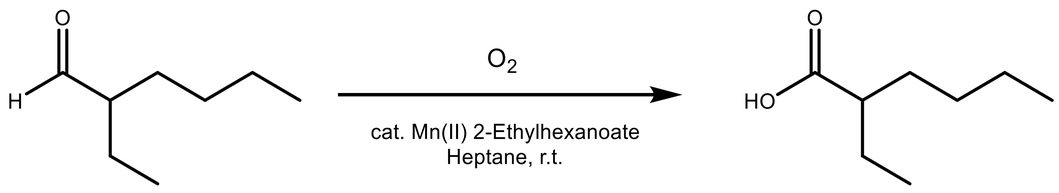
The 3D printed stainless steel 316L middle reactor part contains an integrated cooling system by a cooling layer.



Chemical Application

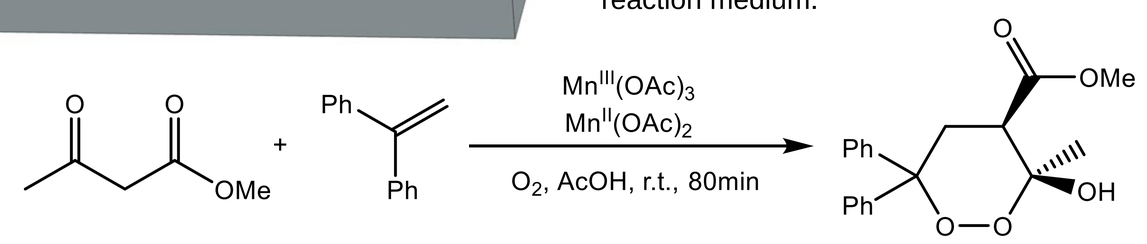
Oxidation of 2-Ethylhexanal to 2-Ethylhexanoic Acid

A conversion up to 90 % was achieved under catalysed conditions in a Cascade of 3 modules with a residence time of 13.4 min. Further, the handling with the exothermic reaction was efficiently and safely cooled by the new integrated cooling system. Confirmation of this was also provided by the overall heat transfer coefficient in range of 244 - 536 $W \cdot K^{-1} \cdot m^{-2}$



Endoperoxide Synthesis

In non-optimised conditions, a conversion of 22 % was achieved with a residence time of 13.4 min. During the reaction, the reactor showed good solids handling due to the good mixing system and the gas dispersing system, resulting in a slightly turbulent reaction medium.



Conclusion and Outlook

The highly flexible design of the O_2miniCSTR makes it possible to obtain a system that can be used for different synthesis requirements, not only for reactions with oxygen. O_2miniCSTRs are a viable tool for the laboratory and are well on their way to becoming an applicable technology for effective continuous manufacturing of pharmaceuticals.

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