

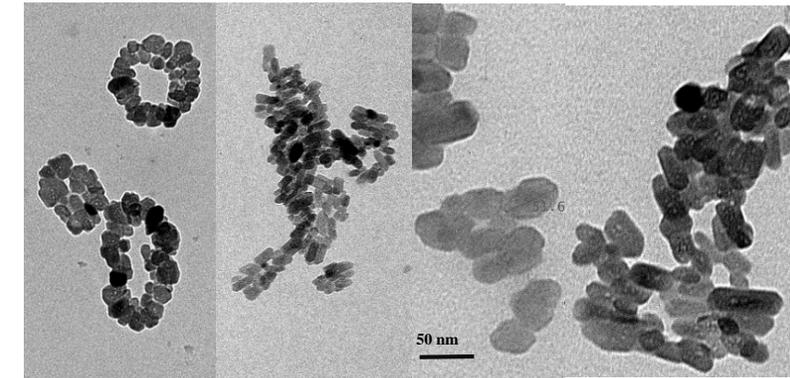
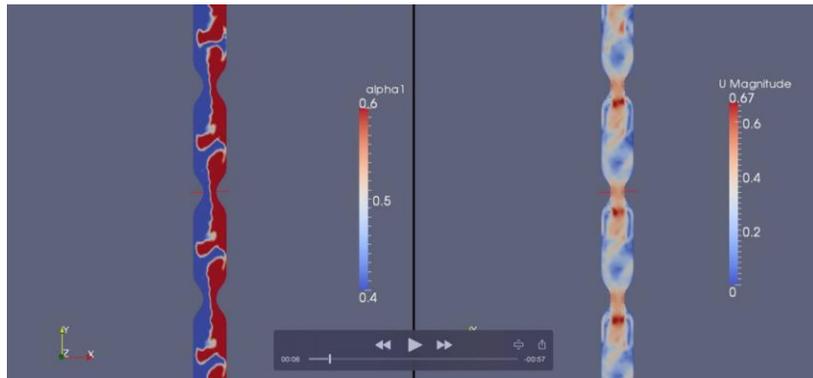
# Innovative platform for process intensification

## Concept and practical examples

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# Oscillatory flow reactor (OFR)

## Concept

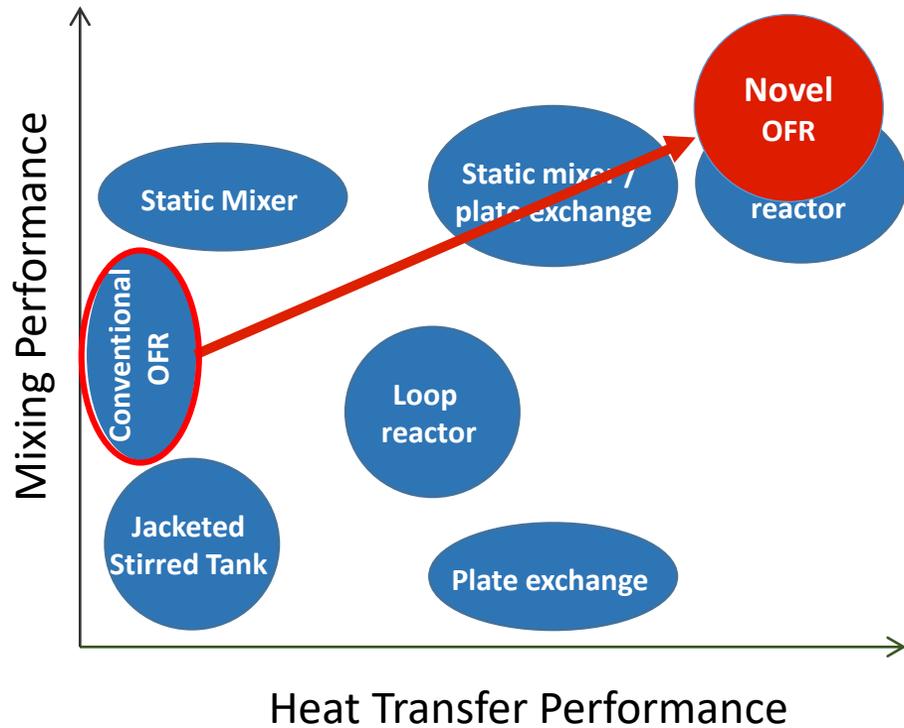
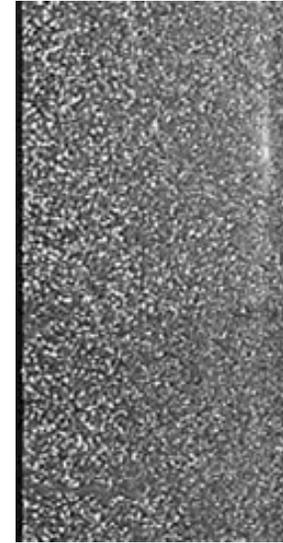
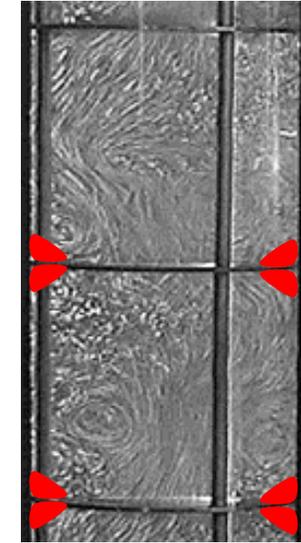
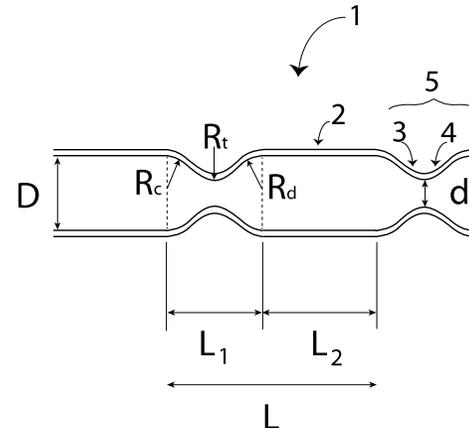


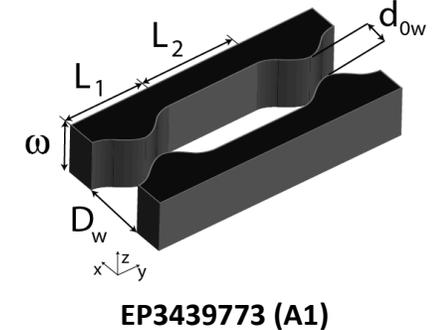
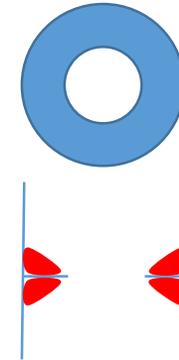
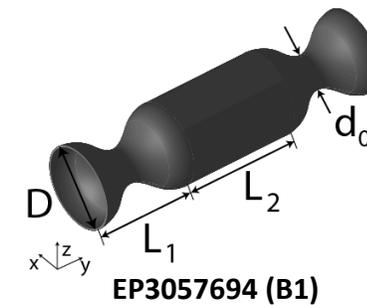
Figure 1. Heat transfer and mixing performance for different chemical reactors.



Oscillatory flow in an unbauffed tube

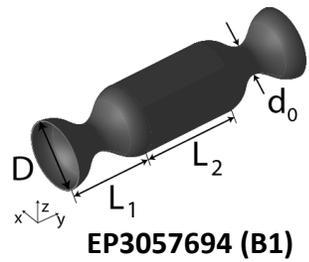


Conventional OFR



# OFR - Smooth periodic constrictions

- Tubes



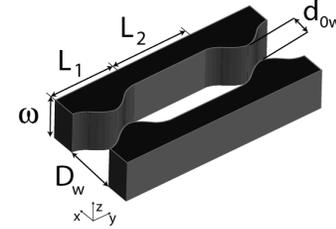
975 mm



300

350

- Channels



150



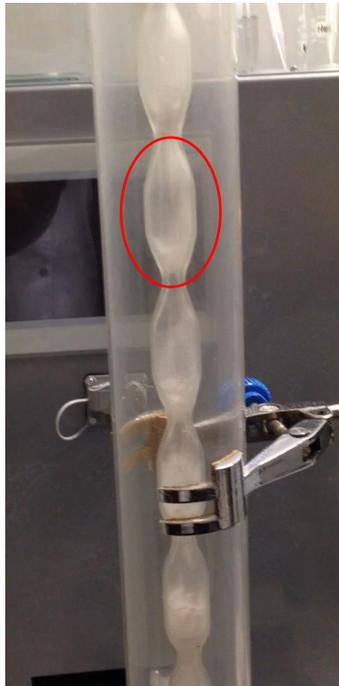
410

600 mm

# Practical examples

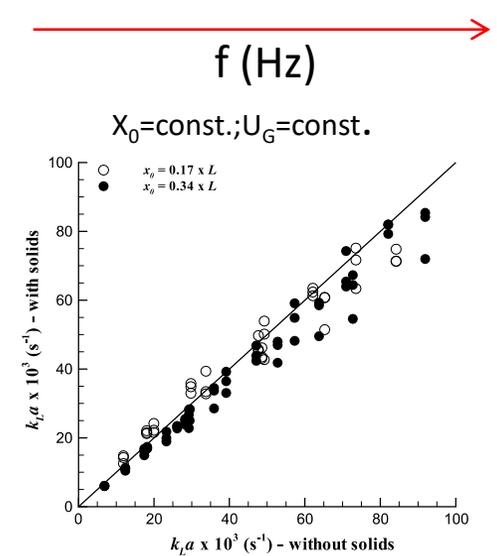
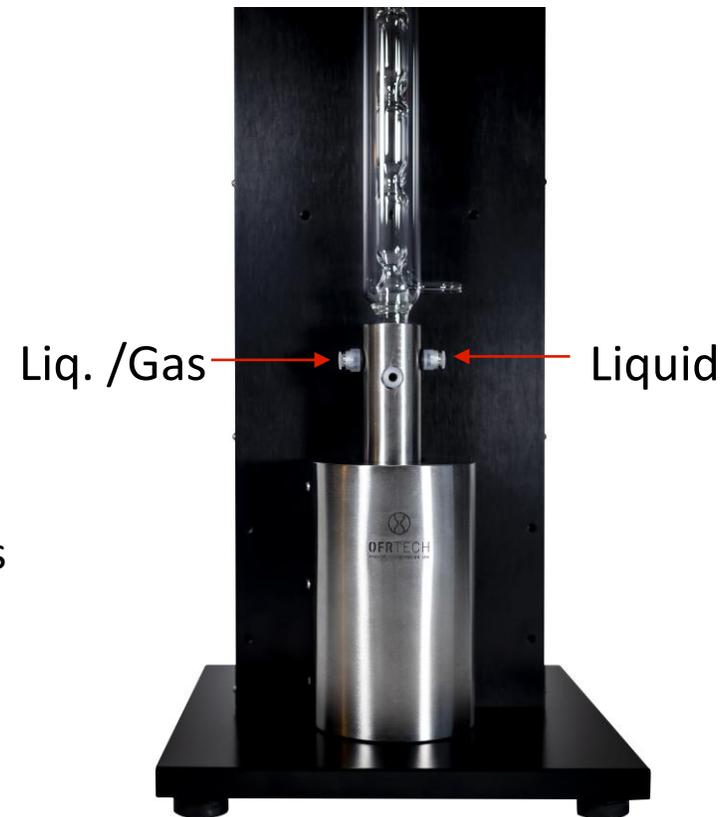
- L/L, G/S, G/L and G/L/S mass transfer
- Powder dryer and particle size separation

- increase the G/L mass transfer process up to 40x



Particle size  
increase

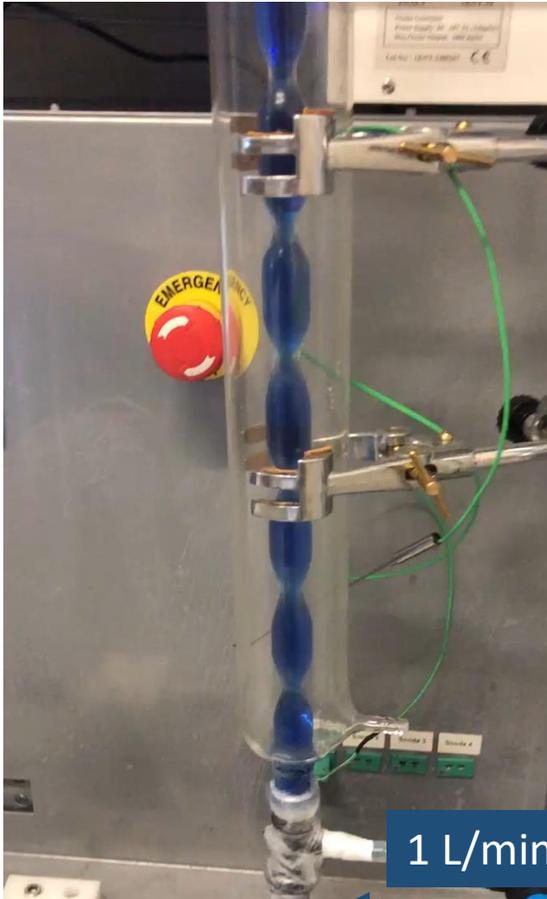
1. Each unit cell work as a fluidized bed dryer
2. Each cell unit has different particle sizes



# Practical examples

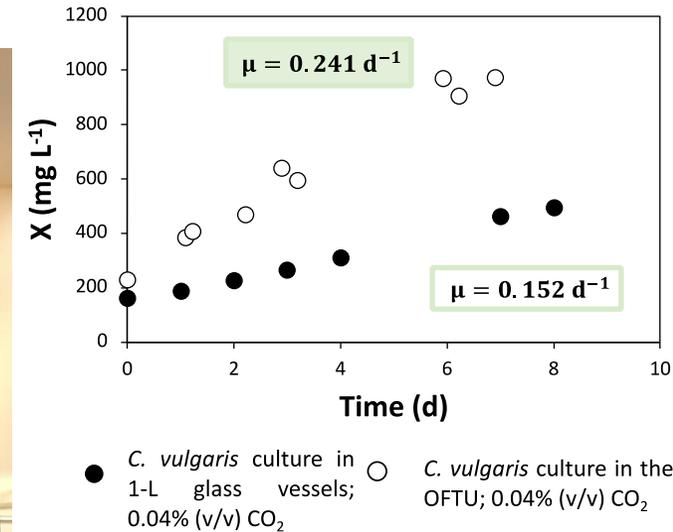
- L/L, G/L and G/L/S mass transfer

## Ozonation water treatment (continuous mode)



- increase the G/L mass transfer process up to 40 x
- OFR-SPC allows working with **low ozone dosages and high liquid flow rates (up to 14 m<sup>3</sup>/day – small prototype; footprint =1 m<sup>2</sup>)**
- OFR-SPC is a **promising alternative** for ozone-driven water treatment;

## Microalgae growth



**Figure 1.** Growth curves obtained for *C. vulgaris* in 1-L glass vessels and in the OFTU, both aerated with atmospheric air.

- Increase the specific growth rate up to 3x
- Control the flocculation

# Practical examples

- Continuous crystallization of Active Pharmaceutical Ingredients (API) and proteins



- Crystal size and shape control;
- Reduction/elimination of by-product formation;
- Space reduction by 15x ;
- Reduction of crystallization time (from 10 h to 7 min.);
- Production flexibility.

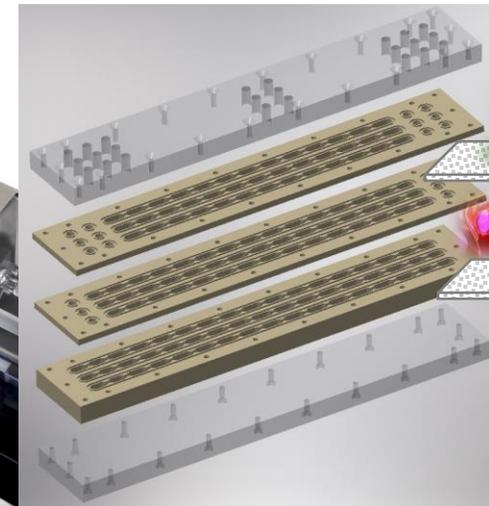
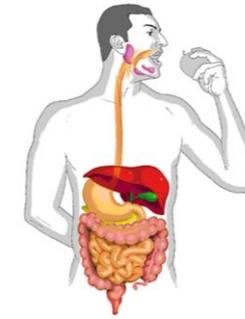
- Colon simulator



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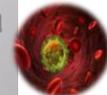


Mucus Layer Microbiota

PETE Membrane (0.2µm)

Caco-2 and HT-29 MTX

PETE Membrane (1 µm)  
treated with collagen I



Immune System

# Acknowledgements

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- VI. NORTE-01-0145-FEDER-000069
- VII. PTDC/BTA-BTA/2902/2021

