

Multiple Spinning Disc Contactor

A high-shear high-gravity approach to PI

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Where Innovation starts

Multiple Spinning Disc Contactor

Answers demands PI equipment for multiphase processes:

- High mass transfer
- High heat transfer
- Short micromixing times
- High Throughput Countercurrent flow Operating Window
- Plug Flow

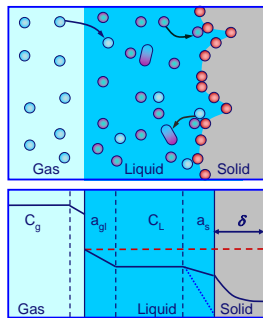
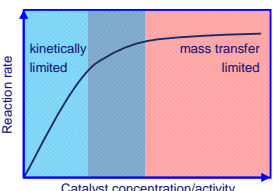
Applications:

- Gas-liquid-solid reactions
- Extraction (LL, LS)
- Distillation, Absorption
- Extreme fast and exothermic reactions
- Crystallization

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Multiphase processes

$$\frac{-r_A}{C_g} = \left(\frac{1}{k_g a_{gl}} + \frac{H}{k_l a_{gl}} + \frac{H}{k_l a_s} + \frac{H}{\eta k_r L_s \delta a_s} \right)^{-1}$$

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Multiple Spinning Disc Contactor

$V_L = 0.059 \text{ m}^3/\text{min}$
 $D = 100 \text{ mm}$
 $\Delta z = 100 \text{ mm}$
 $Q_{L,0} = 0.059 \text{ m}^3/\text{min}$

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Multiple Spinning Disc Contactor

rotor $v_\theta = \omega r$
 stator $v_\theta = 0$

- Gas bubbles detach from gas inlet due to shear
 -> Increase in gas-liquid interfacial area a_{GL}
- High rate of renewal of liquid at bubble interface:
 -> Increase in mass transfer coefficient k_L

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Gas-Liquid Mass Transfer

Gas flow: 400 ml/min
 Liquid flow: 400 ml/min

Gas holdup, ϵ_G (m^3/m^3)
 Rotational disc speed, ω (rad s^{-1})

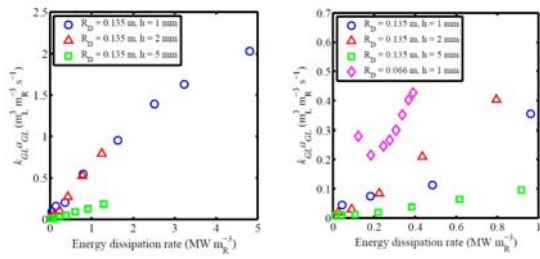
$k_{GL} a_{GL} / \epsilon_G$ ($\text{m}^3/\text{m}^3 \text{ s}^{-1}$)
 Rotational disc speed, ω (rad s^{-1})

$k_{GL} a_{GL} / \epsilon_G \approx 0.5 \text{ m}^3/\text{m}^3 \text{ s}^{-1}$

$\phi_G = 100 \text{ ml min}^{-1}$
 $\phi_G = 400 \text{ ml min}^{-1}$

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Disc Diameter and Rotor-Stator distance



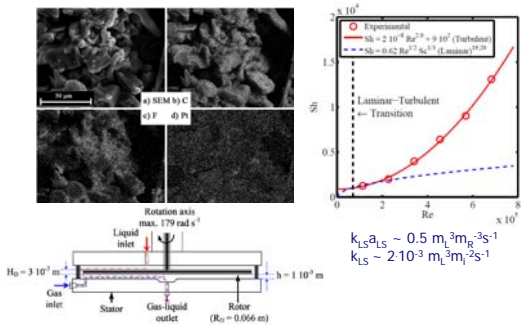
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Liquid-Solid Mass Transfer



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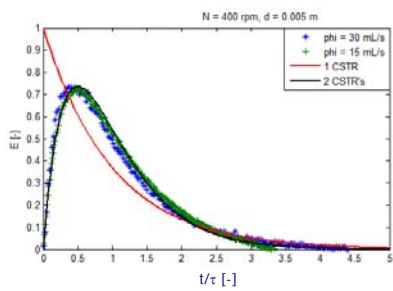
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Residence Time Distribution

Liquid phase only
 Top and bottom are hydrodynamically separated
 Stacking discs leads to **plug flow behavior**



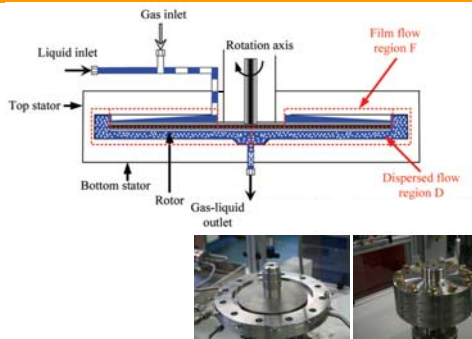
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* Mass Transfer in a Rotor-Stator Spinning Disc Reactor with Coexisting of Gas and Liquid, M. Meeuwse, J. van der Schaaf, J. C. Schouten, Ind. Eng. Chem. Res. 2010
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Answers demands PI equipment for multiphase processes:

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Applications? No!

- Gap research@university -> application in industry
- Requires Applied Research (Expensive)
- Difficult to find funding

- Reliable Process Equipment Manufacturer Essential

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