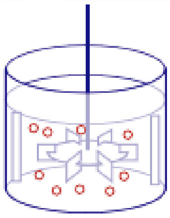
Emulsification & Microencapsulation

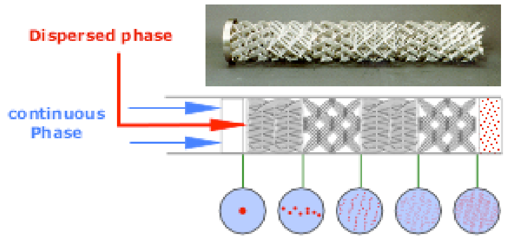
G. Ongmayeb, J. Legrand*, D. Dellavalle & D. Poncelet

Turbine reactor with baffles



Scale up

Static mixers



- Turbulent flow (Kolmogorov theory)

$$\frac{d}{D} = k \ We^{-2/3} \qquad We = \frac{D\rho u^2}{\sigma}$$

- d = 100 - 800 µm
- Dispersion = 30-50 %
- Productivy = 5 L / h

  (assuming a 20 L reactor)
- Time of mixing 5 - 20 min

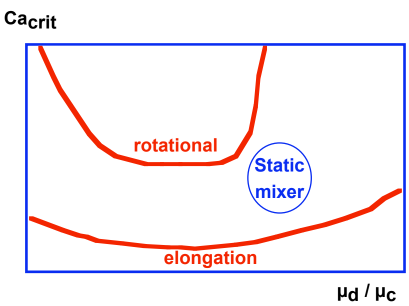
d : droplet diameter, D: reactor diameter, k: design constant, We: Weber number, ρ : density, u: impeller speed, σ : interfacial tension,

- Generally laminar flow
- d = 10 - 500 µm
- Dispersion = 20 - 40 %
- Productivy > 100 L /h

  (assuming 10 cm x 1 cm static mixer)
- Time of dispersion < 1 sec

Size control in static mixers

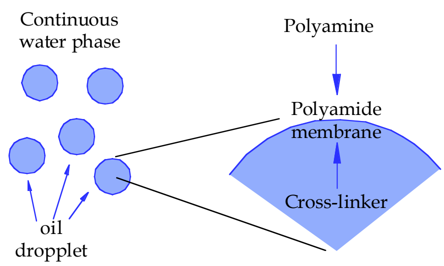
In laminar flows, droplet breakage is controlled by deformation intensity due to rotational shear and/or elongation. The droplet size is deduced from critical capillary number (Ca). This last is function of the viscosity ratio of dispersed/continuous phases and the design of dispersion system.



$$\frac{d}{D_p} = \frac{2\sigma \ Ca_{cr}}{\mu_c \ u_p}$$

d : droplet diameter, σ : interfacial tension, Ca_{crit}: critical capillary number, D_p: pore diameter, u_p: pore liquid velocity, μ : viscosity, c: continuous phase, d : dispersed phase

Applications



- Thermal gelation : K-carrageenane
- Ionic gelation : Alginate
- Polymerization : Nylon
- Cross-linking : Chitosan
- Emulsion & double emulsion
- Formulation before spray drying

ENITIAA and IUT St_Nazaire*, UMR CNRS 6144 GEPEA, rue de la géraudière, 44322 Nantes cedex 3, France - contact : poncelet@enitiaa-nantes.fr