A First Course on Kinetics and Reaction Engineering

Unit 36. Segregated Flow Models

Definitions

micro-mixing - mixing that occurs within a single fluid element

macro-mixing - mixing that occurs between fluid elements

Nomenclature

λ	age (or residence time) of a fluid element leaving a reactor
C_i	concentration of species i, an overbar indicates the average over all fluid elements
$F(\lambda)$	age function equal to the fraction of the fluid leaving a reactor with an age less than λ
$\dot{V}$	volumetric flow rate
n_i	moles of species i, an overbar indicates the average over all fluid elements
t	residence time, an overbar indicates the average over all fluid elements, a prime indicates its use as a dummy variable for integration

Equations

$$dF(\lambda) = \frac{dF}{d\lambda} d\lambda \tag{36.1}$$

$$\overline{n}_i = \int_{F=0}^{F=1} \dot{V} C_i(t') dF(t') = \dot{V} \int_{F=0}^{F=1} C_i(t') dF(t') \tag{36.2}$$

$$\overline{n}_i = \dot{V} \int_{t'=0}^{t'=\infty} C_i(t') \left. \frac{dF(\lambda)}{d\lambda} \right|_{\lambda=t'} dt' \tag{36.3}$$

$$\overline{C}_i = \frac{\overline{n}_i}{\dot{V}} = \int_{t'=0}^{t'=\infty} C_i(t') \left. \frac{dF(\lambda)}{d\lambda} \right|_{\lambda=t'} dt' \tag{36.4}$$

$$\overline{t} = \int_{t'=0}^{t'=\infty} t' \left. \frac{dF(\lambda)}{d\lambda} \right|_{\lambda=t'} dt' \tag{36.5}$$

$$\overline{f}_i = \int_{t'=0}^{t'=\infty} f_i(t') \left. \frac{dF(\lambda)}{d\lambda} \right|_{\lambda=t'} dt' \tag{36.6}$$

$$\int_{F=0}^{F=1} dF(t') = 1 \tag{36.7}$$

$$\int_{t'=0}^{t'=\infty} \left. \frac{dF(\lambda)}{d\lambda} \right|_{\lambda=t'} dt' = 1 \tag{36.8}$$