Process Intensification and Green Chemistry – Notation and Symbology

Chapter 6 (Mixing)

Roman symbol	Definition	Units	Comments
A	Constant (Inertial-convective mesomixing timescale)		$1 < A < 2$ depending on turbulence level
A	absorbance in the experimental cell of length x mm		
A'	absorbance for a 1 mm optical path length		
b_s	inverse of characteristic mixing time	1/s	function of the mixing intensity
c_i or $c_i(t)$	molar concentration of species i	mol/m^3	
$c_{i,0}$	initial molar concentration of species i	mol/m^3	
$\bar{c}_i$	residence-time averaged exit concentration of species i	mol/m^3	
C_D	discharge coefficient of impeller		$0.7 < C_D < 1$
D or D_m	molecular or mass diffusivity	m^2/s	
D_i	impeller diameter	m	
D_{turb}	turbulent diffusivity	m^2/s	
DaI	first Damköhler number		
$DaII_{mx}$	second Damköhler number for mixing		$= t_{mx}/t_r$
$E(t)$	exit age distribution	1/s	
f_i	unconverted fraction of species i		
I	ionic strength	mol/m^3	
I_S	intensity of segregation		
k_j	reaction rate constant for reaction j at temperature T	variable	units depend on the reaction order
k_{mx}	reaction rate constant of complete (fully) segregated conditions		
K_B	equilibrium constant		
l	optical path length	m	
L	total reactor length	m	
L_C	integral length scale of turbulence or concentration macroscale	m	
L_D	characteristic length scale for turbulent dispersion	m	
M	ratio of initial molar concentrations		
n	partial or overall reaction order		
N	agitation speed	1/s	
p	pressure	Pa	
Δp	pressure drop	Pa	
Q	volumetric flow rate	m^3/s	
Q_f	Inlet flow rate	m^3/s	

r_j	reaction rate of reaction j	mol/m^3/s	
$\bar{r}$	mean reaction rate	mol/m^3/s	
r_d	rate of decay of the concentration variance	mol^2/m^6/s	
r_{pipe}	radius of pipe for feed introduction	m	
R	radius	m	
$\bar{R}_i$	mean net rate of disappearance of species i	mol/m^3/s	
Re	Reynolds number		
$S_{P/R}$	selectivity of product P with respect to reactant R		
Sc	Schmidt number		
t	time	s	
$\bar{t}$	mean residence time	s	
t_E	characteristic micromixing time for engulfment model	s	
t_r	characteristic reaction time	s	
t_{mx}	characteristic mixing time	s	
T	temperature	°C or K	
u	flow velocity	m/s	
u_m	mean flow velocity	m/s	
V	vessel volume or volume at position z along reactor length	m^3	
$\dot{V}$	volumetric flow rate	m^3/s	
V_{CS}	completely segregated volume	m^3	
V_R	total reactor volume	m^3	
V_{PM}	perfectly mixed volume	m^3	
X_i or $X_i(t)$	molar conversion of species i		
$\bar{X}_i$	residence-time average exit conversion of species i		
X_S	segregation index		
Y	molar yield		
Y_{CS}	molar yield of complete (fully) segregated conditions		
$Y_{P/R}$	molar yield of product P with respect to reactant R		
z	position along reactor length	m	
z_i	charge number of ion i		
Z	dimensionless position along reactor length		
Greek symbols	**Definition**	**Units**	**Comments**
α	micromixedness ratio		
α_i	ratio of volumetric flow rate of stream i to the total volumetric flow rate		
ε	turbulent energy dissipation rate	W/kg	
ε_λ	molar attenuation (or extinction) coefficient (or absorptivity) of the attenuating species i in the material sample at wavelength λ	m^2/mol	
λ_B	Batchelor length scale	m	
λ_K	Kolmogorov length scale or size of the smallest eddy	m	
μ	dynamic viscosity	Pa s	

ν	kinematic viscosity	m^2/s
ρ	specific gravity or density	kg/m^3
σ^2	variance in the concentration	mol^2/m^6
τ	space time	s
τ_B	time to dissipate eddy of size λ_B	s
τ_c	mean circulation time in mechanically stirred reactor	s
τ_{CSTR}	space time in CSTR	
τ_D	characteristic mesomixing timescale for turbulent dispersion	s
τ_{Ds}	half-life of molecular diffusion within progressively thinning lamellae	s
τ_K	time to dissipate eddy of size λ_K or time for mixing by molecular diffusion within Kolmogorov scale	s
τ_{PFR}	space time in PFR	s
τ_S	inertial-convective mesomixing time	s
Abbreviation	**Definition**	
CSTR	continuous stirred tank reactor	
GC	gas chromatography	
IEM	interaction by exchange with the mean	
PFR	plug flow reactor	
RTD	residence time distribution	