17. Notation.

Symbols	Meaning, Reference	Dimension
A,B,C,P,Q,R,S	reagents	-
A	intermaterial area	m^2
A	cross-flow area in eqs.(2.74)÷(2.79)	m^2
A_c	cross-flow area	m^2
A_i	dimensionless rate of deformation	-
a	volume ratio	-
a	radius of core stream (chap. 4.4)	m
a_V	intermaterial area per unit volume	m^{-1}
C	dimensionless concentration	-
C	dimensionless wave speed (chap. 4)	-
C_i	dimensionless concentration of substance i	-
C_E	energetic cost of mixing	J/m^3
c	concentration	mol/m^3, mol/dm^3
c	wave speed (chap. 2.5 and 4)	m/s
c_i	concentration of substance i	mol/m^3, mol/dm^3
$c_\infty(x)$, $c_\infty(r)$	universal concentration profiles	mol/m^3
c_{A0}	solubility of monomer in eq.(2.16)	kg/m^3
$\overline{c_{i0}} = c_{i0}/(1+a)$	average initial concentration	mol/m^3, mol/dm^3
c_{NaOH}	limiting concentration of NaOH	mol/kg
$\overline{c}_u, \overline{c}_l$	mean concentration in upper and lower part of diffusion chamber	mol/kg
c_V	specific heat	J/(K·kg)
D	molecular diffusivity	m^2/s
D	vessel diameter (chap. 2.4 and 7)	m
D_i	molecular diffusivity of substance i	m^2/s
D_T	thermal diffusivity	m^2/s
D_{ii}	diagonal element of deformation tensor	s^{-1}
$\overline{\overline{D}}$	deformation tensor	s^{-1}
Da	Damköhler number	-
$\overline{Da} = Da/(1+a)$	modified Damköhler number	-
d	impeller diameter	m

d	separation distance in eqs.(2.64)÷(2.65)	m
d	inlet diameter (chap. 10)	m
E	activation energy	J/mol
E	residence time distribution (chap. 2)	s^{-1}
E_{ij}	kinetic energy of particle	J
e	energy input on mixing	J
e_m	minimum energy input on mixing	J
eff	energetic efficiency of mixing	-
eff_V	efficiency of mixing	-
erf	error function $erf(x) = \frac{2}{\sqrt{\pi}} \cdot \int_0^x e^{-x^2} dx$	-
F_i	stoichiometric ratio	-
f, f_i	concentration fraction	-
f	oscillation frequency (chap. 6 and 8)	Hz
G	shear rate	s^{-1}
g	vector correlation coefficient	-
H	liquid depth in vessel	m
He	Heat release parameter	-
h	distance between planes inducing shear flow	m
I_S, I_{SR}, I_{SE}	intensities of segregation	-
I_{kl}	concentration moment	m^2
i	imaginary unit	-
J_i	molar stream	$mol/(s \cdot m^2)$
k, k_1, k_2	second-order reaction rate constants	$m^3/(mol \cdot s)$
		$dm^3/(mol \cdot s)$
L	scale of segregation (chap. 2.1)	m
L	length of cylinders in eqs.(2.64)÷(2.65)	m
L	lenght of mixing units in eq.(2.79)	m
L	reactor scale (chap. 2.3)	m
L	characteristic length scale (chap. 3 and 5.2)	m
L	total length of diffusion chamber (chap. 6)	m
l	width of feeding stream	m
l_m	mean separation distance	m
l_{ij}	distance separating points i and j	m
l_∞	limiting penetration distance	m

M	amount of shear	-
M_i^j	dimensionless gradient concentration moment	-
m	feed discretization	-
m_P	particle mass	kg
N	number of mixing units in static mixer	-
N_i	number of moles of reactant i	mol
$\hat{N}$, $\hat{n}$	direction versors	-
$\dot{N}_i$	total number of moles consumed per unit area at reaction plane (chap. 5.2)	mol/m^2
$\dot{N}_i$	molar inlet stream of reagent i (chap. 10)	mol/s
n	impeller revolution speed	rev/s, rev/min
n	azimuthal mode number (chap. 2.5)	-
n_T	turbine revolution speed	rev/min
P	power input	W
P	pressure in undisturbed flow (chap. 2.5 and 4)	Pa
P_M	minimum power input on mixing	W
P_T	power input on liquid transport	W
Po	power number	-
Pr	Prandtl number	-
p	pressure	Pa
p'	pressure perturbation (chap. 2.5 and 4)	Pa
Q	volumetric flow	m^3/s
Q_c	circulation flow	m^3/s
Q_f	feeding rate	m^3/s, cm^3/min
Q_V	product output	s^{-1}
q	heat release	J/kg
R	universal gas constant	J/(mol·K)
R	mixing unit radius in eq.(2.79)	m
R	filament radius (chap. 3)	m
R	pipe radius (chap. 4)	m
R_i	reaction rate	$mol/(s\cdot m^3)$ $mol/(s\cdot dm^3)$
R_1,R_2	radiuses of annular gap (chap. 8.2)	m
Re	Reynolds number	-

Re_G	generalized Reynolds number	-
Re_S	Reynolds number for annular gap	-
Re_w	Reynolds number for core stream (chap. 4)	-
$\vec{r}$	separation vector	m
r,θ,z	polar coordinates	m, radians,m
r_1,r_2	radiuses of on-line mixer inlets	m
Sc,Sc_i	Schmidt numbers	-
s	striation thickness	m
s	slab thickness (chap. 3, 5, 7 and 9)	m
T	temperature	K, deg
T	dimensionless time (chap. 3)	-
t	time	s
t_C	characteristic scaling time	s
t_c	circulation time	s
t_D	characteristic diffusion time	s
t_{DF}	characteristic mixing time	s
$t_{D1/2}$	mixing time in "rigid" fluid	s
$t_{E1/2}$	mixing time in elongational flow	s
t_F	characteristic deformation time	s
t_f	lifetime of limiting reactant	s
t_{fd}	feeding time	s, min
t_m	mixing time	s
t_R	characteristic reaction time	s
t_{res}	residence time	s
$t_{S1/2}$	mixing time in shear flow	s
$\hat{t}$	tangential versor	-
U,W	radial and axial velocities of unperturbed flow	m/s
U_x	dimensionless translation velocity	-
u,w	radial and axial velocities	m/s
u′,w′	radial and axial velocity perturbations	m/s
V	volume	m^3, dm^3
V_i	volume of solution i	m^3, dm^3
V_i	velocity components of undisturbed flow (chap. 2.5)	m/s

v	velocity	m/s
v_i	linear velocity components	m/s
v_i'	velocity perturbations (chap. 2.5)	m/s
v_n	normal velocity component	m/s
v_r, v_θ, v_z	cylindrical velocity components	m/s
v_r', v_θ', v_z'	cylindrical velocity perturbations (chap. 2.5)	m/s
v_x, v_y, v_z	linear velocity components	m/s
v_x', v_i'	velocity components in Lagrangian frame	m/s
v_{ij}	particle velocity	m/s
$\vec{v}$	velocity vector	m/s
w_P	weight fraction of polymer	-
X	selectivity	-
X,Y,Z	dimensionless distances (chap. 3 and 5.2)	-
X,Y,Z	relative changes of distances in eq.(2.10)	-
$\vec{X}$	position of Lagrangian point	m
x,y,z	Cartesian coordinates	m
x_i	Cartesian coordinate	m
x', x_i'	Cartesian coordinates in Lagrangian frame	m
x_R	position of reaction plane	m
$x_{\lambda/2}$	half wave length of instability	m
$\vec{x}$	position vector	m
Y_i	conversion of reagent i	-
Ze	Zel'dovich number	-
α	rate of stretch	s^{-1}
α	wave number (chap. 2.5 and 4)	m^{-1}
α'	rate of stretch in rotating frame	s^{-1}
α_i	rate of deformation in direction i	s^{-1}
$\alpha_x, \alpha_y, \alpha_z$	direction angles (chap. 2)	radians
$\alpha_x, \alpha_y, \alpha_z$	deformation rates (chap. 5.2)	s^{-1}
β	deflection angle	radians
Γ	dimensionless time	-
Δ_i	dimensionless displacement of reactant profile	-
ΔN_i	number of moles consumed in reaction	mol
Δp_{mixer}	pressure drop in static mixer	Pa

Δp_{tube}	pressure drop in empty tube	Pa
δ	layer thickness (chap. 2 and 8)	m
δ	delta function (chap. 3)	-
δ	phase shift (chap. 6)	deg
δ,δ_i	penetration distance (chap. 5.1, 7 and 9)	m
δ_i	dimensionless gradient width (chap. 5.2 and 8)	-
δ_1,δ_2	width of regions in eq.(2.3)	m
δ_{kl}	Kronecker's symbol	-
ε	rate of energy dissipation per unit volume	$kg/(m \cdot s^3)$
ζ_x	denotes microflow element	-
η	area stretch	-
η	global stoichiometric balance (chap. 10)	-
$\theta=t_D/t_F$	characteristic time ratio (chap. 5.1, 7 and 9)	-
θ_T	dimensionless temperature	-
$\varkappa$	conductivity	S/cm
λ	stretch ratio	-
λ	wavelength (chap. 4)	m
λ	constant in Neumann's solution (chap 5.2)	-
λ_x	scale of microflow element	m
μ	dynamic viscosity	$Pa \cdot s$
ν	kinematic viscosity	m^2/s
ν_i	stoichiometric coefficient	-
ξ	dimensionless position	-
ξ	disturbance of liquid-liquid interface (chap. 4)	m
$\vec{\xi}$	position vector in Lagrangian frame	m
ξ_i	Cartesian coordinates in Lagrangian frame	m
ξ_R	dimensionless position of reaction plane	-
Π_1	modified power number	-
Π_2	modified mixing time number	-
ρ	density	kg/m^3, g/cm^3
σ	interfacial surface tension	N/m
$\vec{\sigma}$	normal stress	N/m^2
τ	warped time	-
τ	shear stress in eq.(2.8)	N/m^2

τ	relaxation time (chap. 6)	s
$\tau_{1/2}$	warped time related to $t_{E1/2}$, $t_{S1/2}$ and $t_{D1/2}$	-
ϕ	volume fraction	-
ϕ	component of Stoke's stream function (chap. 2.5 and 4)	m^3/s
ϕ	$\varepsilon/\bar{\varepsilon}$ (chap. 7 and 9)	-
$\vec{\chi}$	vector motion function	m
ψ	Stoke's stream function (chap. 2.5 and 4)	m^3/s
ψ	dimensionless rate of growth of reaction zone (chap. 5.1)	-
ψ	lamina deflection angle (chap. 3)	radians
$\overline{\overline{\Omega}}$	rotation tensor	s^{-1}

More Important Subscripts

c	continuous phase
d	dispersed phase
f	final value
max	maximum value
o	initial value
out	refers to outlet stream (chap. 4)
1	refers to central stream (chap. 4 and 10)
2	refers to annular stream (chap. 4 and 10)

More Important Superscripts

$\bar{\ }$	mean value
T	matrix transposition
∞	denotes far field value

Special Symbols

$\lvert\ \rvert$	absolute value
Im	imaginary part
< >	environment variable
$\langle\ \rangle_{\zeta_x}$	mean in microflow element
$\langle\ \rangle_A$	area average

$\langle\langle\ \rangle\rangle_A$	mean flow average - $\langle\langle f\rangle\rangle_A = \langle v_n \cdot f\rangle_A / \langle v_n\rangle_A$
$\langle\ \rangle_V$	volume average
$\langle\ \rangle_{exit}$	mean at exit

Differential Operators

$$\nabla = \left[\frac{\partial}{\partial x}\ ,\ \frac{\partial}{\partial y}\ ,\ \frac{\partial}{\partial z}\right] \quad \text{in Catresian coordinates}$$

$$\nabla = \left[\frac{1}{r}\cdot\frac{\partial}{\partial r}r\ ,\ \frac{1}{r}\cdot\frac{\partial}{\partial \theta}\ ,\ \frac{\partial}{\partial z}\right] \quad \text{in polar coordinates}$$

$$Grad\vec{v} = \frac{\partial v_j}{\partial x_i} \qquad i,j = 1,2,3$$

$$\frac{d}{dt} = \frac{\partial}{\partial t} + \sum_{i=1}^{3} v_i \cdot \frac{\partial}{\partial x_i}$$