Process Intensification and Green Chemistry – Notation and Symbology

Chapter 5 (Miniaturization)

Roman symbol	Definition	Units	Comments
a	surface area per unit volume	1/m	
a_s	catalyst surface area per unit reaction volume	1/m	
A	area	m^2	
A/V	surface area of heat transfer to reaction volume	1/m	
c	molar concentration	mol/m^3	
c_{in}	inlet molar concentration	mol/m^3	
c_{out}	outlet molar concentration	mol/m^3	
c_p	specific heat capacity	J/kg/K	
c_0	initial molar concentration	mol/m^3	
$c_{i,0}^{S}$	initial molar concentration of species i at the catalyst surface	mol/m^3	
d or D	inner tube diameter	m	
D_m or D	mass diffusivity	m^2/s	
Da or Da_I	first Damköhler number		
k	reaction rate constant at temperature T	variable	units depend on the reaction order
k_g	gas/solid mass transfer coefficient	m/s	
k_{js}	surface reaction rate constant of reaction j	variable	units depend on the reaction order
k_s	liquid/solid mass transfer coefficient	m/s	
L_c	channel length	m	
m_i	partial reaction order of species i		
n	reaction order		
n_o	number of orifices		
N	agitation speed	rpm	
N_c	number of channels		
Nu	Nusselt number		
NOU	number of operation units		
NTU	number of transfer units of heat exchanger		
p	pressure	Pa	
Δp	channel pressure drop	Pa	
Q	volumetric flow rate	m^3/s	

Symbol	Definition	Units	Comments
r	reaction rate	mol/m³/s	
r or R	radius	m	
Re	Reynolds number		
S	channel cross section	m²	
$S_{P/R}$	molar selectivity of product P with respect to reactant R		
Sh	Sherwood number		
t	time	s	
t_{op}	characteristic time or operation time	s	different characteristic times can be determined, for further details visit slides 6 and 7 of the chapter
t_{glob}	global characteristic time	s	
t_r	reaction time	s	
T	temperature	°C or K	
T_{in}	inlet stream temperature	°C or K	
T_{out}	outlet stream temperature	°C or K	
T_w	cooling/heating thermofluid temperature or wall temperature	°C or K	generally assumed to be constant across reactor length
u	velocity	m/s	
U	overall heat transfer coefficient	W/m²/K	
V	volume	m³	
x	property		
X	conversion		

Greek symbols	Definition	Units	Comments
η	process efficiency or conversion		
θ	liquid-solid contact angle		
λ	thermal conductivity	W/m/K	
μ	dynamic viscosity	Pa s	
ρ	density	kg/m³	
σ	surface tension	N/m	
τ	space time for continuous reactors or reference time	s	
τ_{mod}	modified space time for heterogeneous reactors	kg s/m³	

Abbreviation	Definition
CSTR	continuous stirred tank reactor
PFR	plug flow reactor