Symbols	Definition	Units	Lect. No.	Time
r_A	Reaction rate	mol / m^3 sec	1	03:12
k	Rate constant	sec^{-1}	1	"
C_A	Concentration of reactant A	mol / m^3	1	"
E	Energy	J	1	20:22
ΔE	Activation energy	J / mol	1	21:16
ΔH	Heat of the reaction	J / mol	1	21:46
k_0	Arrhenius constant	-	1	26:32
R	Ideal gas constant	J / mol K	1	"
T	Temperature	K	1	"
A	Reactant	-	1	30:35
B	Product	-	1	"
S	Surface of the solid catalyst	-	1	45:21
k_{ads}	Rate constant for Adsorption isotherm	sec^{-1}	2	14:22
C_{AS}	Concentration of adsorbed species	mol / m^3	2	"
C_S	Concentration of vacant site	mol / m^3	2	"
C_A	Concentration of species A in the bulk	mol / m^3	2	"
C_t	Total concentration of site	mol / m^3	2	16:30
p_{CO}	Partial pressure of species CO	atm	2	24:36
K_{eqr}	Equilibrium reaction rate constant	-	2	30:12
r_d	Rate of desorption	mol / m^3 sec	2	40:24
r_{ads}	Rate of adsorption	mol / m^3 sec	3	08:12
k_a, k_r, k_d	Rate constant for adsorption, reaction and desorption	sec^{-1}	3	"
r_R	Rate of chemical reaction	mol / m^3 sec	3	"
r_O	Overall rate of the reaction	mol / m^3 sec	3	13:58
K_A	Adsorption equilibrium constant for A	-	3	18:35

K_B	Adsorption equilibrium constant for B	-	3	19:50
n	Order of reaction	-	3	30:15
$r_T^{'}$	Reaction rate of toluene	mol/gcat/sec	4	12:22
k	Specific reaction rate	mol/atm2/gcat/sec	4	“
r_{Ad}, r_S, r_D	Adsorption, surface reaction & desorption rates	mol/gcat/sec	4	21:30
k_A, k_s	Specific adsorption and adsorption rates	1/sec/atm	4	“
k_B	reaction rate constant	1/sec		
C_v	Concentration of vacant site	mol/gcat	4	“
p_T, p_{H_2}, p_M, p_B	Partial pressure of toluene, hydrogen, methane, benzene	atm	4	“
$C_{T.S}, C_{B.S}$	Concentration TS, BS occupied site	mol/gcat	4	“
K_T, K_B	Adsorption and desorption equilibrium constant	atm-1	4	“
K_s	Surface reaction equilibrium constant	atm	4	
C_t	Total number of site in the catalyst	mol/gcat	4	“
K_p	Overall partial pressure equilibrium constant $\left(K_T K_S\right)/K_B$	atm	4	“
p_{T_0}	Total partial pressure	atm	4	50:35
X	Conversion	-	4	“
F_{T_0}, F_T	Molar flow rate at inlet and outlet	mol/sec	4	41:40
p_0	Total inlet pressure	atm	4	“
ε	Total fractional change in the number of mole	-	4	46:00
y	Ratio of local pressure w.r.t. initial total pressure	-	4	47:46
θ_{H_2}	Ratio of amount of H2 present in the feed w.r.t amount of toluene present in the feed	-	4	48:10
α	Pressure drop parameter	-	5	05:05
W	Weight of the catalyst	kg	5	16:00
V	Volume of the reactor	m3	5	“
$r_{dep}^{''}$	Rate of deposition of germanium	nm/s	5	27:35
f_{GeCl_2}, f_H	Fraction of sites occupied by GeCl2 and H	-	5	“
k	Specific reaction rate constant	nm/s	5	“

C_t	Total number of active sites	-	6	02:15
$a(t)$	Instantaneous activity of catalyst	-	6	07:15
$k(T)$	Specific reaction rate constant	Depends on rate law	6	13:16
r_d	Catalyst decay rate	sec-1	6	14:40
S_A	Active surface area of the catalyst	m2	6	27:00
$k_d(T_0)$	Decay rate constant at reference temperature	sec-1	6	28:30
N_{A_0}	Initial number of moles of the reactant A	mol	6	32:00
C_{A0}	Initial concentration of species A	mol/m3	6	34:00
C_C	Carbon deposited on the surface	g/m2	6	39:25
C_P	Concentration of poison in the gas phase	mol/m3	7	08:45
C_{t0}	Total active site concentration at t=0	mol/m3	7	10:08
C_{PS}	Concentration of site in which P is presents	mol/m3	7	"
E_d	Activation energy for deactivation of catalyst	J/mol	7	41:45
t	Time	sec	7	43:26
A	Frequency factor	sec^{-1}	8	45:33
F_{A_0}	Entering molar flow rate of species A	mol / sec	8	47:35
F_A	Molar flow rate of species A	mol / sec	8	"
V	Volume of the reactor	m^3	8	"
W	Weight of the catalyst	gm	8	"
D_e	Effective diffusivity	m^2 / sec	9	13:08
D_A	Knudsen diffusivity	m^2 / sec	9	"
ϕ_P	Porosity	-	9	"
τ	Tortuosity	-	9	"
R	Radius of the catalyst	m	9	20:40
W_{Ar}	Molar Flux of species A in radial direction	mol / m^2 sec	9	23:25

ρ_C	Density of the particle	gm / m^3	9	"
k_n	Rate constant (per unit volume)	1/sec.	9	30:10
	Rate constant (per unit weight)	m^3 / gm sec	9	"
	Rate constant (per unit area)	m / sec.	9	"
S_a	Surface area per unit mass of catalyst	m^2 / gm	9	"
C_{A_S}	Concentration of species A in the bulk	mol / m^3	9	"
ψ	Dimensionless concentration	-	9	45:00
λ	Dimensionless radial distance	-	9	"
ϕ_n	Thiele modules	-	9	52:20
η	Effectiveness factor	-	10	27:35
r_{A_S}	Reaction rate at surface (per unit area)	mol / m^2 sec	10	34:20
r'_{A_S}	Reaction rate at surface (per unit weight)	mol / gm sec	10	"
r''_{A_S}	Reaction rate at surface (per unit volume)	mol / m^3 sec	10	"
M_A	Actual/observed molar rate	mol / sec	10	36:00
M_{AS}	Actual molar rate calculated at external surface	mol / sec	10	"
r_A^i	Intrinsic reaction rate	mol / m^3 sec	11	27:36
v_0	Entering volumetric flow rate	m^3 / sec	11	29:25
v	Volumetric flow rate	m^3 / sec	11	"
$r_{A,obs}$	Observed reaction rate	mol / m^3 sec	11	40:25
T_i	Temperature inside a particle	K	11	51:11
β	Adiabatic temperature rise	-	12	07:41
ΔT_{max}	Maximum temperature rise inside the particle	K	12	"
T_S	External surface temperature	K	12	"
γ	Dimensionless activation energy	-	12	12:12
C_{Ab}	Concentration of species A in the bulk	mol / m^3	13	26:36
C_{AS}	Concentration of species A on the surface	mol / m^3	13	"

J_A	Molecular diffusive flux of species A	mol / m^2 sec	13	33:03
W_A	Diffusion flux for equimolar reaction	mol / m^2 sec	13	38:33
k_C	Mass transfer coefficient	m / sec	13	39:22
δ	Film thickness	m	13	“
r_A	Reaction rate per unit external surface area	mol / m^2 sec	13	43:40
k_r	Reaction rate constant per unit external surface area	m / sec	13	
Re	Reynolds number	-	14	08:45
Sc	Schmidt number	-	14	“
Nu	Nusselt number	-	14	10:00
D	Diameter	m	14	“
k	Thermal conductivity	J / m sec K	14	“
h	Convectional heat transfer coefficient	J / m^2 sec K	14	“
Pr	Prandtl number	-	14	“
Sh	Sherwood number	-	14	13:15
C_P	Specific heat	J / mol K	14	“
μ	Viscosity	m / sec	14	“
ρ	Density	g / m^3	14	“
υ	Kinematic viscosity	m^2 / sec	14	“
d_p	Diameter of the particle	m	14	18:39
D_A	Diffusivity	m^2 / sec	14	“
U	Velocity	m / sec	14	20:40
a_c	Mass transfer area per unit volume of reactor	m^2 / m^3	14	35:33
F_A	Molar flow rate	mol / sec	14	“
C_{A0}	Initial Concentration of species A	mol / m^3	14	45:35
X	Conversion	-	14	46:10
L	Length of the reactor	m	14	“
C_{WP}	Weisz-Prater parameter	-	15	05:03
ρ_b	Bulk density	g/m3	15	28:00
k_C	Mass transfer coefficient	m/sec	15	“

C_{Ab}	Concentration of A in bulk	mol/m3	15	“
W_{AZ}	Flux of the species A at z	mol/m2/sec	15	
D_{AB}	Dispersion coefficient of species A	m2/sec	15	40:00
y_{Ab}	Mole fraction of species A in bulk	-	15	“
U	Superficial velocity	m/sec	15	“
C	Total concentration	mol/m3	15	“
Ω	Overall effectiveness factor	-	15	44:45
Φ	Generalized criterion for internal diffusion limitation	-	16	15:00
$C_{A,eq}$	equilibrium concentration of species A at center of catalyst	mol/m3	16	15:58
D_{eA}	Effective diffusivity of species A	m2/sec	16	“
K_2	Adsorption equilibrium constant for CO	cm3/mol	16	21:20
K_3	Adsorption equilibrium constant for CO2	cm3/mol	16	“
A_i	ith species participating in network of 1st order reactions	-	16	30:30
C_j	Concentration of jth species	mol/m3	16	“
k_{ij}	Specific reaction rate for the reaction that leads to formation of ith species starting from jth species	mol/m3/sec	16	“
D_i	Diffusivity of species Ai	m2/sec	16	34:00
∇^2	Laplacian	-	16	36:06
I	Identity matrix	-	16	41:04
k_c	Mass transfer coefficient	m/sec	16	45:50
a_c	Surface are per unit volume	m2/m3	16	“
Re_p	Reynolds number based on particle diameter	-	16	47:10
ϕ	Porosity	-	16	48:15
$-r'_A$	Rate of disappearance of species A	mol/m3 sec	17	01:05
k_c	Mass transfer coefficient	m/sec	17	“
a_c	Surface area per unit volume	m2/m3	17	“
C_A	Concentration of species A in bulk	mol/m3	17	“
Sh	Sherwood number	-	17	“

d_p	Diameter of the particle	m	17	“
D_{AB}	Dispersion coefficient	m2/sec	17	“
ϕ	Porosity	-	17	“
Re	Reynolds number	-	17	“
U	Superficial velocity	m/sec	17	“
Sc	Schmidt number	-	17	“
ν	Kinematic viscosity	m2/sec	17	“
R	Radius of the catalyst particle	m	17	06:45
n	Order of the reaction	-	17	“
k_n	nth order rate constant	-	17	“
C_{AS}	Concentration of species A at surface	mol/m3	17	“
D_e	Effective diffusivity	m2/sec	17	“
A_T	Frequency factor	sec-1	17	“
E	Activation energy	J/mol	17	“
R	Ideal gas constant	J/mol K	17	“
T	Temperature	K	17	“
S_a	Surface area per unit volume	m2/m3	18	08:37
P	Pressure	atm	18	“
L	Length	m	18	“
X	Conversion	-	18	“
h_m	Height of the catalyst packed in scattered condition	m	18	19:26
ε_{mf}	Porosity of the bed under minimum fluidization condition	-	18	29:46
u_b	Bubble rise velocity	m/sec	18	“
δ	Fraction of reaction consist of bubbles	-	18	“
W_S	Mass of catalyst particle present in the reactor	g	18	30:50
ρ_c	Density of catalyst	g/m3	18	“
A_c	Cross sectional area	m2/m3	18	“
h_s	Height of the settled catalyst	m	18	“
ε_s	Porosity of the settled catalyst	-	18	“
h	Height of the catalyst at any time	m	18	“
ε	Porosity of the catalyst at any time	-	18	“
ΔP	Pressure drop (differential pressure)	atm	18	34:00
g	Gravity	m/sec2	18	“
ρ_g	Density of gas	g/m3	18	“
ψ	Sphericity of particle	-	18	“
u_{mf}	Minimum fluidization velocity	m/sec	18	“

η	Density difference between catalyst and gas $\left(=\left[\rho_c-\rho_g\right]\right)$	g/m3	18	36:40
V_P	Volume of the catalyst particle	m3	18	"
A_P	Area of the catalyst particle	m2	18	"
u_t	Maximum fluidization velocity	m/sec	18	"
μ	Viscosity	g/m/sec	18	"
u_e	Velocity of gas in emulsion phase	m/sec	18	47:21
u_S	Velocity of solid flow downward in the emulsion phase	m/sec	18	"
u_{br}	Bubble rise velocity	m/sec	18	"
u_b	Velocity of gas in bubble phase	m/sec	18	"
u_0	Superficial velocity	m/sec	18	"
d_{bm}	Maximum possible bubble diameter	m	19	10:35
d_b	Bubble diameter	m	19	"
d_{b0}	Initial bubble diameter	m	19	"
D_t	Diameter of the bed	m	19	"
n_d	Number of perforation present in perforated plate	-	19	"
δ	Fraction of total bed that is bubbles	-	19	17:00
α	Ratio of volume of wakes per volume of bubbles formed by fluidization	-	19	"
k_b, k_c, k_e	Rate constant of bubble, cloud and emulsion phase	sec-1	19	28:42
C_{Ab}, C_{Ac}, C_{Ae}	Concentration of species A in bubble, cloud and emulsion phase	mol/sec	19	"
$-r_{Ab}, -r_{Ac}, -r_{Ae}$	Rate of disappearance of species A in bubble, cloud and emulsion phase	mol/m3/sec	19	"
$\gamma_b, \gamma_c, \gamma_e$	Ratio of volume of solid catalyst in bubble phase to volume of bubble	-	19	44:12
$A(g)$	Reactant A in gas phase	-	20	02:40
$B(l)$	Reactant B in liquid phase	-	20	"
$C(l)$	Product C in liquid phase	-	20	"
υ	Stoichiometric factor	-	20	"
C_A	Concentration of reactant A	mol / m3	20	"
C_B	Concentration of reactant B	mol / m3	20	"
k	Rate constant	(m3/mol)m+n-1/s	20	"
$-r_A$	Rate of disappearance of reactant A by	mol / m3	20	"

	reaction			
m	Order of reaction for reactant A	-	20	“
n	Order of reaction for reactant B	-	20	“
δ	Thickness of the film	m	20	15:00
D_A	Diffusivity	m2 / sec	20	“
x	Distance from the interface in the liquid	m	20	“
C_A^*	Concentration of A on the gas side at the G-L interface	mol / m3	20	18:20
C_{Ab}	Concentration of A in bulk liquid	mol / m3	20	“
N_A	Molar flux of absorption of A	mol /m2 sec	20	20:00
k_L	Mass transfer coefficient for liquid	m / sec	20	22:00
t	Time	sec	20	30:00
$N_{Ai}(t)$	Instantaneous molar flux	mol /m2 sec	20	37:00
$I(t)dt$	Fraction of all surface elements of age between t and t+dt	-	20	42:18
t_b	Mean residence time	sec	20	44:17
d_b	Diameter of the bubble	m	20	48:48
u_b	Rise velocity of bubble	m / sec	20	“
s	Surface renewal rate $(=1/t_b)$	sec-1	20	52:35
C_{Bb}	Concentration of B in liquid bulk	mol / m3	21	10:18
a	Dimensionless concentration of A $(=C_A/C_A^*)$	-	21	“
b	Dimensionless concentration of B $(=C_B/C_{Bb})$	-	21	“
ξ	Dimensionless distance $(=x/\delta)$	-	21	“
$\sqrt{M}$	Hatta number (Ha)	-	21	13:05
q	Relative abundance factor	-	21	17:30
a_b	Dimensionless bulk concentration of A $(=C_{Ab}/C_A^*)$	-	21	20:10
â	Interfacial area per unit volume of liquid	m2 / m3	21	31:05
V_L	Volume of liquid	m3	21	34:00

P	Ratio of characteristic time for mass transfer and characteristic time for reaction	-	21	35:10
R_A	Rate of absorption	mol / m3s	21	37:50
E	Enhancement factor	-	22	38:08
H	Henry's constant	mol / m3 bar	23	08:05
p_{O_2}	Partial pressure of O2	bar	23	"
λ	Dimensionless distance	-	23	41:48
E_∞	Maximum Enhancement factor	-	23	48:11
b_i	Dimensionless concentration of B at the gas-liquid interface	-	24	10:18
τ	Residence time	sec	24	23:35
θ	Dimensionless time	-	24	32:00
-	-	-	25	-
k_g	Gas side mass transfer coefficient	m / sec	26	22:00
p_{Ab}	Partial pressure of A in bulk	bar	26	"
p_{Ai}	Partial pressure of A at gas-liquid interface	bar	26	"
C_{Ab}	Concentration of A in bulk	mol / m3	26	"
C_{Ai}	Concentration of A at gas-liquid interface	mol / m3	26	"
$A(fluid)$	Species A in fluid phase	-	27	02:37
$B(solid)$	Species B in solid phase	-	27	"
t	Time	sec	27	05:59
s	Solid	-	27	10:09
g	Gas	-	27	"
l	Liquid	-	27	"
R	Radius of unreacted solid core particle	m	27	23:50
R_0	Radius of solid core particle	m	27	41:00

C_{Ag}	Concentration of species A in gas phase	mol/sec	27	42:41
C_{As}	Concentration of species A in surface	mol/sec	27	“
k_g	Mass transfer coefficient	m/sec	27	46:16
N_A	Number of moles of species A (fluid)	mol	27	“
N_B	Number of moles of species B (solid)	mol	27	“
N_0	Initial number of moles of species	mol	27	“
S_{ex}	External surface area per unit volume of catalyst	m2/m3	27	47:14
ρ_B	Density of solid particle	g/m3	27	“
$r(t)$	Radius of unreacted core	m	27	51:10
τ	Time taken for complete conversion	sec	28	07:52
X_B	Conversion of solid	-	28	09:20
W_{Ar}	Molar flux of species A in radial direction	mol/m2sec	28	16:50
D_e	Dispersion coefficient	m2/sec	28	19:13
C_A	Concentration of species A	mol/m3	28	“
C_{A0}	Initial concentration of species A	mol/m3	28	“
r_B''	Intrinsic reaction rate in solid	mol/m3/sec	28	24:20
ϕ_B	Volume fraction of unreacted solid core	-	28	“
k''	Intrinsic rate constant	sec-1	28	35:20
A_S	Area of unreacted core	m2	28	“
V	Volume of unreacted solid core	m3	28	“
y	Mole fraction of species in gas phase	-	28	45:50
k_g	Mass transfer coefficient	m / sec	28	“
u	Velocity	m / sec	28	“
L	Half thickness of the plate used as solid	m	29	05:35
R	Instantaneous radius	m	29	“
R_0	Internal radius	m	29	“
C_A	Concentration of species A	mol/m3	29	15:30
C_{As}	Concentration of species A in surface	mol/m3	29	“
k_r	Specific rate constant	m3 /gm/sec	29	“

W_{Ar}	Flux in radial direction	mol/m2/sec	29	“
k_g	Mass transfer coefficient	m/sec	29	“
D^*	Aris-Taylor dispersion coefficient	-	29	22:18
ρ	Density	g / m3	29	“
d_{p_0}	Initial diameter of particle	m	29	“
$F(d_p)\Delta d_p$	Fractional number of particles between size dp and dp+Ddp	-	29	30:18
N_0	Total initial particles	-	29	“
σ_2, D_g	Distribution parameters	-	29	“
$N(t)$	Number of particle as a function of time	-	29	35:00
$R(d_p)$	Growth rate of dp	m	29	“
A_b	Surface area of bubble	m2	30	11:45
RTD	Residence time distribution	-	30	42:00
N_0	Total moles of tracer	mol	31	05:17
$C(t)$	Concentration of tracer as function of time	mol/m3	31	06:54
ν	Volumetric flow rate of effluent stream	m3/sec	31	09:09
V	Volume	m3	31	“
ΔN	Amount of tracer whose age is between t and t+Δt	mol	31	10:12
$\Delta N/N_0$	Fractional residence time between t and t+Δt	-	31	“
$E(t)$	Residence time distribution function	-	31	12:45
$E(t)dt$	Fraction of fluid entering the reactor time between t and t+Δt	-	31	14:14
ν_0	Constant volumetric flow rate	m3/sec	31	16:33
$C(t)$	Concentration of tracer leaving the reactor at time t	mol/m3	31	17:30
T	Tracer	-	31	27:19
$C_{out}(t)$	Concentration of tracer in the outlet stream at time t	mol/m3	31	32:30
$F(t)$	Cumulative distribution function	-	31	34:30
t_m	Mean residence time	sec	32	01:3

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τ	Space time $(=V/v_0)$	sec	32	02:33
V	Total volume	m3	32	07:20
v_0	Volumetric flow rate	m3/s	32	“
σ^2	Variance	sec2	32	12:19
s^3	Skewness	sec2	32	13:40
θ	Dimensionless time $(=t/\tau)$	-	32	19:50
$I(\alpha)$	Internal age distribution	-	32	21:30
$\delta(t-\tau)$	Dirac delta function	-	32	27:00
C_0	Initial pulse tracer concentration	mol/m3	32	36:49
C	Concentration of species/tracer	mol/m3	32	“
L	Length of the reactor	m	32	43:00
R	Radius of the reactor	m	32	“
u	Velocity	m/sec	32	“
$u_{\max}$	Maximum Velocity	m/sec	32	“
u_{avg}	Average Velocity	m/sec	32	“
$t(r)$	Time spend by the particle at location r	sec	32	“
$t_{\min}$	Minimum time taken for the tracer at exit of the reactor	sec	33	12:13
C_{T0}	Initial total concentration of tracer	mol / m3	33	31:11
P	Perfect Operation (Ideal Reactor)	-	33	32:25
BP	Bypassing	-	33	“
DV	Dead Volume	-	33	“
v_b	By-pass volumetric flow rate	m3/s	33	34:12
v_{SB}	Volumetric flow rate enter the system volume/reactor	m3/s	33	“
v_0	Volumetric flow rate entering the reactor	m3/s	33	“
τ_{SB}	Space time for the system volume with bypass	sec	33	“
V_D	Dead volume	m3	33	41:45
V_{SD}	Volume at which the reaction take place	m3	33	“
V	Total volume of the reactor	m3	33	“

τ_{SD}	Space time for the system with only dead volume	sec	33	“
$E_e(t)$	Experimental measurement of $E(t)$	-	33	47:52
$F_e(t)$	Experimental measurement of $F(t)$	-	33	“
τ_p	Residence time for PFR	sec	34	07:58
τ_s	Residence time for CSTR	sec	34	“
C_{A0}	Concentration of species feed into CSTR	mol/m3	34	16:50
C_{Ai}	Concentration of species leave from the CSTR	mol/m3	34	“
C_A	Concentration of species leave from PRF	mol/m3	34	“
ν_0	Volumetric flow rate of fluid enter	m3/sec	34	“
k	Specific reaction rate constant	sec-1	34	“
$\overline{X}$	Mean conversion	-	35	08:53
$X(t)$	Conversion achieved by globule after spending time t in the reactor	-	35	11:13
N_A	Number of moles of species A	mol	35	13:00
N_{A0}	Initial number of mole enter	mol	35	“
V	Volume	m3	35	“
k	Reaction rate constant	sec-1	35	“
C_{A0}	Initial concentration	mol / m3	35	“
X	Conversion	-	35	“
Da	Damköhler number $(=k\tau)$	-	35	14:55
F_{A0}	Initial molar flow rate of species A	mol/sec	35	17:22
λ	Life expectancy of the fluid in the reactor	sec	35	26:35
$E(\lambda)d\lambda$	Fraction of the total that has life expectancy between l and l+dl	-	35	30:40
$\overline{C_A}$	Average concentration of species A	mol / m3	35	43:58
t	Time	sec	36	02:20
$E(t)$	Residence-time distribution function	sec^{-1}	36	“
τ	Residence time	-	36	12:15
ν	Volumetric flow rate	mol / sec	36	21:4

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$C_i(t)$	Concentration of i^{th} tank at time t	mol / m^3	36	“
N_0	Total amount of pulse injected	mol / sec	36	“
n	Number of tanks	-	36	“
θ	Dimensionless time	-	36	“
σ^2	Variance	-	36	“
F_T	Flow rate of tracer	mol / sec	37	11:04
A_C	Cross sectional area	m^2	37	“
C_T	Concentration of tracer	mol / m^3	37	“
Z	Length	m	37	“
Da	Dispersion coefficient	m^2 / sec	37	14:55
U	Velocity	m / sec	37	“
C_{T_0}	Initial tracer concentration	mol / m^3	37	25:35
ψ	Dimensionless concentration	-	37	30:18
λ	Dimensionless length	-	37	“
Pe	Peclet number	-	37	34:34
t_m	Mean residence time	-	37	46:50
Da	Damkohler number	-	38	13:25
C_{AL}	Outlet concentration of species A	mol / m^3	38	18:26
C_{A0}	Inlet concentration of species A	mol / m^3	38	“
X	Conversion	-	38	“
V_S	Volume of stirred tank	m^3	39	06:28
V_d	Dead volume	m^3	39	“
V	Total volume	m^3	39	“
ν_S, ν_b	Volumetric flow rate for stirred tank, by-pass	m^3 / sec	39	“
α	Fraction of total volume $(= V_S/V)$	-	39	11:50
β	By-pass ration $(= V_b/V)$	-	39	“