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NOMENCLATURE

A	gaseous species that is being absorbed into the liquid B in equation (2.34)
[A]	local concentration of A at any point in the liquid phase, kmol.m^{-3}
[A*]	concentration of dissolved gas A at gas-liquid interface, in equilibrium with gas at interface, kmol.m^{-3}
[A ₀]	concentration of A in bulk of liquid, kmol.m^{-3}
a	gas-liquid interfacial area per unit volume of liquid, m^{-1}
AMP	2-amino-2-methyl-1-propanol
B	base in reaction (2.2); or dissolved reactive species present in the liquid phase (equation (2.34))
[B]	local concentration of B at any point in the liquid phase, kmol.m^{-3}
[B ₀]	concentration of species B in bulk of the liquid, kmol.m^{-3}
D	diffusivity, $\text{m}^2.\text{s}^{-1}$
D _A	diffusivity of dissolved gas A in the liquid phase, $\text{m}^2.\text{s}^{-1}$
D _B	diffusivity of reactant B, $\text{m}^2.\text{s}^{-1}$
D _{CO₂}	diffusivity of dissolved CO ₂ in the liquid phase, $\text{m}^2.\text{s}^{-1}$
D _{N₂O}	diffusivity of dissolved N ₂ O in the liquid phase, $\text{m}^2.\text{s}^{-1}$
D _i	diffusivity of species i in the liquid phase, $\text{m}^2.\text{s}^{-1}$
D _{CO₂-water}	diffusivity of CO ₂ in water, $\text{m}^2.\text{s}^{-1}$
D _{CO₂-amine}	diffusivity of CO ₂ in amine solution, $\text{m}^2.\text{s}^{-1}$
D _{N₂O-amine}	diffusivity of N ₂ O in amine solution, $\text{m}^2.\text{s}^{-1}$
D _{N₂O-water}	diffusivity of N ₂ O in water, $\text{m}^2.\text{s}^{-1}$
d _c	diameter of the wetted wall contactor, m
DEA	diethanolamine
DIPA	di-2-propanolamine
E	enhancement factor defined by equation (2.36), dimensionless
E _{CO₂}	enhancement factor for absorption of CO ₂ , dimensionless
E _∞	enhancement factor for an infinitely fast reaction regime defined by equations (2.41) and (2.42)
f	vapour pressure of liquid, kPa
g	gravitational acceleration, m.s^{-2}
H	Henry's constant, $\text{kPa.m}^3.\text{kmol}^{-1}$
H _i	Henry's constant of species i, $\text{kPa.m}^3.\text{kmol}^{-1}$
H _{CO₂}	Henry's constant for CO ₂ , $\text{kPa.m}^3.\text{kmol}^{-1}$

H_{N_2O}	Henry's constant for N_2O , $kPa.m^3.kmol^{-1}$
$H_{CO_2-water}$	Henry's constant of CO_2 in water, $kPa.m^3.kmol^{-1}$
$H_{CO_2-amine}$	Henry's constant of CO_2 in amine solution $kPa.m^3.kmol^{-1}$
$H_{N_2O-amine}$	Henry's constant of N_2O in amine solution, $kPa.m^3.kmol^{-1}$
$H_{N_2O-water}$	Henry's constant of N_2O in water, $kPa.m^3.kmol^{-1}$
h	absorption length, m
Ha	Hatta number defined by equation (2.38)
K_i	equilibrium constant of reaction i
k_i	rate coefficient of reaction i
k_{-i}	reverse rate coefficient of reaction i
k_{ij}	forward rate coefficient for reaction j, equations (4.10) – (4.12) and equations (5.1) – (5.6)
k_1	pseudo-first-order rate constant for reaction between A and B, s^{-1}
k_2	second order rate constant for reaction between A and B, $m^3.kmol^{-1}.s^{-1}$
k_b	rate coefficient for reaction (2.2)
k_g	gas phase mass transfer coefficient, $kmol.m^{-2}.s^{-1}.kPa^{-1}$
k_L	liquid phase mass transfer coefficient, $m.s^{-1}$
k_L'	liquid phase mass transfer coefficient in presence of chemical reaction, $m.s^{-1}$
k_{mn}	rate constant for reaction, m^{th} order in A and n^{th} order in B, $(m^3/kmol)^{m+n-1}.s^{-1}$
l	fractional liquid volume holdup of B phase, dimensionless
MEA	monoethanolamine
MDEA	N-methyldiethanolamine
m	order of reaction with respect to species A
n	order of reaction with respect to species B
N_{Re}	liquid film Reynolds number
P	total pressure, kPa
p_A	partial pressure of species A, kPa
p_{CO_2}	partial pressure of CO_2 , kPa
PZ	piperazine
PZCOO ⁻	piperazine monocarbamate
PZ(COO ⁻) ₂	piperazine dicarbamate
Q	quantity of gas absorbed by unit area in time of contact θ , $kmol.m^{-2}$
q	total rate of absorption, $kmol.s^{-1}$
R_A	specific rate of absorption of species A, $kmol.m^{-2}.s^{-1}$
R_{CO_2}	specific rate of absorption of CO_2 , $kmol.m^{-2}.s^{-1}$

r_{CO_2}	rate of reaction defined by equation (2.4)
S_1, S_2	coefficients in equation (3.13)
s	fractional rate of surface-renewal, s^{-1}
T	temperature, K
t	time, of the order of contact, s
TEA	Triethanolamine
u	velocity of the liquid element at any depth from surface, $\text{m}\cdot\text{s}^{-1}$
u_s	velocity at surface, $\text{m}\cdot\text{s}^{-1}$
u_i^0	concentration of species i in the liquid phase, $\text{kmol}\cdot\text{m}^{-3}$
u_i^*	initial liquid bulk concentration of species i , $\text{kmol}\cdot\text{m}^{-3}$
u	interfacial concentration of CO_2 in the liquid, $\text{kmol}\cdot\text{m}^{-3}$
V_G	volumetric gas flow rate, $\text{m}^3\cdot\text{s}^{-1}$
V_L	volumetric liquid flow rate, $\text{m}^3\cdot\text{s}^{-1}$
v_L	volume of clear liquid, m^3
w	film thickness, m
w_{PZ}	mass fraction of PZ in solution
w_{MDEA}	mass fraction of MDEA in solution
w_{AMP}	mass fraction of AMP in solution
x	independent spatial variable, m
x_i	mole fraction of species i in equation (4.5)
α	parameter defined by equations (3.19) and (3.25)
α_1	initial CO_2 loading of the solution in equation (4.18), $\text{kmol CO}_2/\text{kmol total amine}$
δ	thickness of diffusion film, m
ϕ_L	fractional liquid volume holdup of B-phase, dimensionless
η	viscosity of the mixture in equation (3.14), $\text{mPa}\cdot\text{s}$
λ	reaction plane location measured from the interface, m
μ	viscosity of liquid, $\text{kg}\cdot\text{m}^{-1}\cdot\text{s}^{-1}$ or $\text{mPa}\cdot\text{s}$
θ	contact time, s
ρ	density of the liquid, $\text{kg}\cdot\text{m}^{-3}$
ν	stoichiometric coefficient in equation (2.34)