VII. NOMENCLATURE

a_s = specific gas–liquid interfacial area, m^2 / m^3

A_i = atomic mass of species i, Chapter III, kg/kmole

Ar = Archimedes number

A_L = cross sectional area of the column occupied by large bubbles, m^2

A_s = cross sectional area of the column occupied by small bubbles, m^2

A_{s_i} = area of region i, defined by Eq. 3.39, m^2

A_x = cross sectional area of the column, m^2

A_x = cross sectional area of the absorbing media, Chapter III, m^2

a = slope of pressure transducer calibration curve, inches water/volts

b = intercept of pressure transducer calibration curve, inches water

Bo = Bond number

B = number of photons crossing a unit area per unit time

B_o = incident number of photons crossing a unit area per unit time

B_i = number of photons crossing a unit area per unit time for source i

B_{oi} = incident number of photons crossing a unit area per unit time for source i

C_s = solids concentration, kg/m^3

C_s^B = solids concentration at the bottom of the dispersion, kg/m^3

C_s^f = solids concentration in the feed, kg/m^3

d = distance through the column, m

d_{Bi} = size of bubble i, m

d_c = column diameter, m

d_{col} = column diameter, m

d_i = distance through the column at position i, m

d_p = particle diameter, m

d_s = Sauter mean bubble diameter, m

E_s = axial dispersion coefficient, m^2/s

$f_{d_{ij}}$ = volume fraction of the dispersion between pressure ports i and j

f_{o_i} = fraction of the incident beam passing through phase i

Fr_g = Froude number = $\frac{u_g}{\sqrt{g d_{col}}}$

f_s = fraction of the cross sectional area occupied by small bubbles

g = gravitational accelerational constant, 9.81 m/s^2

H_{DP} = height of the pressure transducer, m

$H_t(t)$ = height of liquid above the presure transducer at time t, m

$H_t(0)$ = height of liquid above the presure transducer at time t=0, m

h = height, m

h_s = static liquid height, m

h_{exp} = expanded height, m

I = intensity of radiation

I_o = initial intensity of radiation

l_e = entry length, cm

L = expanded height of the dispersion, m

MSE = mean square error, defined by Eq. 2.36

$m_{s\ell}$ = weight of solidified slurry sample, kg

m_1 = weight of structure + sample, kg

m_2 = weight of structure + sample immersed in acetone, kg

N = number of data points

n_i = number of bubbles of size i

psd = power spectral density function

P = pressure, inches water

P = Fourier transform of the autocorrelation function

$\overline{P}$ = average pressure

P_i = pressure

P_n = probability associated with a Poisson process, defined by Eq. 3.29

Pe_p = particle Peclet number = $\frac{u_g d_{col}}{E_s}$

r_c = column radius, m

r_{pos_i} = radial position measured from the center of the column, defined by Eq. 3.38, m

S_c = scale factor used in Eq. 3.34

$s_{d_{ij}}$ = specific gvavity of the dispersion between pressure ports i and j

s_ℓ = specific gvavity of the liquid

$s_{s\ell_{ij}}$ = specific gvavity of the slurry between pressure ports i and j

Re_g = Reynolds number = $\frac{u_g d_{col} \rho_\ell}{\mu_\ell}$

Re_p = particle Reynolds number = $\frac{u_T d_p \rho_\ell}{\mu_\ell}$

RMS = root mean square, defined by Eq. 6.2

t = time, s

u = lag

u_{bs} = rise velocity of small bubbles, m/s

u_{bL} = rise velocity of large bubbles, m/s

u_g = superficial gas velocity, m/s

u_ℓ = superficial liquid velocity, m/s

u_p = hindered settling velocity of particles, m/s

u_r = bubble rise velocity, Eq. 2.28, m/s

$u_{s\ell}$ = superficial slurry velocity, m/s

$u'_{s\ell}$ = $= \frac{u_{s\ell}}{(1-\epsilon_g)}$ in Eq. 4.3, m/s

u_T = terminal rise velocity of a single particle in an infinite medium, m/s

$V(t)$ = volume of liquid above the pressure transducer at time t, m^3

V_i = volume of component i, defined by Eq. 3.11, m^3

$V_L(t)$ = volume of large bubbles that rise above the pressure transucer at time t, m^3

$V_{liq}(t)$ = volume of liquid displaced during Period I of disengagement, m^3

V_o = volume of liquid above the pressure transducer at time t=0, m^3

$V_\ell(t)$ = volume of the liquid entering the dispersion at time t, m^3

$V_{s\ell}$ = volume of solidified slurry, defined by Eq. 2.4, m^3

$V_s(t)$ = volume of small bubbles that rise above the pressure transucer at time t, m^3

V_T = total volume of the slurry, m^3

V_{ij} = volume of the slurry in section ij, m^3

w_i = weighting factor, defined by Eq. 3.40

W_{acet} = weight of acetone displaced, defined by Eq. 2.3, kg

We = Weber number, defined by Eq. 2.28

x = dimensionless height above the distributor, Chapter IV, m

x_i = thickness of species i, Chapter III, m

Z_i = atomic number of species i, Chapter III

Greek Letters

Δh_{ij} = height between preessure ports i and j, inches

ΔI = change in intensity of radiation

ΔP_{ij} = pressure drop across ports i and j, inches water

Δt = time interval, sec

Δx = thickness of the absorbing media, m

ϵ_g = average gas holdup

ϵ_{goL} = volume fraction of large bubbles at steady state

ϵ_{gos} = volume fraction of small bubbles at steady state

$\epsilon_{g_{ax}}$ = axial gas holdup

$\epsilon_{g_{ij}}$ = gas holdup between pressure ports i and j

ϵ_{ℓ} = average liquid holdup

$\epsilon_{\ell_{ij}}$ = liquid holdup between pressure ports i and j

ϵ_{meas} = measured gas holdup

ϵ_{pred} = predicted gas holdup

ϵ_{r_i} = radial gas holdup at location i

ϵ_s = average solids holdup

$\epsilon_{s_{ij}}$ = solids holdup between pressure ports i and j

γ_{xx} = autocovariance function

κ_i = Compton scattering coefficient of component i, Chapter III, m^{-1}

μ = mean of the time series, Chapter IV

μ_{ℓ} = liquid viscosity, Chapter II, kg/m-s

$\mu_{s\ell}$ = slurry viscosity, Chapter II, kg/m-s

μ_i = attenuation coefficient of species i, Chapter III, m^{-1}

μ_{ij} = attenuation coefficient of species i associated with source j, Chapter III, m^{-1}

ω_s = weight fraction of solids

ρ_i = density of the component i, kg/m^3

ρ_{acet} = density of acetone, kg/m^3

ρ_d = density of the dispersion, kg/m^3

ρ_g = density of the gas, kg/m^3

ρ_p = particle density, kg/m^3

ρ_s = density of solids, kg/m^3

$\rho_{s\ell}$ = density of the solidified slurry, kg/m^3

ρ_w = density of solidified wax, kg/m^3

ρ_{water} = density of water, kg/m^3

ρ_{xx} = autocorrelation function

σ_ℓ = surface tension of the liquid, N/m

σ_i = Compton scattering coefficient of component i, Chapter III, m^{-1}

τ_i = Compton scattering coefficient of component i, Chapter III, m^{-1}

Φ_ℓ = volume fraction of liquid in the slurry

$\overline{\Phi_\ell}$ = average volume fraction of liquid in the slurry

Subscripts

1,2,... = component number

g = gas

ℓ = liquid

sℓ = slurry

s = solids

T = total

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IX. ACKNOWLEDGEMENT

We are grateful to Mike Noak and Randy Marek for their help with design and construction of experimental apparatus, and to Manne Ramakrishna for his technical assistance with the preparation of the final report. SASOL reactor wax was supplied by Sasol Technology Ltd. of South Africa, through Dr. Ben Jager.

☆U.S. GOVERNMENT PRINTING OFFICE: 1991 _548_138/40037