VII. NOMENCLATURE

a	specific gas-liquid interfacial area, $6\epsilon_g/d_s$ (m^{-1})
b_i	intercept associated with the i-th line
d_B	bubble diameter (mm)
d_{Bi}	diameter of bubbles in class i (mm)
d_{MAX}	largest dimension or caliper diameter of a bubble (mm)
d_{MIN}	smallest dimension or caliper diameter of a bubble (mm)
d_{ave}	average of d_{MIN} and d_{MAX} (mm)
d_{cat}	catalyst particle size (μm)
d_{chord}	chord diameter of a bubble (mm)
d_{circ}	area equivalent diameter of a bubble (mm)
d_c	bubble column diameter (m)
d_{Feret}	Feret diameter of a bubble (mm)
d_o	orifice diameter (mm)
d_{ocr}	critical orifice diameter (mm)
d_s	Sauter mean bubble diameter (mm)
f_i	volume fraction of bubbles of size d_{Bi}
g	gravitational constant = 9.81 m/s^2
H	expanded bed height at time t (m)
H_o	expanded bed height at time 0 (m)
H_s	static bed height (m)
k_l	liquid side mass transfer coefficient (m/s)
n_i	number of bubbles of size d_{Bi}
n_o	number of holes in a perforated plate
N	number of bubble size classes from DGD technique

P	pressure (Pa)
s_i	slope associated with the i-th line
s_d	specific gravity of the gas-liquid dispersion (-)
s_ℓ	specific gravity of the liquid (-)
t	time (s)
T	operating temperature (°C)
u_{Bi}	rise velocity associated with bubbles of size d_{Bi} (m/s)
u_g	superficial gas velocity (m/s)
u_j	jet velocity or gas velocity through the orifice (m/s)
V_g	volume of gas in the gas-liquid dispersion (m^3)
V_i	volume of a gas bubble of size d_{Bi} (mm^3)
V_T	total volume of the gas-liquid dispersion (m^3)
w_{cat}	weight percent catalyst in the slurry (%)

Greek Letters

ϵ_g	average gas hold-up (%)
ϵ_{go}	average gas hold-up (-)
ϵ_{goi}	gas hold-up due to the presence of bubbles of size d_{Bi} (-)
ϵ_{gp}	predicted value of average gas hold-up (%)
μ, μ_ℓ	liquid viscosity (mPa.s)
ρ_d	density of the gas-liquid dispersion (kg/m^3)
ρ_g	density of gas (kg/m^3)
ρ_{H_2O}	density of water (kg/m^3)
ρ_ℓ	density of liquid (kg/m^3)
σ	surface tension (N/m)

Dimensionless Numbers

Bo	Bond number, $d_c^2 \rho_\ell g / \sigma$
F	flow number, $g d_B^{5/3} (\rho_\ell - \rho_g) \rho_\ell^{2/3} / \mu^{4/3} \sigma^{1/3}$
Fr	Froude number, $u_g / \sqrt{d_c g}$
Ga	Galileo number, $d_c^3 g \rho_\ell^2 / \mu_\ell^2$
V	velocity number, $u_B d_B^{2/3} \rho_\ell^{2/3} / \mu^{4/3} \sigma^{1/3}$
We	Weber number (orifice), $d_o \rho_g u_j^2 / \sigma$

Acronyms

DGD	dynamic gas disengagement
DOE	Department of Energy
DP	differential pressure
FT, F-T	Fischer Tropsch
HPSL	high pressure side line - DP system
ID	inside diameter
KW	Krupp wax
LPSL	low pressure side line - DP system
MP	molten paraffin wax
MSE	mean square error
PP	perforated plate
PW	product wax
SMP, SP	sintered metal plate
SN	single nozzle
SS	stainless steel

Subscripts

B	bubble
g	gas
ℓ	liquid
L	large bubbles
M	medium size bubbles
o	at time t=0
S	small bubbles

VIII. REFERENCES

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IX. ACKNOWLEDGEMENT

We are grateful to William Deutchlander, Robert Drummond, Mike Noak and Dr. Khan Nguyen-tien for their help with design and construction of the experimental apparatuses, and to Dragan Petrovic, John Swank and Dr. V.R. Shrotri for their help with experimental measurements and data analysis. Sasol wax was kindly supplied by John McArdle of UOP Inc. with permission from Dr. Mark Dry of SASOL, and Mobil's reactor waxes were obtained from U.S. DOE Pittsburgh Energy Technology Center through courtesy of Mobil Research and Development Co. Also, we wish to thank Professor Ron Darby at Texas A&M University for permission to use Brookfield Viscometer.