

NOMENCLATURE

Symbol	Description	Unit
α	Gas void fraction	-
α_S	Void fraction in slug body	-
Γ	Drainage flow rate into the bottom layer	kg/m ² s
ε_1	Average percentage error	%
ε_2	Absolute average percentage error	%
ε_3	Standard deviation	%
λ_L	Non-slip liquid holdup	-
μ_G	Viscosity of gas	cp
μ_L	Viscosity of liquid	cp
μ_{MN}	Mixture non-slip viscosity	cp
μ_{MS}	Mixture slip viscosity	cp
θ	Inclination angle	deg (rad)
ρ_C	Mixture density in gas core	kg/m ³ (lbm/ft ³)
ρ_G	Density of gas	kg/m ³ (lbm/ft ³)
ρ_L	Density of liquid	kg/m ³ (lbm/ft ³)
ρ_{MN}	Mixture non-slip density	kg/m ³ (lbm/ft ³)
ρ_{MS}	Mixture slip density	kg/m ³ (lbm/ft ³)
σ	Surface tension	N/m (dynes/cm ²)
τ_F	Wall shear stresses for liquid film	N/m ² (lbf/ft ²)
τ_G	Wall shear stresses for gas	N/m ² (lbf/ft ²)
τ_I	Interfacial shear stresses	N/m ² (lbf/ft ²)
τ_L	Wall shear stresses for liquid	N/m ² (lbf/ft ²)
τ_{LB}	Wall shear stresses for the bottom liquid-film	N/m ² (lbf/ft ²)
τ_{LT}	Wall shear stresses for the top liquid-film	N/m ² (lbf/ft ²)
τ_S	Slug body shear stresses	N/m ² (lbf/ft ²)

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A	Pipe cross sectional area	$\text{m}^2 (\text{ft}^2)$
A_C	Pipe cross sectional area occupied by gas core	$\text{m}^2 (\text{ft}^2)$
A_F	Pipe cross sectional area occupied by liquid film	$\text{m}^2 (\text{ft}^2)$
A_G	Pipe cross sectional area occupied by gas	$\text{m}^2 (\text{ft}^2)$
A_L	Pipe cross sectional area occupied by liquid	$\text{m}^2 (\text{ft}^2)$
C	Constant value for Eq. (2-39)	-
C_o	Distribution parameter	-
d	Pipe diameter	$\text{m} (\text{ft})$
D_B	Deposition rate	$\text{kg/m}^2\text{s}$
d_{CB}	Critical bubble size for buoyancy	$\text{m} (\text{ft})$
d_{CD}	Critical bubble size for deforming	$\text{m} (\text{ft})$
d_{LB}	Hydraulic diameter for bottom liquid-film	$\text{m} (\text{ft})$
d_{LT}	Hydraulic diameter for top liquid-film	$\text{m} (\text{ft})$
d_{max}	Maximum bubble size	$\text{m} (\text{ft})$
(dP/dL)	Pressure gradient	$\text{Pa/m} (\text{psi/ft})$
$(dP/dL)_{SG}$	Pressure gradient for superficial gas flow	$\text{Pa/m} (\text{psi/ft})$
$(dP/dL)_{SL}$	Pressure gradient for superficial liquid flow	$\text{Pa/m} (\text{psi/ft})$
E_B	Entrainment rate	-
EB	Elongated-bubble flow	-
e_i	Relative error	-
E_S	Surface free energy	J/s
E_T	Turbulent kinetic energy	J/s
f	Friction factor	-
f_B	Liquid-wall friction factor for bottom liquid-film	-
FE	Liquid entrainment fraction	-
f_G	Gas-wall friction factor	-
f_I	Interfacial friction factor	-
f_L	Liquid-wall friction factor	-

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Fr_G	Gas Froude number	-
f_{SG}	Superficial gas-wall friction factor	-
f_{SL}	Superficial liquid-wall friction factor	-
f_T	Liquid-wall friction factor for top liquid-film	-
g	Gravitational acceleration	m/s ² (ft/s ²)
H_C	Liquid holdup in the gas core	-
h_F	Average liquid film thickness	m (ft)
H_F	Liquid holdup in the film zone	-
h_{FB}	Liquid film thickness for bottom of pipe	m (ft)
h_{FT}	Liquid film thickness for top of pipe	m (ft)
H_L	Liquid holdup	-
h_L/d	Average liquid level	-
H_S	Liquid holdup in slug body	-
Ku_G	Kutadela number	-
L_F	Length of liquid film zone	m (ft)
L_S	Length of slug body	m (ft)
L_U	Length of slug unit	m (ft)
n	Total number of data points	-
N_{ReG}	Gas Reynolds number	-
$N_{ReG,t}$	Critical gas Reynolds number	-
N_{ReL}	Liquid Reynolds number	-
N_{ReLB}	Liquid Reynolds number for bottom liquid-film	-
N_{ReLT}	Liquid Reynolds number for top liquid-film	-
N_{ReM}	Mixture Reynolds number	-
Q_G	Volumetric flow rate of gas	m ³ /s (ft ³ /s)
Q_L	Volumetric flow rate of liquid	m ³ /s (ft ³ /s)
R_{sm}	Minimal liquid holdup within the slug body	-
S_F	Wetted perimeter of liquid film	m (ft)

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S_G	Wetted perimeter of gas	m (ft)
S_I	Interfacial perimeter	m (ft)
S_L	Wetted perimeter of liquid	m (ft)
T	Temperature	deg-C (deg-F)
v_d	Drift velocity	m/s (ft/s)
v_F	Liquid film velocity	m/s (ft/s)
v_{FB}	Liquid-film velocity at bottom of pipe	m/s (ft/s)
v_{FT}	Liquid-film velocity at top of pipe	m/s (ft/s)
v_G	Gas velocity	m/s (ft/s)
v_{Gdb}	Velocity of dispersed-bubbles in slug body	m/s (ft/s)
v_L	Liquid velocity	m/s (ft/s)
v_M	Gas-liquid mixture velocity	m/s (ft/s)
v_S	Velocity within the slug body	m/s (ft/s)
v_{sF}	Slug front velocity	m/s (ft/s)
v_{SG}	Superficial gas velocity	m/s (ft/s)
v_{SL}	Superficial liquid velocity	m/s (ft/s)
$v_{SL,\delta}$	Superficial liquid velocity determined Eq. (2-39)	m/s (ft/s)
v_{sT}	Slug translational velocity	m/s (ft/s)
X	Lockhart and Martinelli parameter	-
x_{LM}	Lockhart and Mattinelli parameter	-
Y	Lockhart and Martinelli parameter	-