

NOMENCLATURE

Roman symbol

p	pressure	bar
u	velocity	m/s
L	Length	mm
A	Area	mm ²
F	Force	N
d	Diameter	mm
t_h, t	Thickness	mm
H	Height	mm
C_d	Co-efficient of Discharge	
C_c	Co-efficient of Contraction	
K	Cavitation Parameter	
R_o	Initial Radius	mm
t	Time	s
R	Rayleigh Plesset	Equation
U	Velocity	m/s
R_c	Rate of mass transfer for Condensation	
R_e	Rate of mass transfer for Evaporation	
k	Kinetic Energy	Joule (J)
D	Diameter	mm
C_v	Velocity Co-efficient	
R_b	Bubble Radius	
n_0	Bubble Nuclei Number	
R	Bubble Radius	
P_v	Vapor Pressure	bar
P_{inj}	Injection Pressure	bar
P_{back}	Back Pressure	bar
u_p	Particle Velocity	m/s

u_a	Air Velocity	m/s
F_x	Force due to Mass, Acceleration and Pressure	N
F_D	Drag Force	N
A_p	Cross-Section Area of Particle	mm ²
C_D	Drag Co-efficient	
d_p	Particle Diameter	mm
r	Radius of Droplet	mm
We	Weber Number	
B_0	$B_0=0.61$, Model Constant	
Z	Ohnesorge Number	
We_p	Weber Number	
We_a	Weber Number	
T	Taylor Number	
Re	Reynolds Number	
L_b	Breakup Length	mm
C	Model Constant (for non-evaporating = 20)	
x,y,z	Position Coordinate	
u,v,w	Velocity	m/s
W_n	Nozzle Width	mm
T_i	Inlet Temperature	°C
T_f	Final Temperature	°C
P_i	Inlet Pressure	bar
P_f	Final Pressure	Bar
Q_i	Volume Flowrate at Inlet	LPM
Q_f	Volume Flow Rate	LPM
\dot{m}_{theo}	Theoretical mass flow rate	kg/s
D_h	Hydraulic Diameter	mm
L_c	Cavitation Length	mm

Greek symbol

ρ	density	kg/m ³
σ	Surface Tension	N/m
α	Volume Fraction	
γ	Angle	
ρ_v	Vapor phase Density	kg/m ³
ρ_l	Liquid Phase Density	kg/m ³
μ_{eff}	Effective Viscosity	Pa·s
μ_m	Molecular Viscosity	Pa·s
μ_t	Turbulent Viscosity	Pa·s
α_v	Fraction of Vapor Phase	
ρ_p	Particle Density	kg/m ³
ρ_a	Air Density	kg/m ³
τ_{KH}	Characteristics Breakup Time	s
Ω_{KH}	Frequency	Hz
λ_{KH}	Wave Length	
ϵ	Kinetic energy	Joule (J)
ω	Dissipation Rate	

Subscript

inj	Injection
cav	Cavitation
sep	Separation
c	Contracta
v	Vapour
min	Minimum
aero	Aerodynamic
rel	Relative
back	Back
i	Inlet

m	Mean
o	Outlet
in	Inlet
out	Outlet
amb	Ambient
p	Particle
α	Air
theo	Theoretical
f	Final

Abbreviations

IC	Internal combustion
CRDI	Common Rail Injection System
CP	Centrifugal Pump
PCV	Pneumatic Control Valve
VCO	Valve Covered Orifice
WCO	Waste Cooking Oil
FAME	Fatty Acid Methyl Ester
FFA	Free Fatty Acid
HC	Hydrodynamic Cavitation
CFD	Computational Fluid Dynamic
PSIA	Pound per Square Inch Absolute
CN	Cavitation Number
LDV	Laser Doppler Velocimetry
CT	Computed Tomography
SLE	Selective Laser Etching
CCD	Charge Coupled Device
fps	Frame Per Second
RP	Rayleigh Plesset
VOF	Volume of Fluid

HEM	Homogeneous Equilibrium Model
EVET	Equal Velocity Equal Temperature
CICSAM	Compressive Interface Capturing Scheme for Arbitrary Meshes
LES	Large Eddy Simulation
DDM	Discrete Droplet Model
KHACT	Kelvin Helmholtz Aerodynamic Cavitation Turbulence
DNS	Direct Numerical Simulation
ECN	Engine Combustion Network
TSPIV	Tomographic Stereo Particle Image Velocimetry
SST	Shear Stress Transport
ZGB	Zwart Gerber Belamri
RANS	Reynolds Average Navier-Stoke
RHS	Right Hand Side
DPM	Discrete Phase Model
DRW	Discrete Random Walk
KH	Kelvin Helmholtz
RT	Rayleigh Taylor
LPM	Litres per minute
GI	Galvanized Iron
CN1, 2, 3, 4, 5	Cavitation Nozzle 1, 2, 3, 4, 5
VMC	Vertical MachiningCentre
CN 3W	Cavitation Nozzle 3, Water
CN 3D	Cavitation Nozzle 3, Diesel
CN 3B	Cavitation Nozzle 3, Bio-Diesel
CN 4W	Cavitation Nozzle 4, Water
CN 5W	Cavitation Nozzle 5, Water
CN 5D	Cavitation Nozzle 5, Diesel
CN 5B	Cavitation Nozzle 5, Bio-Diesel
SMD	Sauter Mean Diameter

B00	0% Bio-Diesel blend with Diesel (100% Diesel)
B10	10% Bio-Diesel blend with Diesel (10% Bio-Diesel & 90% Diesel)
B20	20% Bio-Diesel blend with Diesel (20% Bio-Diesel & 80% Diesel)
B100	100% Bio-Diesel
RNG	Renormalization Group
SS	Schnerr and Sauer
CFL	Courant Friedrichs Lewy
STP	Spray Tip Penetration
SSD	Single Size Distribution
NIST	National Institute of Standard and Technology
SCA	Spray Cone Angle
SOI	Start of Injection
EOI	End of Injection
ROI	Rate of Injection
IRDCI	Injection Rate Discharge Curve Indicator
TKE	Turbulent Kinetic Energy
MPD	Mean Particle Diameter
W	Water
D	Diesel
B	Bio-Diesel
WDB	Water, Diesel, Bio-Diesel