International Journal of Automotive Technology, Vol. 21, No. 1, pp. 23−32 (2020)
DOI 10.1007/s12239−020−0003−1

pISSN 1229−9138/ eISSN 1976−3832

EXPERIMENTAL AND COMPUTATIONAL INVESTIGATION OF DIESEL AND GASOLINE INJECTION IN A DIRECT INJECTION COMPRESSION IGNITION ENGINE

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(Received 29 November 2018; Revised 7 March 2019; Accepted 25 April 2019)

ABSTRACT−In this paper, the numerical simulation of the diesel and gasoline fuels injection in a constant volume chamber and in a cylinder under the operating conditions of a compression ignition (CI) engine is conducted. The simulation results are compared with the experimental data which derived from fast imaging techniques. In order to check out the possibility of using gasoline instead of diesel to increase the volumetric efficiency of the CI engine, the spray characteristics of the gasoline and diesel with injection pressures of 40 and 80 MPa, as well as temperatures of 243, 273 and 313 K, under cold start condition is investigated. The results show that under the same conditions, the vapor penetration length for the two fuels is approximately equal and due to the lower volatility of the diesel fuel, its liquid penetration length in 40 and 80 MPa injection pressures was found to be 7 and 9 mm higher than gasoline, respectively. In addition, the reduction in fuel temperature from 313 K to 243 K leads an increase in the penetration of gasoline and diesel liquids by 12 and 10 mm, respectively. Finally, the decrease in the evaporation rate causes a non-homogeneous mixture and results an increase in the unburned hydrocarbons and emissions.

KEY WORDS : Compression ignition engine, Fuel temperature, Injection pressure, Diesel and gasoline, Numerical simulation

NOMENCLATURE

ρ : total gas density, kg/m³
$\vec{v}$: velocity vector of the gas, m/s
p : static pressure, Pa
$\overline{\overline{\tau}}$: stress tensor, N/m²
T : temperature, K
k_{eff} : effective thermal conductivity coefficient, W/m·K
k_g : thermal conductivity coefficient of vapor, W/m·K
E : internal energy, J
h : enthalpy, J
X_f : mass fraction of the fuel
μ : effective viscosity, kg/m·s
μ_m : molecular viscosity, kg/m·s
g : gravity acceleration, m/s²
c_p : special heat, J/kg·K
v' : turbulence fluctuation of gas velocity, m/s
r : droplet radius, m
u : liquid velocity, m/s
σ : surface tension, N/m
Pr_k : prandtl number of turbulent kinetic energy
Pr_ε : prandtl number of turbulence dissipation rate
Pr_d : prandtl number of droplet
C_μ : constant
$C_{\varepsilon 1}$: constant
$C_{\varepsilon 2}$: constant
$C_{\varepsilon 3}$: constant
C_s : constant
C_ε : constant
B_0 : constant
B_1 : constant
$C\tau$: constant
C_{RT} : constant
We_{limit}: constant
$m_{s,\text{ limit}}$: constant

SUBSCRIPTS

CI : compression ignition
DICI : direct injection compression ignition
ATDC: after top dead center
BTDC: before top dead center

1. INTRODUCTION

Conventional CI engines which work with diesel fuel,

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