A Numerical Analysis for the Spray Characteristics of Liquefied n-butane Fuel

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Abstract

LPG fuel is an environmentally friendly fuel since it emits CO_2 less than other conventional fuels. This research aims to investigate the spray characteristics of liquefied n-butane fuel experimentally in a constant volume chamber. Based on the experimental results, numerical simulation was made in order to understand the process of phase change from BTDC 12 degree to ATDC 20 degree both in diesel and n-butane fuels.

Introduction

As a prime fuel gasoline and diesel fuel have been used in many application so far but the gorbal warming and their limited amount of deposits are decreasing day by day due to the increase of its usage all over the world. To come up with the solution on these problems, these have been studied in many ways. It has been reported that a share of LPG as the alternative fuel can be increased gradually by the interest of low emission vehicle and development of alternative fuels in the aspect of domestic energy supply. As a clean energy vehicle, a LPG vehicle hardly emits PM and SO_2 and even CO_2 10% less than a diesel vehicle. In addition, its charging procedure is easier than LNG since LPG fuel can be stored in the liquid state at a normal temperature and a lower pressure. By direct injection of LPG inside a cylinder it is easy to control the exact amount of air to fuel ratio. Also, the improved cooling effect of a combustion chamber by the latent heat for vaporization helps to increase engine power and decrease the emissions at the exhaust. In addition, it can be expected that there is a homogeneous mixture of air and fuel, because LPG has a lower molecular weight and a high vapor pressure and thus a uniform mixtures of fuel and air can be formed.

Experiment & Numerical Approach

The experiment for the visualization of spray was conducted under the condition of a constant volume chamber (⌀ 86.2 mm X 39 mm). For numerical simulation, a commercial code Fluent 6.3 was used and combustion chambers of compression ratio 18:1 were modeled by using CATIA V5 and corresponding mesh was generated by Gambit program of Fluent 6.3.

Results and Discussion

Spray shapes of LPG and diesel were photographed and compared under a constant volume chamber. The photos of spray in time sequence were obtained from the start of spray to arrival at a cylinder wall under the varying ambient pressure, P_{amb} = 0.0-3.0 MPa. The simulation was conducted from BTDC to ATDC in both n-butane aqnd diesel fuels and compared spray characteristicsw such as spray angles and penetration distances.

References

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