

STUDY OF MODELLING SPRAY PENETRATION OF BIODISEL FUEL UNDER TRANSIENT ENGINE CONDITIONS

Ahmed Abed Al-Kadhem Majhool, Abbas Alwi Sakhir ALJeebori

Mechanical Engineering Department,
College of Engineering, Al-Qadissiya University,
IRAQ.

ABSTRACT

In this study, numerical investigations are conducted for biodiesel spray under transient engine conditions. The spray tip penetration of biodiesel has been studied in a comparison with diesel fuel in a diesel engine under transient engine conditions. The predicted results are compared with experimental data with a chosen case for highly ambient pressure. The study uses the Eulerian-Eulerian approach for the two phase flow simulation. In the validated computer programme both used liquid fuels are treated in terms of spray moments of drop size distribution. One parameter is selected for the analysis and to study the spray characteristics through the examination and tracking the behavior of the biodiesel. The obtained results for biodiesel fuel and diesel fuel of the spray tip penetration show a good agreement with the experimental results.

Keywords: Two-phase flow, spray moment method ,biodiesel , diesel, spray penetration

INTRODUCTION

The common understanding of the necessity to use a clean, biodegradable and renewable fuel as alternative fuel has led to present the biodiesel as outstanding solution for the energy security and environment problems. During the last two decades , a big effort has been spent on the effect of alternative fuel properties. In the same way, biodiesel can improve the thermal efficiency through the optimum combustion process and reduced exhaust emission characteristics of diesel engine which is elected by fuel properties and spray atomization characteristics .Applicative research based on using different biofuels expressed that the fuel with higher density, viscosity and surface tension gives shorter spray tip penetration and large cone angle (Kusak *et al.*, 2002; Lee *et al.*, 2005; Wengian, 2006; Allen, 1998; Yamane & Shimamoto, 2001).

Experimental and theoretical study to the characteristics of an undiluted biodiesel fuel were made by Park *et al.* (2009). Their investigation were led to when the injection pressure increased the injection delay time decreased due to the increase in spray injection velocity. They used KIVA-3V code to perform the numerical calculations. The results of spray tip penetration for biodiesel has similar trend as it compared with diesel fuel at different injection and ambient conditions.

The impact of various fuel temperature and ambient gas conditions were studied by (Park *et al.*, 2009). In their experimental and numerical work, they found that the spraytip penetration has the same pattern in spite of the different in fuel properties due to the change in fuel temperature.

An experimental and numerical calculations have been performed by (Xiangang *et al.*, 2010). They used the light scattering technique to measure non-evaporating spray of diesel and two biodiesel under high injection pressure up to 300 MPa. The obtained results were showed that the biodiesel fuel gives longer injected delay time and spray tip penetration while the cone angle is smaller compared with the diesel fuel. Also, they confirm that the physical properties of biodiesel affected on spray atomization processes significantly.

A FLUENT v6.3 and CONVERGE code were implemented by (Som *et al.*, 2010) to simulate a comparison for the behavior of spray under ambient and evaporation conditions of biodiesel with petrodiesel fuel. The predicted results showed that the biodiesel fuel has poor atomization characteristics compared to diesel fuel. The spray tip penetration and SMD were found higher where as smaller cone angle was obtained for biodiesel.