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Investigation of Water-Diesel Emulsion Characteristics using Optical Technique

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ABSTRACT

The idea of using water-in-Diesel (W/D) emulsion in recent studies as fuel for diesel engines is to reduce the emissions. The introduction of water into a diesel engine using W/D emulsion has a number of potential benefits and can be used as an alternative fuel. One of important factors to use this fuel was the distribution of water droplets in emulsion and emulsifier stability. In the present work, the effect of emulsifier dosage (water in diesel ratio) and heating of W/D emulsion on the stability period with using optical technique was investigated. Five samples of W/D emulsion at different emulsifier dosages (5%, 10%, 15%, 20%, and 25%) water content were studied, whereas the heating of emulsions was carried out for 40°C, 60°C, and 80°C. The results obtained from the current work manifested that an increase in water dosage to W/D emulsion had bad effects on the stability period, also, the increase in heating temperature for W/D emulsion revealed a negative effect on the emulsion stability.

Keywords: Water-diesel emulsion fuel; Optical technique; Stability of mixtures; Surfactant.

NOMENCLATURE

A_b	droplet area	d_b	droplet diameter

1. INTRODUCTION

In recent studies, the idea of using the emulsions: water in diesel or diesel in water, as fuel for diesel engines is to increase the oxygen charge in combustion mixture and reduce the emissions. Several researchers Chen and Tao (2005), Kannan and Udayakumar (2009), concluded that water-in-diesel (W/D) emulsion combinations are to reduce the emissions of NOx, CO_2 and unburned hydrocarbon (HC). Also, a research has shown that it can effectively reduce the maximum flame temperature and increase the combustion efficiency thus reduces both unburned hydrocarbon and emissions, Park *et al.* (2000), Andrea *et al.* (2003), Tauzia *et al.* (2010) and Subramanian (2011). So there are many advantages to use W/D emulsion as a fuel for diesel engines such as more complete combustion, leading to better fuel economy and cleaner burning fuels with fewer emissions. To the present date, new researches on W/D emulsion are active and even its comparative advantage to its base fuels is not widely known. Also, the unusual physical behavior of the emulsion concerning mixing and evaporation within the combustion chamber and lack of understanding of the phenomenon of combustion and the composition of soot inside the combustion chamber was one of the most important reasons to study the emulsions properties.

Several research methodologies have been used to study W/D emulsion as a fuel for diesel engine both inside and outside the engine combustion chamber. Abu Zaid (2004), Alahmer *et al.* 2010, Selim *et al.* 2001, Tanaka *et al.* (2005) and (2007) have used horizontal stainless steel and aluminum surfaces to study the evaporation of W/D emulsion by varying the surface temperature from 200 to 550°C at atmospheric pressure. While Tsue *et al.* (1996) have been used the hot surface was isolated from the atmosphere with a high pressure cylindrical chamber, this surface was made of duralumin. So the application of both suspension single droplet and hot surface as a means to examine both the microexplosion phenomena for diesel emulsion is very important to predict the air/fuel mixing process. The results might not be accurate as compares with the major assumptions. However, the empirical investigation of the effect of these phenomena in the composition of combustion and emissions within the combustion chamber remains