講演番号	344

文献番号	20225344

Combustion, Emission and Soot Analysis of Diesel-Biodiesel-Ethanol Blenaded Fuels on Common Rail Direct Injection Diesel Engine

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KEY WORDS:**heat engine, compression ignition engine, combustion analysis,** Biofuel, Diesel-Biodiesel-Ethanol Blend [A1]

In Thailand, biodiesel is produced from palm tree while ethanol could be produced from sugarcane, cassava and mollases. The motivation of this research are to reduce the depletion of fossil fuel resource and green house gases emission from diesel fuel production and to reduce the emission of particulate matters from diesel engine combustion by adding renewable oxygenated biodiesel and ethanol fuels with diesel fuel. B10 fuel ,which 10 vol% of palm oil biodiesel is mixed with 90 vol% of diesel fuel, had been already used as commercial fuel for diesel vehicles. In this study, 5% and 10% of bioethanol were blended to commercial grade B10 fuel by weight ratio and named as B10E5 and B10E10. The combustion, emission and engine performance were experimentally tested on a four-cylinder direct injection diesel engine which is coupled with the eddy current dynamometer. The schematic diagram of engine test stand is shown in Fig.1. The experiments were performed under different loads of 56Nm, 84Nm, 112 Nm and 140Nm at the engine speed of 1500 rpm.

The fuel consumption increased with the increasing amount of ethanol in blends although there were no impact on the brake thermal efficiency by fuelling with ethanol blended fuels. The combustion analysis were performed form the online in-cylinder pressure data and crank angle. Rise in in-cylinder pressure, pressure rise rate and heat released rate were observed. Lower cetane number of blended fuel contribute to longer ignition delay and advanced the premixed combustion peak. Moreover, the fuel oxygen molecules of ethanol help in diffuse combustion phase. The carbon monoxide (CO) and carbon dioxide (CO2) emissions are reduced by blendeing ethanol because of lower carbon content of ethanol but NO emission increased due to higher combustion temperature and higher oxygen content of ethanol. The smoke intensity could be reduced around 75% by adding ethanol to the based diesel fuel. As the fuel oxygen content increased, the emitted particle number is lesser with the smaller agglomerate particle diameter. The average sizes of agglomerate particle diameter of B10,B10E5, and B10E10 are 0.2μm ,0.19μm, and 0.17μm respectively as shown in Figure 2.

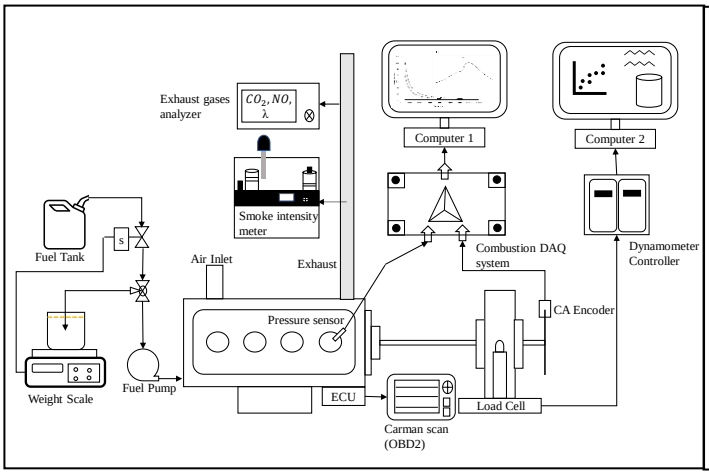

Fig.1. Schematic diagram of Engine experiment

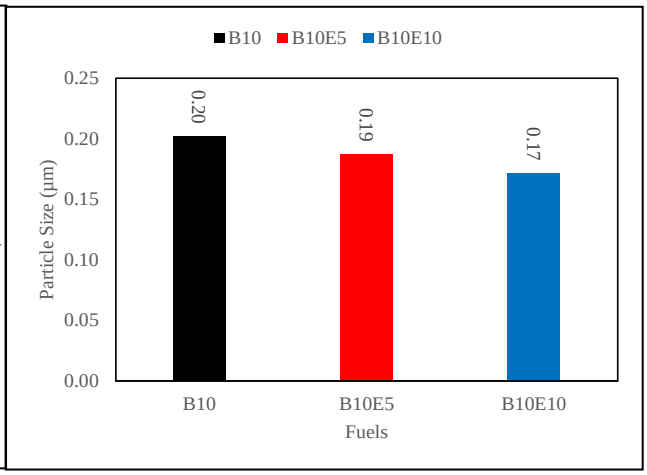

Fig 2. Average particle diameter of B10,B10E5, and B10E10.