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Effect of emulsification and blending on the oxygenation and substitution of diesel fuel for compression ignition engine

Ftwi Y. Hagos[a,b,*], Obed M. Ali[a,b], Rizalman Mamat[a,b], Abdul A. Abdullah[a,b]

[a] Automotive Engineering Center, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[b] Automotive Engineering Research Group (AERG), Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

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ABSTRACT

Global emission standards are getting more stringent in which the existing diesel engine technologies are on the brink of losing their permit to operate. While there are successful engine side researches that can target the current emission norms, their implementation in existing engines will not be possible due to their higher price tag. With this respect, fuel side improvement with no or minimal modification to engine hardware is the best way to address the issue in the existing engines. The commonly used fuel oxygenators in diesel engines are water, alcohol, biodiesel and the combinations of these. The method of oxygenation and their corresponding results on the combustion, performance and emissions that have been reported in the literatures are widely varied. The current review article targets the blending and emulsification techniques used in the oxygenation and fuel substitution of diesel. Based on the misconceptions about the stability of emulsions, many researchers are found to use the term blending even though the technique they have used is emulsification. While blending of fuels is convenient for fuels which have relatively similar boiling temperature, emulsification technique should be followed for fuel mixtures of varied boiling temperature so that the benefit of micro-explosion can be reflected in the fuel atomization. Secondary atomization resulting from the micro-explosion phenomenon of emulsified fuels and fuel oxygenation are responsible for the improvement of combustion, performance and CO and PM emissions. Latent heat of vaporization is found to be responsible for the reduction of NOx emissions.

Abbreviations: ASI, after the start of injection; BSFC, brake specific fuel consumption; BTE, brake thermal efficiency; CI, compression ignition; CO, carbon monoxide; CO_2, carbon dioxide; DEE, diethyl ether ($C_4H_{10}O$); DI, direct injection; DME, dimethyl ether; D75B15E10, 75% diesel, 15% biodiesel and 10% ethanol; EGR, exhaust gas recirculation; FIE, fuel injection equipment; HC, hydrocarbon; HLB, hydrophilic-lipophilic balance; KOME, Karanja oil methyl ester; NO, nitric oxide; NO_2, nitrogen dioxide; NOx, nitrogen oxides; N_2O, nitrous oxide; PM, particulate matter; SI, spark ignition; SOx, sulfur oxides; THC, total gaseous hydrocarbons; TPOMEr, Thevetia peruviana oil methyl este; VOC, volatile organic compounds; WiDEn, water in diesel emulsio; WTO, World trade Organization; Φ, equivalence ratio

* Corresponding author at: Automotive Engineering Center, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia.
E-mail address: ftwi@ump.edu.my (F.Y. Hagos).

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