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Effect of ethanol percentage for diesel engine performance using virtual engine simulation tool

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Abstract

Exhaust emission is one of the kind emission have contribute to the greenhouse effect in the world. Ethanol is one of the best tools to fight air pollution from vehicles. From its biodegradable nature to reductions in greenhouse gas and tailpipe emissions, ethanol provides a tool to address environmental concerns without requiring an entirely new way for goods and people to get from one place to another. Ethanol contains 35% oxygen and with adding oxygen to fuel results in more complete fuel combustion, reducing harmful tailpipe emissions. This paper addresses the possibility study of ethanol percentage to changing of performance and exhaust emissions for Diesel Engine using Virtual Engine Simulation Tool AVL Boost. In this study the blend formulation between Ethanol and Diesel Fuel were E0, E2.5, E5, E7.5 and E 10. The performance of diesel engine simulated in 1,000-1,500 rpm with 0, 10, 20, 30, 40, 50 and 60 Nm engine loads. The direct blending of ethanol and diesel fuel has advantages reducing exhaust emissions CO, Soot and NOx percentages. The engine power break of pure diesel is slightly lower than those of E2.5-E10, especially for speed above than 1400 rpm. The simulation work with the same results compare to the experiments can reduce the cost of research.

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Keywords: ethanol percentage; engine simulations; diesel engine; emissions ; performance

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1. Introductions

Indonesia still relies on fossil fuels (conventional) specifically for the industrial, power generation and transportation systems. This dependence will further reduce the amount of oil reservest here. Exhaust emissions resulting from fuel combustion is one of the main sources of greenhouse (such as CO, CO2, HC) that cause global warming. To reduce dependence on fossil fuel sand reduce the influence of the environmental impact needs to be done diversification of energy sources, especially renewable and environmentally friendly. Climate change and global environmental issues caused by the development and use of energy is a consideration in the selection of alternative energy.

Climate change and global environmental issues caused by the development and use of energy is a consideration in the selection of alternative energy. Vegetable oil (vegetable oil) is one of the alternative energy sources that a lot of attention. Ethanol is commercially produced using either a wet mill or dry mill process. Wet milling involves separating the grain kernel into its component parts (germ, fibre, protein, and starch) prior to fermentation.

Many investigations are related to the influence of the blend formulation between ethanol and diesel fuel. E.T. Jimenes et al reported the physical and chemical properties of ethanol-diesel fuel blends. This study reported that using additives to avoid phase separation and to raise flash point, blends of diesel fuel with ethanol up to 15% can be used to fuel diesel engines if engine performance tests corroborate it [1]. Another investigation also reviewed ethanol and diesel blend. In this paper, the properties and specifications of ethanol blended with diesel fuel are reported. These factors include blend properties such as stability, viscosity and lubricity, safety and materials compatibility. Besides that, the effect of the fuel on engine performance, durability and emissions is also discussed in this paper. The critical factor in ensuring fuel compatibility with the engines is the formulation of additives to maintain blend stability[2]. While, P. Stage de Caro et al showed the behaviour of a diesel–ethanol mixture with two organic additives were selected for their different physico-chemical parameters. Properties directly related to engine parameters (viscosity, cetane number, heat content, volatility) and those characterising fuel quality (homogeneity, cold properties, anticorrosiveness and volatility) were explored. Fuel formulations were prepared with 2% additive and ethanol contents between 10 and 20% in volume in relation to the diesel fuel[3].

Diesel engines are the most efficient engines of all types of internal combustion engine (ICE, internal combustion engines). Current emission control has become central to the development of diesel engines, due to the use of fossil fuels would cause the climate change, which can lead to environmental damage. Many studies explain that the use of ethanol diesel related to improving performance and lowering exhaust emissions. O. Can et al investigated that the ethanol addition reduces CO, soot and SO2 emissions, although it caused an increase in NOx emission and approximately 12.5% (for 10% ethanol addition) and 20% (for 15% ethanol addition) power reductions[4]. Research on exhaust emissions in diesel engines Fuelled with Ethanol-diesel blends has also been done by H. Jinceng et al [5, 6]. However, Li et al investigated Combustion characteristics were analysed in a compression ignition engine fuelled with diesel–ethanol blends with and without a cetane number improver. The research inform that, for the same brake mean effective pressure and engine speed, the maximum cylinder pressure Pmax, the ignition delay, the premixed combustion duration, and the fraction of heat release in premixed combustion phase will increased[7]. Fumigation ethanol in a small capacity diesel engine also been investigated by B.S Chauhan et al. In this study concluded that fumigated Diesel engine exhibit better engine performance with lower NOx, CO, CO2 and exhaust temperature. And the other hand, fumigated Diesel Engine reported increase of unburned hydrocarbon (HC) emission in the entire load range. Considering the parameters, the optimum percentage was found as 15% for ethanol fumigation[8].

Assessments on the new engines performance and emissions obtainable are actually performed in the research and development stages using dedicated simulation tools which offer the possibility to envisage what are the best paths to be followed. By using the simulation engine can reduce the costs of research engine performance and exhaust emissions compared with laboratory tests. The previous study of injection timing for diesel engine operating with gas oil and hydrogen rich gas using AVL Boost investigated by Adrian BIRTAS et al [9]. As for Voicu et al reported a numerical simulation of the influence of injection characteristic on performance and emissions of a tractor diesel engine by using AVL[10].

Many research investigating ethanol in diesel engine, however, it was concluded that the combustion characteristics of ethanol/diesel fuel blends in diesel engine have not been clearly investigated when using the simulation software. “Virtual Engine Simulation Tool” with advanced models for accurately predicting engine