



# An experimental investigation of Perkins A635-44 diesel engine performance using D-Series fuel <sup>☆</sup>

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## ABSTRACT

This paper reports the results of an investigation using a newly developed fuel mixture called “D-Series fuel” on a Perkins A635-44 direct injection diesel engine. The biodiesel and bioethanol fuels were added to diesel fuel in a manner that specifications of the formed mixture did not change considerably. The performance of the engine under test was then evaluated without any modification or change in engine components and systems using the D-Series fuel. The obtained data was statistically analyzed using two factors completely randomized design to study the effects of the engine speeds and fuel blend types on the engine power, torque, and specific fuel consumption. The analysis of variance showed that the engine speeds and fuel types had statistically significant effects at 1% probability level ( $P < 0.01$ ) on the average values of the engine power, torque and specific fuel consumption. The mean values of engine power were increased in the range of 59.14–69.5 kW with increasing the engine speed. The engine power did not show significant difference for all the fuel blends except for the  $D_{100}B_{10}E_{10}$ , 65% diesel, 25% biodiesel and 10% bioethanol, blend which decreased the engine power. The engine torque was decreased with increasing the engine speed for all the fuel blends in range of 319–296 N m. The maximum torque reduction was about 25 N m for neat petro-diesel fuel. The engine torque was decreased significantly ( $P < 0.01$ ) when the engine speed ranged from 1600 to 2000 rpm. The engine specific fuel consumption was increased significantly when the engine speed ranged from 1900 to 2000 rpm. The engine specific fuel consumption was greater for all the fuel blends when compared to neat diesel fuel. The  $D_{100}B_1E_1$  fuel blend could be suggested as an appropriate alternative for neat petro-diesel fuel, though the  $D_{100}B_{10}E_0$  and  $D_{100}B_{10}E_{10}$  blends could be also suggested for greater ratios of biodiesel and bioethanol application in D-Series fuel application.

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## 1. Introduction

Production and application of non-fossil energy sources are necessary due to excessive fossil fuel consumption, increasing price of petroleum products, depletion of the available reserves of oil and also high environmental pollution caused by combustion engines. Biofuels as an alternative source have the advantages of being renewable, non-toxic, safe and reduce pollutions caused by combustion [1]. Among different types of biofuels, both bioethanol and biodiesel fuels as liquefied biofuels have made significant progress [2,3]. Bioethanol is a kind of alcohols with  $C_2H_5OH$  formula, which has various names such as ethyl alcohol, second type alcohol, and grain alcohol. Bioethanol is a volatile, flammable and

colorless liquid, which dissolves completely in water and organic solvents and is highly hydrophilic [4,5]. Bioethanol production of plant materials is common in different countries of the world. Bioethanol can also be produced from the fermentation of sugar and starch [6]. Specifications of bioethanol is similar to gasoline, so it could be used easily in spark ignition internal combustion engines with different blend mixtures without considerable changes in fuel supply system as well as in vehicles powered by fuel cell [7].

Biodiesel fuel could be produced by natural resources such as plant oils, animal fats, waste oils and algae. The specifications of biodiesel are similar to diesel fuel but it has not some of the disorders such as sulfur, nitrogen and aromatic polycyclic. Biodiesel fuel can be used neatly or blended with diesel fuel in transportation systems, heating buildings and factories, and also in industrial processes without any change in fuel supply systems [8–10]. Production of biofuels from biomass materials as a domestic source cause reduction in energy cost, non-dependence to imported fuels, and management of biomass [2].

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# Perkins A63544 Manual

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