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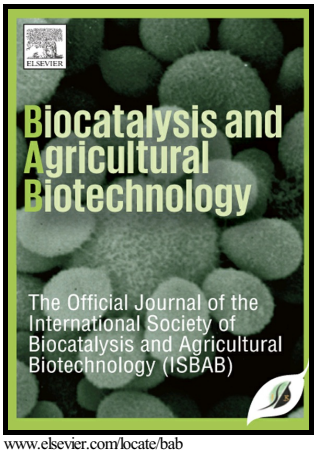

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Experimental Investigation of the suitability of 1-Butanol Blended with Biodiesel as an Alternative Biofuel in Diesel Engines

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ABSTRACT:
Vegetable oils, biodiesels, bio-alcohols and bio-gas are some of the popular biofuels evaluated for their suitability in compression-ignition (CI) engines. Among these, bio-alcohols can be produced from any kinds of biomass through fermentation and biosynthesis and they do not require extra land for cultivation. Therefore, bio-alcohols can be considered as the next generation alternative fuels for automobiles. Investigations have been already initiated to determine the effects of bioalcohols, such as methanol and ethanol, in automobiles as fuel. However, they pose some problems like miscibility, phase separation, low cetane number and low calorific value. On the other side, the effects of higher alcohols, such as butanol, pentanol, octanol, are investigated very rarely. In this work, the effects of higher alcohol addition on the engine performance and emissions characteristics are investigated on a single cylinder diesel engine. Conventional diesel and biodiesel are taken as the reference fuels. 1-Butanol of blends (10%, 20%, 30%, 40%, and 50%) was mixed with the remaining biodiesel as the testing fuel blends. Experiments were conducted on a single cylinder compression ignition diesel engine for four load conditions (5 kg, 10 kg, 15 kg and 20 kg) at a constant speed of 1500 rpm. Brake thermal efficiency and emissions of CO, NOx and HC were recorded and discussed. From the experimental results, it is evident that the addition of butanol with biodiesel seems to an alternative fuel that can replace conventional diesel fuel in terms of both engine emissions and performance.

Keywords: bioenergy, biofuel, butanol, biodiesel, emissions, diesel engine

1. INTRODUCTION:

Biodiesel has proved as one of the promising alternative fuels, which has the potential to reduce the dependency of fossil fuels and environmental problems of using diesel alone. Various sources of biodiesel are food crops and edible oils, nonfood crops and nonedible oils, and other feedstock that does not require agricultural land. However, these production of these sources require the landspace, cultivation, proper maintenance, harvesting and processing. Bioalcohols, on the other hand, can be produced from any waste biomass using microorganisms and the production of bioalcohols is considered to be cheaper than producing biodiesel [1,2]. As biomass, agricultural wastes and other wastes can be used for the production of alcohols, bioalcohols are considered to be the next generation alternative fuels that do not affect the food market and extra land requirement for cultivation [3-5]. Lower alcohols, such as methanol, ethanol, propanol and butanol, have been used for alternative source of energy. However, they pose some problems like lower densities, toxicity, poor cetane number, low calorific values, corrosion, phase separation, lower flash points, higher latent heat of vaporization, transportation issues etc. [6,7]. The use of higher alcohols, such as butanol, pentanol, hexanol, on the other hand, has advantages over lower alcohols and has no phase separation problem, better cold flow properties, better blending stability, high density, high calorific value and high cetane number, less corrosion and higher flash points [8,9]. Therefore, the research on the suitability of bioalcohols as vehicular fuel is of great interest in recent times. As compared to diesel fuel, higher alcohols show lower cetane numbers, lower calorific value and higher latent heat of evaporation. This limits the use of bioalcohols as direct fuel and they can be used as blends along with diesel or other alternative fuels [7].

Research on the effects of alcohol blends has already been started. Kumar et al. [10] investigated the effects of n-octanol/diesel blends and found that n-octanol addition improved brake thermal efficiency with lower emissions of smoke, NOx, HC and CO. Campos-Fernandez et al. [11] showed that the pentanol/diesel blends had increased brake thermal efficiency. Wei et al. [12] showed that the diesel/n-pentanol blends produced no significant difference in brake thermal efficiency with higher emissions of CO, HC and NOx than the diesel fuel. Yilmaz and Atmanli [7] showed that diesel-1-pentanol blends increased reduced the