UNIVERSITI TEKNOLOGI MARA

EFFECTS OF ETHANOL ADDITIVES ON SPARK IGNITION ENGINE PERFORMANCE AND EMISSIONS FUELLED WITH METHANOL-GASOLINE BLENDS

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AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Emissions of greenhouse gases resulting from automobile exhaust emissions is a major concern in recent years due to its effect on climate change. Therefore, an environmentally friendly alternative for fossil fuel needs to be developed to reduce heavy reliance on fossil fuels. Ethanol possesses a great potential to serve as substitute to gasoline due to its favourable physicochemical properties. This research investigated the effects of ethanol additives on spark ignition engine performance and emissions fuelled with methanol-gasoline blends. Four ethanol-methanol-gasoline blends or GEM blends were prepared with variable ethanol concentrations (0%, 5%, 10%, 15%) and constant methanol concentration (10%). Resultant blends were denoted as M10, E5M10, E10M10, and E15M10 in reference to each respective alcohol constituents. Physicochemical properties of these blends were measured in terms of density, calorific value, as well as kinematic viscosity and the results were compared to that of pure gasoline. Results showed that density and kinematic viscosity of ethanol-methanol-gasoline fuel blends increases with ethanol concentration. E15M10 has shown the most improvement in terms of density and kinematic viscosity with 10.7% and 18.7% increase respectively as compared to pure gasoline. In contrast, calorific value was found to decrease as ethanol concentration decreases. E15M10 possesses lowest calorific value with 16.9% decrease as compared to pure gasoline. Engine performance and emissions were carried out on a single-cylinder SI engine at constant speed of 3000 rpm under various engine loads of 1.6, 3.2, and 4.8 Nm. Results showed that generally ethanol-methanol-gasoline fuels possess increased BSFC and BTE on average than pure gasoline. E15M10 displayed highest increment of BSFC at 17.2% average increase with respect to pure gasoline. E10M10 has displayed the highest improvement in BTE with an average of 9.4% increase as compared to gasoline. Meanwhile, no significant variations of EGT were observed. Exhaust emissions indicate that all ethanol-methanol-gasoline blends produced increased CO_2 and NO_x emissions while CO emissions decreases. E15M10 showed the most reduction in CO emissions with 90.6% decrease compared to pure gasoline while E10M10 has shown the most increased CO_2 and NOx emissions with 1.0% and 6.7 times increase respectively. In conclusion, ethanol-methanol-gasoline fuel blends improved engine performance and emissions in terms of BTE and CO emissions in comparison to pure gasoline. Thus, ethanol additives are a practical alternative for blending with methanol-gasoline fuels in lower blend ratios.

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