UNIVERSITI TEKNOLOGI MARA

THE EFFECT OF ISO-BUTANOL ADDITIVE IN METHANOL-GASOLINE BLENDS ON ENGINE PERFORMANCE AND EXHAUST EMISSION USING SPARK IGNITION ENGINE

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 16th May 2016 to conduct the final examination of Hazim Bin Sharudin on his Master of Science thesis entitled "The effect of iso-butanol additive in methanol-gasoline blends on engine performance and exhaust emission using spark ignition engine" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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AUTHOR'S DECLARATION

I declare that the work in this thesis/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.

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ABSTRACT

The application of alcohol fuels on spark ignition (SI) engine has recently become an attraction as an alternative to gasoline fuel. This is due to the concerns on environmental pollution, depletion of fossil fuels, and stringent regulation. Alcohol fuel is indeed an attractive alternative fuel as it had been found to improve octane number, enhance oxygen content, and reduce carbon monoxide emissions. One of the well-known alcohol fuels is methanol fuel that can be blended with gasoline to produce better engine operation in spark ignition engine. Blended methanol-gasoline fuels can be improved further by adding higher carbon number alcohol, such as iso-butanol, as they have higher energy content and they are able to displace more gasoline fuels than methanol-gasoline fuels. However, studies concerning the addition of iso-butanol in lower ratio methanol-gasoline fuels, specifically on fuel properties and engine operation, have not been investigated thoroughly. Therefore, this research looked into the feasibility of the iso-butanol additive (5, 10, 15%) into a lower ratio of 5% methanol-gasoline blended fuel (M5) on unmodified spark ignition engine. The performances of iso-butanol additive in methanol-gasoline blends were compared with base gasoline fuel. Experimental investigation on the characterization of the iso-butanol additive on lower ratio methanol-gasoline blended fuel was first performed. The characterization of fuel involved was density, lower heating value, kinematic viscosity, latent heat of vaporization, Reid of vapour pressure and oxygen content. Other than that, engine testing was performed by using four-cylinder spark ignition engine to test all the blended fuel involved. The engine performance, such as brake power, brake thermal efficiency (BTE), brake specific fuel consumption (BSFC), and exhaust gas temperature (EGT), had been determined. For exhaust emissions, the parameters, such as oxides of nitrogen (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), and unburned hydrocarbon (HC), were also measured. From the test results, improvement was recorded at kinematic viscosity, density, latent heat of vaporization, and oxygen content for iso-butanol additive of 5%, 10%, and 15% with 5% of the methanol-gasoline fuel blends. On the other hand, a reduction was recorded for both heating value and Reid vapour pressure for all blended fuel with iso-butanol additive in comparison to that of base fuel. Moreover, as for engine performance, M5B15 displayed improvement in engine brake power, BTE, and EGT compared to other blended fuels. Nevertheless, higher fuel consumption was recorded for all methanol-gasoline blended fuels with iso-butanol additive compared to base gasoline fuel. In terms of engine emissions, M5B15 exhibited the lowest CO and HC emissions compared to base gasoline fuel. However, the increasing trend projected by NO_x and CO_2 emissions had been recorded in all iso-butanol additive in methanol-gasoline fuels with M5B15 exerting the highest emissions. Thus, it can be concluded that iso-butanol additives are indeed a viable option to be blended with the existing lower ratio methanol-gasoline as an alternative fuel for the operation of spark ignition engine.

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