UNIVERSITI TEKNOLOGI MARA

THE IMPROVEMENTS OF SPARK IGNITION (SI) ENGINE'S PERFORMANCE AND EMISSIONS USING DIFFERENT RESEARCH OCTANE NUMBER (RON) GASOLINE BLEND WITH ETHANOL - METHANOL

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MSc

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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

An internal combustion engine's performance and emission depend on the fuel quality that runs it. For the spark-ignition engine type, the quality of the gasoline is determined by its research octane number or RON. Generally, the higher the RON number is, the better it can resist engine knocking, thus increasing the performance. Nevertheless, a high-performance engine emits hazardous gases from the exhaust emissions to the surrounding. Therefore, an environmentally friendly alternative fuel needs to be explored to replace this non-renewable fossil-based gasoline. Alcohol such as ethanol and methanol possess a great potential to substitute gasoline due to their favourable physicochemical properties. This study investigated the effects of dual alcohol additives blended with a different research octane number gasoline on the performance and emissions of a spark-ignition engine. In Malaysia, three commercial petrol types are available for vehicle users, typically RON95, RON97, and the most premium grade RON100. The ethanol-methanol-gasoline blends were prepared with a fixed concentration of 15% ethanol and 10% methanol with the respective baseline fuel. The resultant blends were denoted as E15M10R95 and E15M10R97. The pure RON95 and RON97 gasoline are also being tested, whereby all fuel blends are benchmarked with the RON100 premium-grade gasoline. The physicochemical properties of these blends were measured in terms of density, kinematic viscosity, as well as calorific value, and later, were tested in a small spark-ignition gasoline engine. The results showed that the density and kinematic viscosity of ethanol-methanol-gasoline fuel blends increases compared with their pure gasoline reference. Inversely, the calorific value was found to decrease as the dual alcohols were added to the base fuel. The engine performance and emissions experiments were carried out on a single-cylinder SI engine at a constant 3000 rpm speed using 20%, 30%, 40% and 50% engine loads. In general, the results demonstrated that the Brake Specific Fuel Consumption (BSFC) for all fuels decreases as applied engine load increases. For the Brake Thermal Efficiency (BTE), it is observed that all fuels exhibit discrete incremental changes as the applied engine load increases with E15M10R95 shown the most profound results compared to RON100. Meanwhile, no significant variations of Exhaust Gas Temperature (EGT) were observed as an applied load on the engine gradually increased. The exhaust emissions indicate that ethanol-methanol-gasoline blends produced higher CO_2 and NO_X emissions while CO emissions decrease. In conclusion, the ethanol-methanol-gasoline fuel blends improved engine performance and emissions in terms of BSFC, BTE and CO emissions compared to pure gasoline. Thus, dual alcohol additives are a practical alternative for blending with a lower grade RON95 fuel exceeding a premium grade RON100 gasoline performance.

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