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STUDY ON PERFORMANCE AND EMISSIONS OF SI ENGINE FUELED BY DIFFERENT FUELS

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ABSTRACT

In recent years, reducing the exhaust gas emissions of internal combustion engines yet maintaining the same engine performance has become one of the most important challenges for automotive companies. Using clean energy, such as alternative fuels, could offer a promising solution for reducing air pollution. In the current work, a comparative study was carried out on the engine performance and exhaust gas emissions of a one cylinder, four stroke spark ignition engine using gasoline, ethanol and LPG fuels. For this reason, a model was proposed. The results were collected at various engine speeds (1500, 2000 and 2500 rpm). It was found that there was a slight variation in engine performance, while there was a marked difference in exhaust gas emissions between gasoline and the other selected fuels.

Keywords: emissions, performance, SI engine, alternative fuels.

1. INTRODUCTION

In the last two decades, the cost of fuels produced from crude oil has increased dramatically. Moreover, there are increasing concerns about the natural contamination of such fuels, which has encouraged many researchers to take an interest in alternative engine fuels. There are several possible alternative fuels, such as ethanol, propane, methane and biodiesel that could be used for spark ignition engines. These options have been known since the automobile was first produced [1-6]. According to previous studies, gaseous fuels could offer a promising alternative fuel for internal combustion engines because they have a higher octane number and higher calorific value than standard fuel, which will improve the combustion qualities and result in less toxic pollution [7-13]. With this in mind, some gaseous fuels, such as liquefied natural gas (LNG) and liquefied petroleum gas (LPG), have been widely used in commercial vehicles [14-18]. Researchers have carried out numerous examinations concerning the use of alcohol fuels (either pure or blended with gasoline fuel) in SI engines at different operating conditions. Cooney *et al.* [19] studied the influence of two different ethanol-gasoline mixtures, one E20 (20% ethanol + 80% gasoline, by volume) and one E84 on ignition qualities at a constant engine load and speed under various compression ratios of 8, 10, 12, 14 and 16:1, respectively. The results showed that the burning duration diminished only with E20 without any influence by any further ethanol added to the gasoline fuel.

Hsieh *et al.* [20] investigated the effect of E5 (5% ethanol mix with 95% gasoline, by volume), E10, E20 and E30 on spark ignition engine performance and exhaust gas emissions at different operating conditions. They concluded that the torque was almost similar to that of gasoline, whereas the brake specific fuel consumption (BSFC) increased when using mixed fuels. The carbon monoxide (CO) emissions of ethanol blends decreased at all selected conditions because it has a higher octane number, which improves the combustion process. In order to comprehend the execution and emanation qualities of an SI engine, Pourkhesalian *et al.* [21] numerically studied the effects of gasoline, hydrogen, propane, methane, ethanol and methanol on engine performance, combustion characteristics and emissions at selected operating conditions. As per the outcomes, the engine power and the emissions of CO and NOx diminished, while the BSFC increased when using these selected alternatives fuels rather than gasoline.

Celik [22] used an ethanol-gasoline E25 mix (25% ethanol+ 75% gasoline, by volume), E50, E75 and E10 in a spark ignition engine at different compression ratios (6:1, 8:1 and 10:1) under a constant engine speed and load. As indicated by the test results, with an expansion ethanol ratio in the fuel mix, the BSFC constantly expanded, while the CO, CO_2 and NOx emissions decreased. The optimal engine performance and exhaust gas emissions occurred when using ethanol blend E50 at the compression ratio of 10:1. The aim of this work is to investigate the engine performance, combustion characteristics and emissions of a one cylinder four stroke spark ignition engine fueled with gasoline, ethanol and LPG at different speeds under a constant engine load.

2. ENGINE MODEL

The specifications of the engine that was used in the numerical study are illustrated in Table-1. Recently, the AVL program has been considered one of the best programs for simulating an internal combustion engine at different operating conditions. The AVL program provides several types of standard fuels, as well as different sub model options, to simulate engine performance, combustion and emission formations. The starting point involved building a one-cylinder SI engine in the program and then providing all the requirements to make the program run. The model was firstly run at the engine speeds of 1000, 1500 and 2000 rpm, respectively by using gasoline fuel. The results of the model were collected and compared with the results that were provided by the manufacturer in order to test the usefulness of the model. Further running was carried out using ethanol and LPG fuels at the same engine speeds. A comparison was made