The Effect of Fuel Additives on Spark Ignition, and Their Implications on Engine Performance: An Experimental Study

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Abstract. This paper is designed to present an experimental study being recently conducted for investigating the effect of some fuel additives on the performance of spark ignition within a benzene engine. Three types of additives were added separately (Gasoline Additive, Gasoline Booster, and Octane Booster) to pure gasoline with a volumetric ratio 1:6, 1:7, and 1:8 respectively. Four separate laboratory experiments being conducted using an internal combustion engine at rotational speed ranges from 600 to 3000 rpm, where the three mixtures and the pure gasoline itself were used.

The findings showed that there was a positive effect on the engine performance as the brake power increases by 8%, 13% and 23% at the use of Gasoline Additive, Gasoline Booster, and Octane Booster respectively as compared with using only the pure gasoline. The brake thermal efficiency (η_{th}) was also affected positively showing its maximum value of about 8% for Octane Booster, and with a minimum value for using Gasoline Additive at about 4.7%. In addition, this study showed that the value changes in the brake specific fuel consumption for Gasoline Additive, Gasoline Booster, and Octane Booster was at the levels of 1%, 2%, and 5% respectively compared with using only the pure gasoline. Furthermore, the results also showed that the use of Octane Booster gave the highest level of air fuel ratio.

Keywords: Additives, Ignition, Performance, Spark.

1 Introduction

The assessment of performance levels of any engine depends on some key factors; among of them is to focus on the performance of brake power, brake specific fuel consumption, brake thermal efficiency, air to fuel ratio, engine speed, and the emission issues [1]. Most importantly is the type of the used fuel, which is considered to be one of the most important indicators that affect the engines' performance especially the combustion engines [2].

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With the aim of improving the quality of the fuel in order to obtain its best performance levels, it must be a focus on the improvements of the Octane number which can be improved by Catalytic reforming, Isomerization, Alkylation, Cracking, and adding especial additives. The most important materials that could be added to the gasoline are organic compounds (organometallic) such as Tetra Methyl Lead or Tetra Methyl Lead, where both of them should be added by a certain percentage levels based on the Octane issues within the pure gasoline [2].

Many research have been conducted on the effect of the additives to the gasoline on performance of the engines' spark [3]-[7], stating that using additives improves the Octane number, thereby the engine performance positively affected. In this research, the focus is on investigating three commercial additives that available within the local market to show their effects on the pure gasoline based on the improvements on the engine performance and on any other related issues. The additives were added separately to the pure gasoline (collected directly from the refinery) in order to investigate the impact of these additives on the engine's performance based on the engine power, and the engine's thermal efficiency, the specific fuel consumption, and the ratio of fuel to air.

2 Experimental Study

Laboratory experiments for this study took place using an internal combustion engine model GR03061000/037A with a single-cylinder four-stroke, along with a compression ratio and spark timing. The engine was hitched to a hydraulic dynamometer fixed on a steel frame and linked to cooling, fuel systems. A dashboard includes gauges speed spin, plucks and inside and outside cooling water, compression ratio indicator and the pressure difference on both sides of intake air nozzle. In addition, Table 1 shows the related characteristics of the used engine [7].

Table 1 The specifications of the used engine

Engine Model	An internal combustion engine
Number Of Strokes	Four-Stroke
Number Of Cylinders	Single-cylinder
Diameter Of Piston	90 mm
Length Of Stroke	85 mm
Swept volume	541 mm^3
Compression Ratio	4.175
Cooling System	cooling water
Type Of dynamometer	Hydraulic