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Automotive and Tractor Engineering Department
Faculty of Engineering
Minia University

A Comparative Study of The Performance of Gasoline and Compressed Natural Gas Fuelled Passenger Car

By

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ABSTRACT

Recently the world have turned to compressed natural gas instead of traditional gasoline as a fuels for their cars. For the former doesn't produce the same amount of emission as the latter fuel.

A Historical review of available published work was introduced and showed the need for extra work on studying the effect of some designing parameters on emissions, noise level, and vibration response, so as to achieve the ideal employment of the engine fuelled by compressed natural gas.

Within this work, it became possible to convert a spark ignition engine of passenger car Fiat 125p, commonly used in Egypt. So as to work on either compressed natural gas or gasoline by the same ignition circuit. This study includes the description of measurement instruments of the experimental procedure.

The work investigated the effects of the designing parameters which are engine speed, static spark timing, spark plug gap, contact breaker points gap, and valve tappet clearance on emission, noise level, and vibration emitted from the engine.

From the results of the work, it has been observed that using compressed natural gas instead of gasoline comparatively decreases the emitted carbon monoxide and hydrocarbon emissions in particular besides noise level and vibration caused by engine running. By this we can declare that compressed natural gas is a friend of nature, in view of its role in minimizing air pollution which has become the most warring problem in the present time.

Moreover, there are certain recommendations concerning the engine fuelled by compressed natural gas which is meant to receive less emissions, noise level and vibration. Finally, comments and recommendations for future work are given for extending the study circle about the subject matter.

Sympole	Description	
SFC	Specific Fuel Consumption	(g/kWh)
SO_x	Sulfur Oxides	
SST	Static Spark Timing	(degree)
SPL	Sound Pressure Level	(dBA)
THC	Total Hydrocarbon	(ppm)
TWC	Three-Way Catalytic	
UBHC	Unburned Hydrocarbon	(ppm)

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INTRODUCTION

1.1 Background

Recent years have produced social demands for reducing automobile exhaust gas emissions, where fuel composition has a strong influence on the quantity and quality of the pollutants emitted by internal combustion engines (I.C.E,s). As a consequence, a considerable research effort has been under-taken in order to reduce emissions improving fuel characteristics. In particular, a growing interest is focused on alternative fuels due to their behavior in terms of pollution. Alternative fuels available from energy resources is compressed natural gas (CNG). One effort to meet such demands is research and development in various fields of CNG. Compressed natural gas is an outstanding fuel in view of its intrinsic characteristics. Infact it is gaseous and as a consequence it forms easily homogeneous air fuel mixtures and does not need any enrichment during cold starts or transient conditions, thus allowing a reduction of exhaust emissions. Also CNG has some advantages, no measurable smoke and no sulfur dioxide emissions, very low particular emissions, and very low tendency to smog formation, relatively low contribution to the green house effect, excellent anti-knock characteristics, and low hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxides (NOx) emission. Therefore, compressed natural gas appears to be available alternative to gasoline at this time, hence the natural gas dedicated engine represent a good solution to achieve low exhaust emissions and low noise level.

Natural gas vehicles (NGVs) are drawing international attention for their role in global environmental protection as an oil- alternative energy. The number of NGVs replacing gasoline and diesel vehicles is expected for rapid increase. Currently there are approximately 1000 natural gas fueled vehicles in operation through out Egypt.

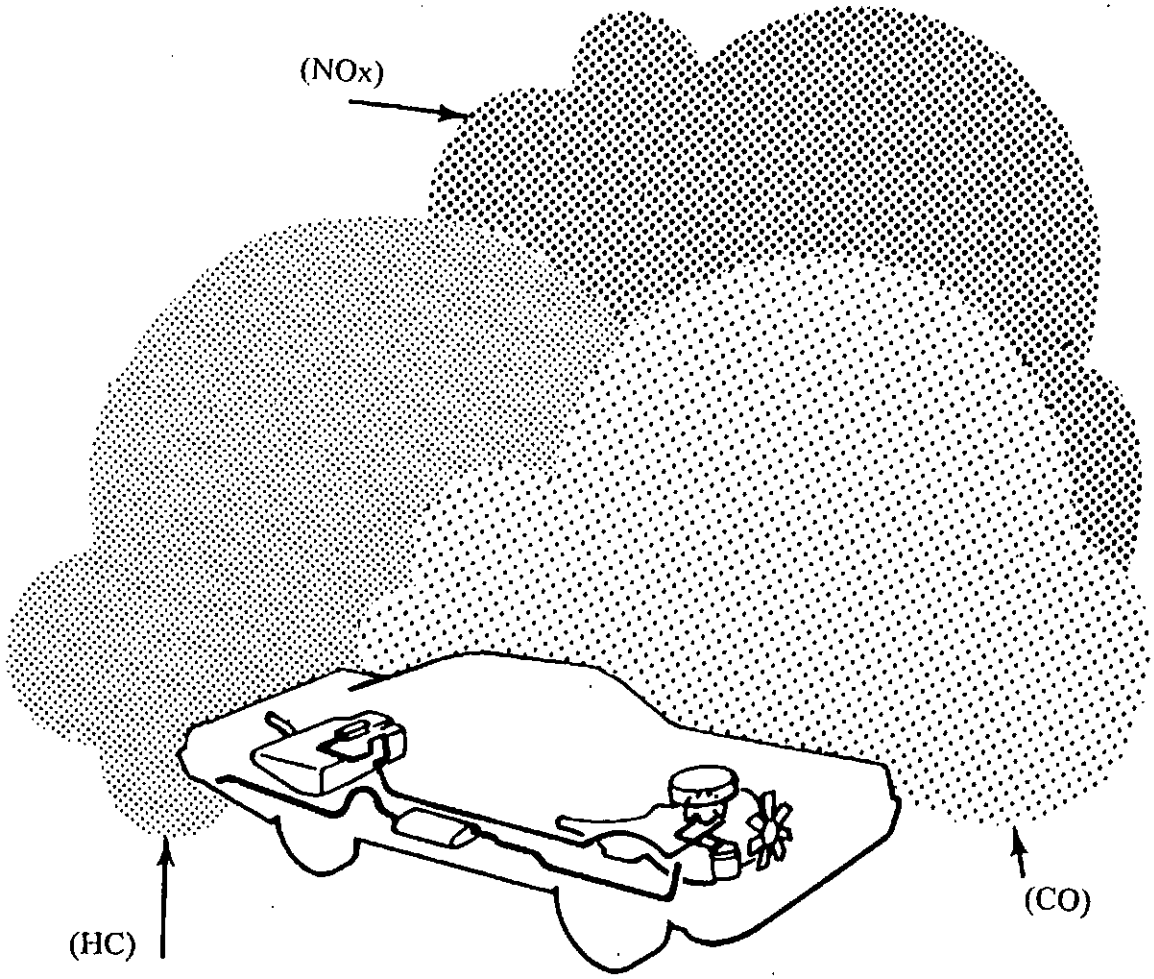
Most of engines now used for the NGVs, however, they are not dedicated ones. That is, most of the present natural gas engines do not make most the specific characteristics of natural gas, such as its high octane number. Alternative gas engine converted from a gasoline engine, foran instancing, has an engine the same as the base engine. As the engine system is not optimized for natural gas use, the performance power output and thermal efficiency is not as satisfactory that of the base gasoline engine. The power generally decreases (10 to 20 %), and the thermal efficiency is no better than the base engine [1].

Owing to the high hydrogen to carbon ratio (4:1) of natural gas, it tends to burn more completely than gasoline, thus reducing harmful carbon monoxide unburned hydrocarbons, and not emitted led from engine. Fig. (1.1) indicates three major pollutants emitted by CNG and gasoline vehicles [2]. The main emission drawback associated with natural gas fuel use the formation of oxides of nitrogen, and to a lesser degree, nitrogen dioxide.

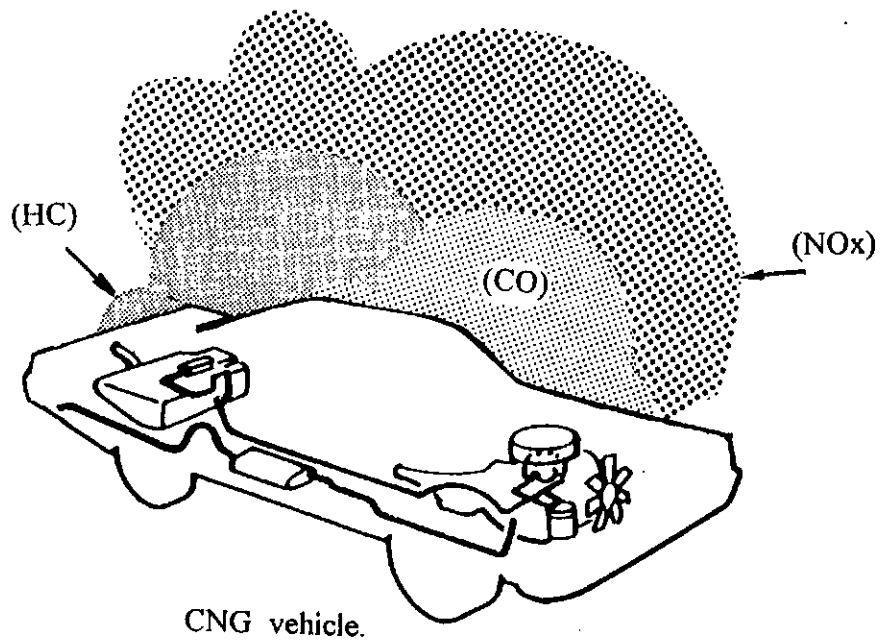
When a passenger vehicle is converted to natural gas fuel from gasoline without any further modifications a power output loss will be realized due to the decrease in energy density of the air-fuel mixture because the natural gas occupies approximately five times the volume as gasoline. But the pollutants decrease from natural gas vehicles than gasoline vehicles.

1.2 Thesis layout

A literature survey was conducted in order to identify the recent and historical trends involved with natural gas fuelled passenger car. The most published works showed the influence of the vehicle which converted to operate with alternative fuel, natural gas and gasoline. All these papers regard to low emission and noise level for natural gas vehicles.



Gasoline vehicle.



CNG vehicle.

Fig.(1.1) Hydrocarbon (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) are the three major pollutants emitted by a vehicle [2].

The experimental results was taken on idle engine speed for parameters, engine speed, static spark timing, spark plug gap, contact breaker points gap, and inlet and exhaust valve tappet clearances and also the results was taken in road to loaded the vehicle engine by road resistances as the rolling and the air resistances for passenger vehicle model 125p Fiat. This vehicle and all instrumentation used in this study already had been acquired for use in the vehicles laboratory. The vehicle engine parameters had controlled as the cooling system, air flow-rate, and engine speed. The results in this study suggest decreasing the emission, noise level, and vibration response for natural gas than gasoline fuelled passenger cars.

1.3 Thesis objective

The objective of this study is to develop a dedicated natural gas vehicle from a gasoline vehicle, and compare the performance of CNG and gasoline fueled passenger vehicle, to gain an advantage in emission and noise level over a gasoline vehicle, and given a recommendations for the natural gas vehicles companies to adjust the difference clearances.