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Mitigation of Greenhouse Gases (CO2) through the use of the Hybrid Engine (Hydrogen Fuel)

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Abstract

This research paper proposes a hybrid engine (Hydrogen fuel) as an alternative to using clean energy, aimed at lower fossil fuel consumption, reducing the use of gasoline, reduce greenhouse gas emissions to the atmosphere and mitigate air pollution and global warming[1]. The analysis is based on random samples of carburetor-engine vehicles, which have a low complexity of the engine, taking the levels of CO2 and hydrocarbons as measurements, with the objective of determining the performance of the use of hydrogen in the vehicle [2].The engines of vehicles in Lima are not prepared for this type of fuel combination, so this experimental research required the adaptation of the vehicle's operating system and the installation of a Hydro Assist Full Cell kit, that means it became a Hybrid engine (Hydrogen - Gasoline); to, finally, evaluate and examine the effects it produces on the environment and the economy [3].

I. INTRODUCTION

The light radiation that is absorbed in a shortwave by the earth's surface and returned to the atmosphere in a longwave in the form of heat radiation is retained mainly by CO2, water vapor, and other gases that are components of the atmosphere, a phenomenon known as the greenhouse effect.

As a result of the retention of heat energy, the average temperature on the surface of the Earth reaches about 15 ° C, which is conducive to the development of life on the planet.[4]

Many countries have rules on air quality concerning the hazardous substances it may contain[5]. These regulations mark the maximum levels of concentration that guarantee public health. Norms have also been established to limit air pollutant emissions produced by different sources of pollution.[6][1] However, the nature of this problem cannot be resolved without an international agreement. In March 1985, at a convention sponsored by the United Nations, 49 countries agreed to protect the ozone layer. In the Montreal Protocol, renegotiated in 1990, the progressive elimination of certain ChloroCarbon and FluoroCarbon compounds is requested before the year 2000 and offers assistance to developing countries to make this transition.

II. EXPERIMENTAL STAGE

2.1 Conditioning Stage of the Analysis Unit

At this stage, the execution of the technical adaptation in the vehicle's operating system begins.

Step 1: The total maintenance of the vehicle is carried out, making it a greater refinement that implies: change of spark plugs, change of engine oil, change of gearbox oil, change of filters, and change of carburetor.

Step 2: Once the maintenance and refining of the vehicle have been carried out, the changes of the main and slow jets extracted from the carburetor are made, thus being the low one from 90 to 85 and the

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high one from 160 to 150, to regulate the passage of gasoline to the engine.

And so on, changes are made in each test of adjustment of the jets until reaching the lowest that is 70 and the highest 110, managing to control the passage of gasoline to the engine.

Classic carburetors bring two circuits, or systems: Low and High Power. The low circuit doses the fuel necessary for idling (regulating) and transfer between a closed butterfly and an open butterfly.

The main jet, dose the gasoline for the other acceleration conditions.

Step 3: Total Engine Cleaning.

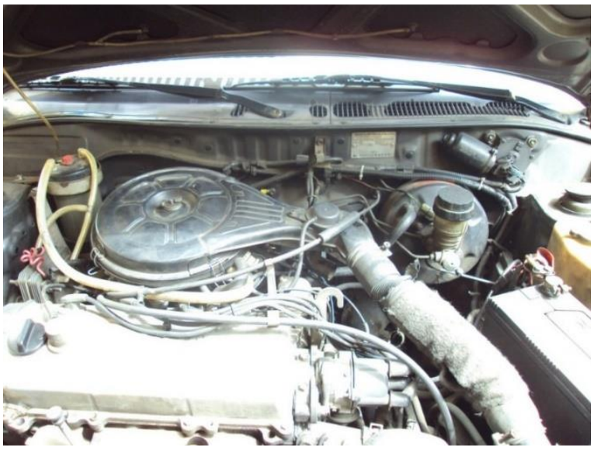

Figure 1. Engine Cleaning.

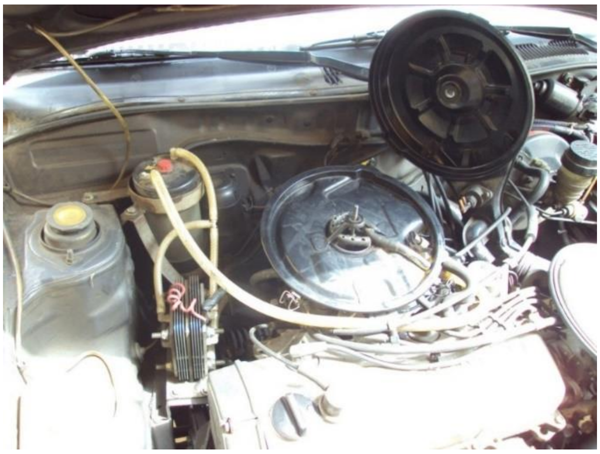

Figure 2. The equipment used for thisexperiment a Hydro Assist Full Cell Kit.

2.2 Hydrolysis process within the equipment

Once the solution (a mixture of distilled water with potassium hydroxide) is prepared in a glass container, the contents are poured into the container, it is closed tightly, and the respective connections are made to the fuel cell. Once properly connected, the vehicle is started, and the chemical process begins. By the action of the energy emitted by the vehicle's battery, it starts to generate the Hydrogen, passing towards the engine through the conduit connected to the carburetor.

FORMS

Table 1 : Composition

Anode: $2H_2(g) + 4OH(aq) = 4H_2O(I) + 4E$		**Cathode**: $O_2(g) + 2H_2O(I) + 4e = 4OH(aq)$		**Total**: $2H_2(g) + O_2(g) = 2H_2O(I)$
Welectrolysis $H_2O \rightarrow H^+ + OH^-$ $2H_2O \rightarrow\leftarrow\leftarrow H_3O^+ + OH^-$	**Reaction in the cathode** $2H_3O^+ + e^- \rightarrow H_2 + 2H_2O$	**Adding KOH** $KOH \rightarrow K^+ + OH^-$	**Rx. on the cathode** $K^+ + e^- \rightarrow K$ $K + H_2O \rightarrow KOH + H_2g$	**Rx. on the anode** $OH^- - e^- \rightarrow O_2(g) + H_2O$

Table 2; Calculations TPN

T	273 K (O^0 C)
P	1 atm
2.0 g + H_2	22.4 Lt. to TPN

Table 3: Calculation of Hydrogen generated in electrolysis

2 H_2O	2 H_2 + O_2
36 g →	4 g.

500 g	X
P H_2O =	1g./ml (water density)
X =	(500g X 4g) / 36 g.
500 ml =	500g. (volume H_2O consumed)
X =	55.55 g. of H_2 (g)
Moles of H_2 =	55.55 g/(2g/mol)
	27.78 moles of H_2

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Calculation of occupied H2 volume: using the ideal gas law

$V = nRT / P$

Where: n = 27.78 moles

R C 0.082 L. atm

T C 298 ^{0}K (25 ^{0} C)

Replacing in 1

V = 27.78 mol X 0.082 L atm X298^0 K / 1.00 atm mol ^{0}k

V = 678.71 L of H2

Calculation of the amount of H2O vapor generated by the combustion of hydrogen;

Rx has to be.

$H_2 + {}^1/_2\, O_{2(g)} \rightarrow H_2O\ (v)$
$2g \rightarrow 18g$
$55.55g \rightarrow X$
X = 55.55X 18 / (2)
X = 500g.
P H_2O = tg/ml after 500g/(1g/ml) density of the H_2O
<u>Vol = 500ml.</u>

Figure 3. Hydrolysis process.

Figure 4. Complete equipment conditioned.

In the implementation of the kit for the experimentation, several elements were conditioned in the vehicles for their operation, as shown in Figure 3 and Figure 4; also, Table 4 shows the data obtained from the experimentation. [6]

Table 4 : Engine evaluation

Vehicle No.	Date	Carburetor engine	Carbon dioxide(%)	Hydrocarbons (ppm)	Engine condition
1	15/03/2019	Yes	8.1	26.1	Good
2	15/03/2019	Yes	8.7	28.5	Good
3	15/03/2019	Yes	7.9	31.1	Good
4	15/03/2019	Yes	8.0	29.9	Good
5	15/03/2019	Yes	8.5	32.6	Good
6	15/03/2019	Yes	9.0	34.2	Good
7	15/03/2019	Yes	8.9	30.2	Good
8	15/03/2019	Yes	8.6	31.9	Good

III. RESULTS

A progressive increase in savings in gasoline from 12.7% to 28.0% and a decrease in the level of carbon dioxide from 8.1% at the start of the tests was up to 3.9% (- 4.2 percentage points), as well as at the hydrocarbon level from 26.1 ppm to 10.8 ppm (- 58.6%).

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at the hydrocarbon level from 26.1 ppm to 10.8 ppm (- 58.6%).

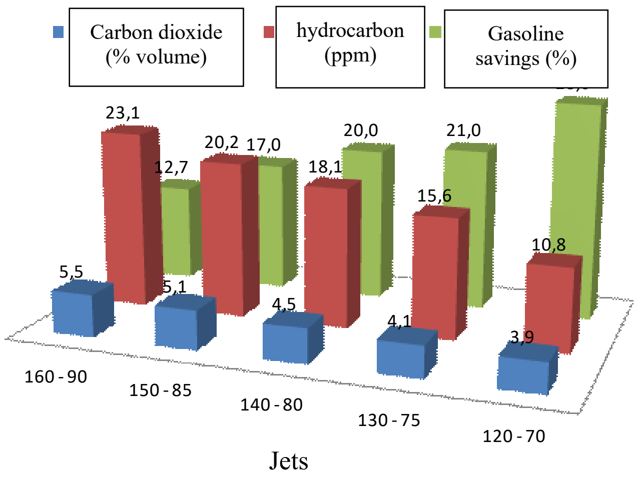

Figure 5. Comparative test results in vehicle No. 1 (exhaust pipe).

Concerning the level of carbon dioxide contamination, the No. 3 vehicle is the one with the lowest value (3.0%), and the No. 7 vehicle has the highest value (4.7%). This represents a variation of 1.7 percentage points between the 2 vehicles, so it is concluded that the Daihatsu brand vehicle was less polluting to the environment.

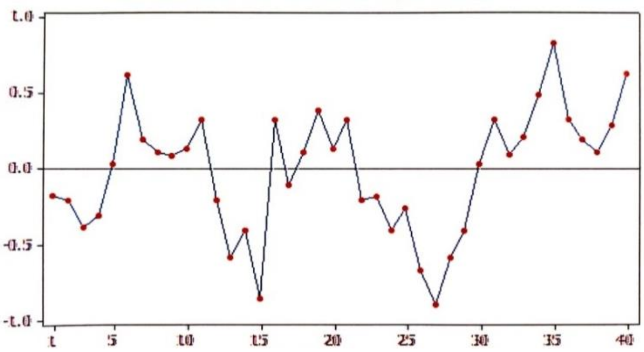

Figure 6.the behavior of the carbon dioxide variable

We can observe in the Gauss-Newton equation obtained, the behavior of the carbon dioxide variable with the results obtained in the model giving a residual minimum, each red point is an experimental test taken from the 8 samples taken by the 5 repetitions of test each as shown in figure 6

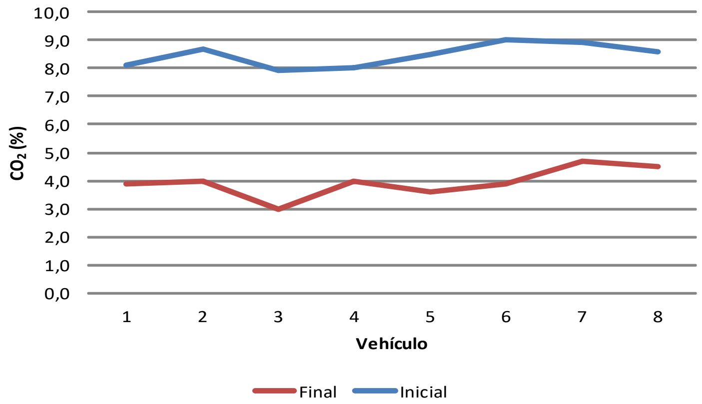

Figure 7Comparative results of the initial test vs. final test of the level of carbon dioxide contamination by vehicle.

On the level of pollution of hydrocarbons, the No. 1 vehicle is the one with the lowest value (10.8ppm), and the No. 6 vehicle has the highest value (15.0ppm). This represents an increase of the latter of 38.9%, so it is concluded that the vehicle of the Hyundai brand was the least polluting to the environment.

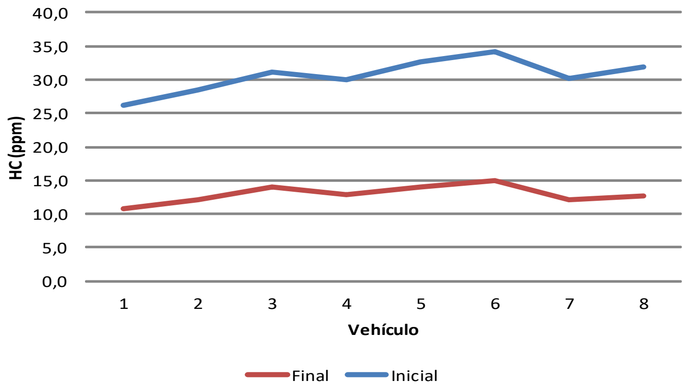

Figure 8.Comparative results of the initial test vs. final test of the level of contamination of hydrocarbons by vehicle.

IV. DISCUSSION

According to the results obtained in the present investigation in the use of the hybrid engine, the decrease in the emission of carbon dioxide, as well as in hydrocarbons, lead to savings in the consumption of gasoline, which will contribute to mitigate pollution environmental (atmospheric)

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produced by excessive emission of carbon dioxide. [8]

The results obtained from the concentrations of the gases involved (carbon dioxide, hydrocarbons) in the present experiment, are obtained by using the instruments corresponding to the data collection, whose accuracy and precision are a function of their calibration, and of technical problems presented (low power, engine drowning, lack of starting). Therefore, the installation must be carried out by qualified personnel, which currently represents a limitation in our country.

V. CONCLUSIONS

The hybrid engine lowers the emission levels of CO2 and HC gases, having reached a level of 3.0% CO2 and 14.0 ppm HC in experimental light vehicles in Metropolitan Lima, representing a decrease of 4, 9 percentage points and 55.0%, respectively, concerning the initial measurement of these parameters.

The maximum level of fuel savings reached in the experimental test is 32.0%, there being an additional saving capacity if it is taken into account that according to the manufacturer of the hybrid motor converter equipment, the saving is 50.0%.

Once the necessary tests and calibrations of the programmable injection operation have been carried out, the conclusion is reached that improves the operation of the system based on electronic calibrations for the correct operation of the vehicle.[9]

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