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AN APPRAISAL OF THE FEASIBILITY OF GASOLINE PRODUCTION BY USING ALTERNATIVE ADDITIVES.

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ABSTRACT

Toxic lead additives to gasoline are no longer used in many countries worldwide. The principle objectives of the present work are to upgrade the quality of some petroleum products through various operations. This study investigated the effect of alternative additives such as Methanol, MTBE on the 80 RON gasolines, light and heavy Naphtha via different blends of variable percentages. The CFR engine was employed to measure the Octane number of the produced blends while mixtures of other alternative additives were prepared and added to the previously mentioned blends. The obtained results showed that the additives have led to a significant improvement of the measured octane number of gasoline. Nevertheless, it was noted that decreasing the Methanol percentage had a negative effect on the environment. As illustrated by the results, it is noted that the gain in the research octane number in the methanol blended samples is higher than base gasoline. Also, the gaseous emissions produced on combustion such as carbon monoxide, nitric oxides and unburnt hydrocarbons have shown a noticeable decrease of 26% for unburnt, 16% for CO and 14.5 % for NOx. However, Carbon dioxide emissions have increased by 5.6 % which may are attributed to the complete combustion of the fuel on the expense of Carbon monoxide emissions. Moreover, the effect of oxygenate addition on the volume of air required to was detected in the decrease in the NO_x emissions.

Keywords: additives, improvement of gasoline, Enhancing of octane number and light and heavy Naphtha

1. INTRODUCTION

Gasoline is one of the most required products of the petroleum industry. It is produced in the refinery and used as a fuel for transportation. In an inserted refinery, about 70% of the crude converted into gasoline. Gasoline considers the main dropper, is gotten from crude oil in a refinery. Complex mixture of light hydrocarbons containing 5 to 10 carbon atoms and owing boiling range of 40^{o}C to 190^{o}C. A typical gasoline is predominantly a mixture of paraffin's (alkanes, saturated hydrocarbons which are single bonded), naphthenic (cycloalkanes, cyclic saturated hydrocarbons), aromatics and olefins (alkenes, unsaturated hydrocarbons which are double bonded) gasoline at the level consumer called petrol or super, benzoyl, motor spirit or gas. [1].

Last years, the petrochemical mode for the production of fuels improved stable to face the request of both, the jointly increasing amounts and the permanently increasing knock reluctance of gasoline. Different additives were applied to provide the required chartered of the highly knock resisting super kind gasolines used today. Components that are used selective are antiknock factor to improve octane number of unleaded gasoline divided into many groups: metallic, alcohols, aromatics, and others [2].

Fuel additives are compounds formulated to improve the quality and effect of the fuels that is used in motor vehicles. However in some cases, the supplier combine the additive into the gasoline itself; in other times, the fuel additive is purvey as a sever product that consumers may use to improve the personification of engines.

Methanol is the simplest alcohol that can be used as a building block to larger chemicals. It is a colorless polar liquid miscible with water at room temperature, highly toxic to humans and flammable nature. Therefore, special care must be taken in handling, transportation and storage. Request for cleaner and ersatz energy is increased quickly due to trait in methanol production and the increasing of methanol consumed is predictable to probable continue until the end of this deed. Methanol is widely used as a candid material for formaldehyde production, MTBE and acetic acid [3].

The present work therefore was to investigate the production of Gasoline 80, Gasoline 92 and gasoline 95 from light and heavy Naphtha and produce gasoline from gasoline 80, effect of additive on improvement of the measured octane number of gasoline.

2. MATERIALS AND METHODS.

2.1 Gasoline specification.

Gasolines are usually defined by government regulation, where properties and test methods are clearly defined. In the US, several government and state bodies can specify gasoline properties, and they may choose to use or modify consensus minimum quality standards, such as American Society for Testing Materials (ASTM). The US gasoline specifications and test methods are listed in several readily available publications, including the Society of Automotive Engineers (SAE), and the Annual Book of ASTM Standards.

All feeds and products of Reformer and Power Former units were tested by ASTM standard and IROX analyzer. ASTM standard methods which are used for testing petroleum cuts in this project are:-

2.1.1Cooperative Fuel Research Engines (CFR) (D2699, D2700)

2.1.2 Summary of Test Method

1- The Research RON of a spark-ignition engine fuel is determined using a standard test engine and operating conditions to compare its knock characteristic with those of PRF blends of known RON. Compression ratio and fuel-air ratio are adjusted to produce standard AKI for the sample fuel, as measured by a specific electronic detonation meter instrument system. A standard AKI guide table relates engine CFR to RON level for this specific method. The fuel-air ratio for the sample fuel and each of the primary reference fuel blends is adjusted to maximize AKI for each fuel.

2- The fuel-air ratio for maximum AKI may be obtained:

a-By making incremental step changes in the mixture strength, observing the equilibrium AKI value for each step, and then selecting the condition that maximizes the reading.

b-By picking the maximum AKI as the mixture strength is changing from either rich-to-lean or lean-to-rich at a constant rate.

2.2 Ricardo E6/MS

Single cylinder variable compression ratio

It is a research engine that can operate on different types of fuel and is dedicated to the research of fuel.

To measure the performance of the motor fuels and different compared to this species petro.

Model	Ricardo E6
Engine configuration	**Single cylinder, four-stroke, naturally aspirated, water cooled**
Bore	**87.3 mm**

Stroke	**110 mm**
Compression ratio	**Variable**
Rated power	**8 kW @ 3000 rpm**
Fuel system	**Carburetor**

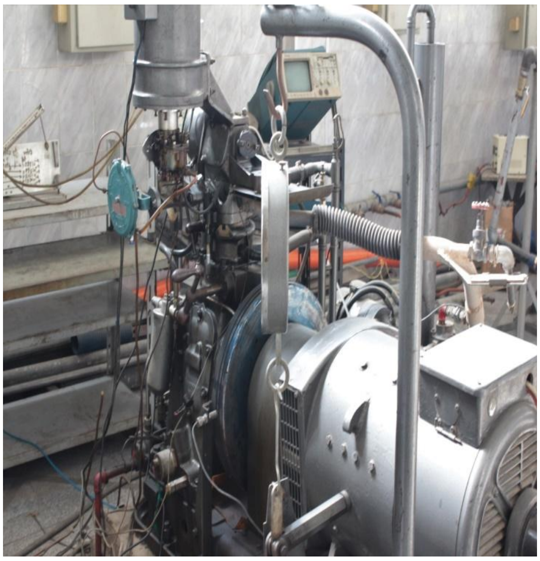

Fig (1): structure of Ricardo E6/MS

Fig (2): structure of C.F.R. used in experiments

3. RESULTS AND DISCUSSION

In the present study gasoline was produced from Wataneya petrol / gas station, where selected components were added to the gasoline to enhancing octane number.

Table 3.1: Comparison between Octane Number of Gasoline 80 before and after treatment of mixture 1

Number of samples	Component	Octane Number
1	Gasoline (80)	79.3
2	Gasoline +Additive	96.1

The models and method in table 3.1 have previously showed that the ignition quality has been upgraded from 79.3 to 96. It was clear that it has increased by 16.8 octanes. This may be attributed to the fact that some oxygenates improves the performance of the fuels.

3.1.2: Effect of the oxygenate on reduced gasoline exhaust gases in mixture 1.

In the present study we used commercial gasoline and blended gasoline of mixture 1 in an engine 131 Fiat.

The data of Table 3.2 showed the improvement in measurement components of exhaust after addition. The unburned hydrocarbon emissions have decreased by 26%. And carbon monoxide (CO) emissions have decreased by 16%. The nitric oxides (NO_x) emissions has decreased by 14.5 %, and the Carbon dioxides (CO_2) emissions has increased by 5.6 %. Due to the addition of the oxygenate, the air required to burn the fuel decreased so the amount of NO_x decreased. Which means that using this booster will directly decrease air pollution.

Table 3.2 Comparison between components of exhaust gases in different samples.

Fuel type	Average measurement of Exhaust			
	Hc(PPM)	CO_2 Vol(%)	Co Vol(%)	NOx(PPM)
Gasoline (80)	192.5	10.68	0.80	36.25
Methanol+ Gasoline (80)+Additive	141	11.28	0.67	31
The Change (%)	-26.8	5.6	-16	-14.5

Results showed that by adding oxygenate, a completed burnt hydrocarbon occurred, for this reason values are reduced. Increasing the percentage of oxygenate in the blend will reduce the carbon dioxide emissions and consequently will save carbon credit expenditures. And we conclude that adding oxygenates to the gasoline blends is environmentally and economically better, and especially methanol which has more environmental and economic impacts.

3.2: Upgrading Octane Number in mixture 2:

In the second mixture, we used three additives (which consists of heavy naphtha, light naphtha and gasoline 80) with e methanol and other additives (heavy naphtha, light naphtha and gasoline 80) that we used as a base.

3.2.1: Effect of methanol on gasoline blends octane number in mixture 2:

The five blends shown below are considered
1-730 crude oil+100Xx+2%Yy+150 Methanol
2-750 crude oil+100Xx+2%Yy+130 Methanol
3-750 crude oil+100Xx+4%Yy+110 Methanol
4-710 crude oil+100Xx+4%Yy+150 Methanol
5-820 crude oil+100Xx+3%Yy+150 Methanol

Table 3.2.1: Comparison between octane numbers of different blending

Number of blended	Components	RON of crude oil	RON of crude oil and blended	Improvement on octane
1	730 crude oil+100Xx+2%Yy+150 Methanol	heavy Naphtha 49	86.9	+37.9
		Light Naphtha 73	96.3	+23.3
		Gasoline (80) 78	99.7	+21.7
2	750 crude oil+100Xx+2%Yy+130 Methanol	heavy Naphtha 49	84.4	+35.4
		Light Naphtha 73	95.3	+22.3
		Gasoline (80) 78	99.2	+ 21.2
3	750 crude oil+100Xx+4%Yy+110 Methanol	heavy Naphtha 49	91.5	+42.5
		Light Naphtha 73	98.8	+25.8
		Gasoline (80) 79.1	Over 100	++++
4	710 crude oil+100Xx+4%Yy+150 Methanol	heavy Naphtha 49	94.2	+45.2
		Light Naphtha 73	Over 100	++++++
		Gasoline (80) 79.1	Over 100	+++++++
5	820 crude oil+100Xx+3%Yy+50 Methanol	heavy Naphtha 49	83	+34
		Light Naphtha 73	93.2	+20.2
		Gasoline (80) 79.1	98.2	+19.1

From table 3.2.1 we selected E5 because the percentage of adding methanol is 5% as it is the international standard, and the heavy naphtha in the blend 5 had an octane number of 49 before adding the additives. And after additives it became 83, which mean the heavy naphtha increased 34 octanes. Regarding the light naphtha before adding the additives its octane number was 73, and after additives it became 93.2, which mean the light naphtha increased 20.2 octanes. And regarding the gasoline 80, before adding the additives its octane number was 79.1, and after additives it became 98.2, which mean the gasoline 80 increased 19.1 octanes.

We selected E2 because the percentage of adding methanol is 13% as it is the international standard and the increase of the amount of methanol will increase the volume and then the production. Before adding the additives, the heavy naphtha's in the blend 2 octane number was 49, and after additives it became 84.4 which mean the heavy naphtha increased 35.4 octanes. Regarding the light naphtha, before adding the additives its octane number was 73, and after additives it became 95.3 which mean the light naphtha increased 22.3 octanes. And regarding the gasoline 80 before adding the additives, its octane number was 79.1, and after additives it became 99.2 which mean the gasoline 80 increased 21.2 octanes.
Although these results achieved high octane and economic profits, but the decision to select one of these blends will depend on the environmental results which will be closer to the international standards.

3.2.3: Effect of the oxygenate on reduced gasoline exhaust gases in mixture2.

In the present study, the reason to select the best perform of blends represent in efficiency of reduced exhaust gases. We analyze blends 1, 2, and 5 in mixture 2, moreover all blends continue different three types of fuel (heavy Naphtha, Light Naphtha and gasoline 80).

Table 3.2.2: Effect of the oxygenate on reduced gasoline exhaust gases in blend1at mixture2.

Blend 1	**Hc(PPM)**	**CO Vol(%)**	**Co Vol (%)**	**NOx(PPM)**
Gasoline 92 RON(92.2)	**2859**	**4.2**	**0.09**	**25**
Gasoline 80 RON(99.7)	**2503**	**3.6**	**0.22**	**72**

Table 3.2.4: Effect of the oxygenate on reduced gasoline exhaust gases in blend2 at mixture2.

Blend 2	**Hc(PPM)**	**CO Vol(%)**	**Co Vol(%)**	**NOx(PPM)**
Gasoline 92 RON(92.2)	**2836**	**5.1**	**0.13**	**31**
Naphtha 73 RON(95.3)	**2780**	**5.5**	**0.26**	**50**

3.2.5: Effect of the oxygenate on reduced gasoline exhaust gases in blend5 at mixture2.

Blend 5	Hc(PPM)	CO Vol(%)	Co Vol(%)	NOx(PPM)
Gasoline 80 RON(79.1)	3428	5.24	0.07	57
Gasoline 80 RON(98.2)	3256	5.5	0.24	108

Data showed that, the blend 1, 2 and 5 were having positive effects regarding the environmental factor: its decreases carbon monoxides and unburnt hydrocarbons and converted Co noxious to Co_2 un noxious across combined atom oxygen in the additive. The lowest value of nitric oxides (NOx) emissions (25 PPm) was recorded at blend 1; it increased gradually to 31 at blend 2 in Gasoline 92. However, it was 72 PPm at blend 1 in Gasoline 80 and the minimum value of 50 PPm was detected at Naphtha 73 in blend 2. The results revealed that, the (NOx) emissions were significantly in blend 2. Statistical analysis of gas chromatography detected efficiency for blend 1.2 and 5 as U7 in the range of aromatics, Olefins and Benzene.
According to the lowest percentage of NOx, Economically and high octane number we selected Light naphtha at the blend 2 in mixture 2.

3.4.: Economy study of mixture 2.
Benzene Consumption

- According to the dates June-2013 to July-2014:

1. Benzene 80: 3, 261, 327 Ton
2. Benzene 90: 89, 358 Ton
3. Benzene 92: 2, 568, 345 Ton
4. Benzene 90+ Benzene 92=2,657,703 Ton
5. Benzene 95: 7, 518 Ton
6. Then our total Consumption is 5, 926, 548 Ton

4. CONCLUSION

Gasoline 80 and Gasoline 92 are produced from mixing Gasoline 95 with Naphtha. The decrease in the cost of Gasoline 95 will lead to the decrease in the cost of Gasoline 80 and gasoline 92.

We can dispense the importation of gasoline by 95% and save 76 $ per ton

(5Million tons= saving 7 Billion EG per year). Direct decrease in air pollution due to the decrease of harmful exhaust emissions.

The best results are achieved in blend 1 and 2, however reducing carbon monoxide (CO), CO_2 and the unburnt hydrocarbon they are nearly similar in the results, while EGR (Exhaust gases Recirculation valve) has reduced No_x to zero. On other hand the combination of unburnt hydrocarbon with (CO) makes bad zone, which is why blend 2 is the best. In addition, it allows the savings in the carbon credit due to the decrease in carbon emissions.

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