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IMPLEMENTATION OF ALCOHOL PRODUCED FROM SUGARCANE IN INTERNAL COMBUSTION ENGINE

R. A. Chy.[1], M. S. Rabbi[2], J. U. Ahmmed[3] and Md. Kamrul Hasan[4]

[1]Graduate Student, Dept. of Mechanical Engineering, CUET
[2,4]Lecturer, Dept. of Mechanical Engineering, CUET
[3]Assistant Professor, Dept. of Mechanical Engineering, CUET

Abstract: *For better future search of alternative fuel is inevitable. Due to limited reservation of fuel, the fuel prices are increasing day by day which jeopardize the economy of developing or underdeveloped countries. The main purposes of this research are to use alcohol i.e. ethyl alcohol - which can be produced from sugarcane economically, to study the engine response for different ethanol gasoline mixture (Gasohol) and to study the exhaust emission for different ethanol gasoline mixture. In this research, Internal Combustion Engine i.e. motorcycle is used for the implementation of ethyl alcohol. Starting with the gasoline ethyl alcohol mixture (90%-10%) named as E-10, it is tried to increase the amount of ethyl alcohol in the medley up to 60% and tried to find out the response of the engine. The exhaust emission for different gasoline ethanol mixture is studied in this research. From exhaust data calculation, it has been seen that, instead of regular gasoline, E20 reduces carbon monoxide (CO) emissions by as much as 15.4 per cent, carbon dioxide (CO_2) emissions by 7 percent. Besides, E20 can be used in IC engine without any modification. Therefore, E20 can be used in IC engine easily. Emission products of alcohol driven vehicle are environment friendly, which is very important in today's global warming situation. Therefore, this research is termed as amicable to environment.*

Keywords: Ethyl alcohol, Gasohol, Internal Combustion engine, Exhaust emission.

1. INTRODUCTION

A crisis of energy, a crisis of oil dependence- with the fuel prices increasing the world is facing serious problem and we have to believe that one-day fossil fuel reserves will be depleted. Due to this reason world is facing problems related to fuel and mostly in fuel price in the recent years[4]. The countries like us who are not rich in oil, have to buy fossil fuels from oil rich countries. Hikes in oil prices affect us a lot in our socio-economic development. So, we should search for alternative fuel or non-conventional fuel which will decrease the excessive dependency on fossil fuel, ensure future reserve and definitely make us self-dependent on fuel. Some well known alternative fuels include bio-diesel, bio-alcohol (ethanol, butanol), bio-diesel, chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil and other biomass sources. Ethanol is a renewable, relatively safe fuel that can be used with few engine modifications[2]. Its energy density is higher than some other alternative fuels, such as methanol. The objectives of the research can be summarized as follows:

1. To implement alcohol i.e. ethanol in the IC engine.
2. To study about the engine response at different gasoline ethanol mixture (gasohol).
3. To study the exhaust emission at different gasoline ethanol mixture.

2. PROPERTIES

Fuel can be defined as a material that is burned or altered in order to obtain energy. An important property of a useful fuel is that its energy can be stored to be released only when needed, and that the release is controlled in such a way that the energy can be harnessed to produce work. Bio-fuel can be elaborately defined as solid, liquid, or gas fuel consisting of, or derived from biomass. Biomass can also be used directly for heating or power—known as biomass fuel. Bio-fuel can be produced from any carbon source that can be replenished rapidly e.g. plants. Many different plants and plant-derived materials are used for bio-fuel manufacture. First-generation bio-fuel refers to bio-fuels made from sugar, starch, vegetable oil, or animal fats uses conventional technology[1]. Some of the fuel properties are given in the Table 1:

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Table 1: Fuel Peoperties[2]

Fuel	Density	Energy content (MJ/L)	Theoretical air fuel ratio (Kg/Kg)	Calorific value (MJ/Kg)	Flash Point	Auto ignition point	Octane number
Gasoline	730-770	34.8	14.7	48	230	650	91
Diesel	820-860	38.6	15	46.1	330	480	15-20
Ethanol	790	23.5	9	29.7	285	450	129
Methanol	790	17.9	6.5	22.7	285	680	123
NG	0.68-.7	-	9.5	54	-	850	-
Bio-diesel	880	-	12.4	40	-	420	-

Bio-fuel can be elaborately defined as solid, liquid, or gas fuel consisting of, or derived from biomass. Biomass can also be used directly for heating or power—known as biomass fuel. Bio-fuel can be produced from any carbon source that can be replenished rapidly e.g. plants. Many different plants and plant-derived materials are used for bio-fuel manufacture. First-generation bio-fuel refers to bio-fuels made from sugar, starch, vegetable oil, or animal fats uses conventional technology. Bio-alcohols are biologically produced alcohols, most commonly ethanol, and less commonly propanol and butanol, are produced by the action of microorganisms and enzymes through the fermentation of sugars or starches (easiest), or cellulose (which is more difficult). Ethanol is a volatile, flammable, colorless liquid that has a strong characteristic odor. It burns with a smokeless blue flame that is not always visible in normal light. The ethanol production methods used are enzyme digestion (to release sugars from stored starches, fermentation of the sugars, distillation and drying). The distillation process requires significant energy input for heat[2]. The characteristics of Methanol, Ethanol, Butanol along with Octane are given in Table 2:

Table 2: Characteristics of Methanol, Ethanol, Butanol an Octane[2]

Fuel	Specific Gravity	Boiling point (^{0}C)	Latent heat (Btu/lb)	Combustion energy (Btu/lb)	Vapor Pressure @ 100F (psi)	Stoichio-metric air-fuel ratio
Methyl alcohol	0.79	65	503	10,260	4.6	6.5
Ethyl alcohol	0.79	78	396	13,160	2.2	9
Butyl alcohol	0.81	117	186	15,770	0.3	11.2
Octane	0.70	210	155	20,750	1.72	15.2

From Table 2, we have seen that ethanol has high boiling point, combustion energy (Btu/lb) and Stoichiometric air-fuel ratio compared to methanol. And it can be preferred over methanol, as methanol is toxic also. All of the alcohols are soluble in water, but butyl alcohol is relatively insoluble compared to methyl and ethyl alcohol. Less engine power is produced as the water content of an alcohol increases. Further, vapor lock, fuel mixing and starting problems increase with water.

2.1 Gasoline and Alcohol Mixture (Gasohol)

Mixing alcohol with gasoline produces gasohol. Advantages of fuel blends are that alcohol tends to increase the octane rating, which is particularly important in unleaded fuel, and reduce carbon monoxide (CO) emissions from the engine. A mixture of 10 percent ethanol in gasoline produced more power when the carburetor was adjusted for gasoline[5]. Because of its higher stoichiometric air-fuel ratio, butyl alcohol can be mixed with gasoline in higher concentrations without affecting performance. Similarly, because of its low stoichiometric air-fuel ratio, only a small quantity of methyl alcohol can be mixed with gasoline without affecting performance. In other words, a fuel blend containing 20 percent methyl alcohol requires modification of the carburetor fuel jets to optimize power output, whereas a 20 percent blend of butyl alcohol does not.
The different gasohols are delineated below:

2.1.1. E5, E7, E10: E5 is a mixture of 5% ethanol and 95% gasoline, E7 is a mixture of 7% ethanol and 93% gasoline and E10, is a fuel mixture of 10% ethanol and 90% gasoline that can be used in the internal combustion engines of most modern automobiles. According to the Philippine Department of Energy, the use of not more than a 10% ethanol-gasoline mixture is not harmful to cars fuel systems. Similar blends include E5 and E7. These concentrations are generally safe for recent engines that run on pure gasoline. Some regions and municipalities mandate that the locally sold fuels contain limited amounts of ethanol[5].

2.1.2. E15: E15 contains 15% ethanol and 85% gasoline. This is generally the greatest ratio of ethanol to gas that is recommended by auto manufacturers that sell vehicles in the United States, though it is possible that many vehicles can handle higher mixtures without trouble. Flexible-fuel vehicles (FFV) are designed to take higher concentrations, up to 96% v/v ethanol (and no gasoline).

2.1.3. E20:E20 contains 20% ethanol and 80% gasoline. Since begin 2008 they offer in Thailand E20 with tax reductions for "E20" engine cars, after E10 was already widely used in the local market.

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2.1.4. E85: E85 is a mixture of 85% ethanol and 15% gasoline. This mixture has an octane rating of about 105. This is down significantly from pure ethanol but still much

3. METHODOLOGY

The addition of a small amount of gasoline helps a conventional engine start when using this fuel under cold conditions. E85 does not always contain exactly 85% ethanol. In winter, especially in colder climates, additional gasoline is added (to facilitate cold start Ethanol is to be used in the mixture of gasohol (gasoline & alcohol)[3]. We will make E10 called gasohol, which is the fuel mixture of 10% ethanol and 90% gasoline. The ethanol that will be used should be pure as well as it would be more than 90% ethanol. The ethanol was collected had 96% ethanol content. Ethanol has its stoichiometric air fuel ratio of about 9:1, while octane has 15.2:1, so more ethanol is needed in case of ethanol driven vehicle rather than octane driven vehicle. So in the mixture of ethanol gasoline mixture i.e. gasohol, more fuel is needed for mixing with air in the carburetor.

3.1 Mixing Ethanol with Octane

Firstly 1L octane and 500mL 96% ethanol was taken in the plastic bottle in the laboratory for the testing. Two 50mL beaker along with a transparent plastic pipe were also taken. Firstly,for making 50ml octane ethanol mixture i.e.gasohol 45ml octane was taken to the beaker and then 5ml ethanol was added. Thus E10 gasohol was produced which contained 10%ethanol with 90% octane. Similarly, ,for making E20 gasohol which contain 20%ethanol with 80% octane, 40ml octane was taken to the beaker to which 10ml ethanol was added. E30 gasohol which contain 30%ethanol with 70% octane was produced by adding 15ml ethanol with 35ml octane. E50 gasohol which contain 50%ethanol with 50% octane was produced by adding 25ml ethanol with 25ml octane. Finally, E60 gasohol which contain 60%ethanol with 40% octane was made.It was made by taking 40ml octane to the beaker and then adding 10ml ethanol .

3.2. Implementation of Ethanol in Motorbike Engine

The motorbike that is selected for this research is in Fig. 1

Fig. 1: YAMAHA GLADIATOR 125CC motorbike

Firstly, octane remained in the carburetor was depleted.Then different mixture of octane ethanol mixture i.e. gasohol were tested in the engine of the selected motorbike YAMAHA GLADIATOR 125 CC motorbike. Then, before the starting of the engine, E10 mixture was fed through the plastic pipe from the beaker containing to the carburetor. This was done because after depletion of octane from carburetor it possesses no fuel for initial mixing. Then, when engine was started with the turning of the ignition key the motorbike was started without any disturbance. The fuel consumption rate was measured by watching the time (by stopwatch) taken for the consumption of 50 ml mixture. Similarly different mixture as E30, E50, and E60 were also tested to the engine. In all case fuel consumption rate were also measured. Finally, 100% octane was given to the engine and fuel consumption rate was also measured.

3.3 Exhaust Emission Analysis by Using Exhaust Gas Analyzer

The data related to the exhaust emission for different gasohol mixture i.e. E20, E30, E50, and E60 were taken by using exhaust gas analyzer. It has a device which had to hold at the free end of the motorbike's exhaust tube. This device is connected with digital display device which gave the information about the exhaust gasses, the percentages of the exhaust gases.These data were taken after some period from the holding of the device to exhaust pipe because it showed it's unstable value and took some period to become stable.Finally, The data related to the exhaust emission for 100% octane was taken by using this exhaust gas analyzer.

4. DATA COLLECTION AND ANALYSIS

Data we've collected from the exhaust gas analyzer are in Table 3.

Table 3: Exhaust anlysis of different composition of Gasohole

Fuel	O_2	CO_2	CO g/kWh	NO_X mg/kWh
E20	8.6%	17.64%	0.108	84
E30	4.7%	17.67%	0.091	88
E50	4.3%	17.62%	0.069	111
100%Octane	11.6%	17.71%	0.262	26

These data of exhaust emission products are plotted in XY graphs (Fig. 2-5) to see the effects on the percentage of different gasses in exhaust in different gasohol.

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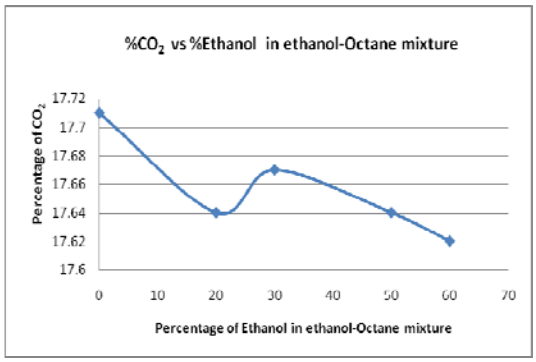

Fig. 2: Percentage of CO_2 In Exhaust Emission

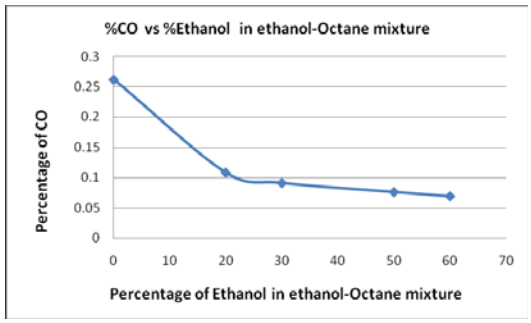

Fig. 3:. Percentage of CO (G/Kwh) In Exhaust Emission

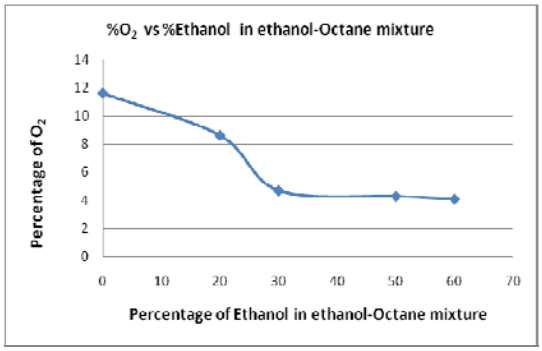

Fig. 4: Percentage of O_2 In Exhaust Emission

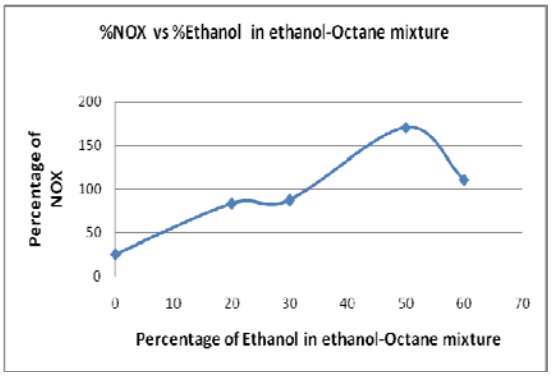

Fig.5: Percentage of NO_x (Mg/Kwh) in Exhaust Emission

Gasohol is considered to have positive environmental effects. Studies show that using gasohol, instead of regular gasoline, reduces carbon monoxide (CO) emissions by as much as 15-20 per cent, carbon dioxide (CO_2) emissions by 7-9 percent after using different gasohol mixture. Moreover excess O_2 is reduced and NOX is increased which is harmful for environment as it causes acid rain. Ethanol is a safe replacement for toxic octane enhancers in gasoline such as benzene, toluene and xylene. ETBE lowers gasoline volatility and is, thus, particularly effective in reducing VOC emissions from automobiles. So, E20 can be used in IC engine with no or very little modification of engine and it is environmental. More over from the fuel consumption data it can be said that, ethanol fuel is consumed more than the octane.

4.1 Fuel Consumption

50 ml 100% octane is consumed in 15.9 min
50 ml E20 is consumed in 15.6min
50 ml E30 is consumed in 15.3.min
50 ml E50 is consumed in 15.2min
50 ml E60 is consumed in 14.8min
So, ethanol is consumed more quickly than octane.

4.2 Cost Estimation of Ethanol in Bangladesh

From the data taken from KERU & CO. LIMITED, about 7% sugar is obtained from one sugarcane. Last year, in KERU & CO. LIMITED, about 148,5880 metric ton sugarcane was crashed which gave 10,3900 metric ton sugar and Production cost of 1 proof litre ethanol = 75.29 Tk.
1 proof litre =1.6-1.7 litre(conventional)
Therefore, Production cost of 1 litre ethanol = 40 tk
It can be further reduced by increasing sugarcane production in Bangladesh and adopting new technology for producing ethanol.

5. RESULT AND DISCUSSION

From the above observations, it can be stated that, E20 can be treated as a very good fuel without any engine modification. Starting from 5percent ethanol up to 20 percent ethanol (E20) can serve as a good economical fuel without any engine modification. Moreover, from exhaust data calculation, it has been seen that, instead of regular gasoline, E20 reduces carbon monoxide (CO) emissions by as much as 15.4 per cent, carbon dioxide (CO_2) emissions by 7 percent. Moreover excess O_2 is reduced and NOX is increased by 2.23% which is harmful for environment as it causes acid rain. And by varying the ethanol content up to 60 percent as E60 in the mixture, it has been seen that, carbon monoxide (CO) emissions is reduced by up to 19.3 per cent, carbon dioxide (CO_2) emissions by 9 percent. NO_X is increased by up to 3.26 percent in the different ethanol octane mixture. From the fuel rate consumption it can be said that, ethanol octane mixture consume more fuel than the

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100 percent octane. So, it can be said after this research that, Ethyl alcohol has long been used as an automotive fuel in two ways: First, it replaces gasoline outright in a somewhat modified internal combustion engine, and secondly, it is an effective "octane booster" when mixed with gasoline in blends of 10 to 30 percent and requires no engine modification. These blends achieve the same octane boosting (or anti-knock) effects as petroleum-derived aromatics like benzene or metallic additives like tetraethyl lead. Moreover, now-a-days in Bangladesh the octane price is about 90Tk while production cost of ethanol is 40Tk per litre. So, using ethanol is economical. It can be further reduced by increasing sugarcane production in Bangladesh and adopting new technology for producing ethanol.

6. CONCLUSION

Fuel crisis and its continuous price hike indicate future red signal in the field of fuel reservation & economy. Alternative fuel isone of the best solution of this crisis. The major environmental concern, according to an IPCC (Intergovernmental Panel on Climate Change)report, "Most of the observed increase in globally averaged temperatures since the mid-20th century is due to the observed increase in anthropogenic greenhouse gas concentrations" since burning fossil fuels are known to increase greenhouse gas concentrations in the atmosphere, they are a likely contributor to global warming. By applying the gasohol mixture in IC engine, this bad effect can be reduced. Moreover, there is not enough fuel reservation in our country. So, our economy is going to fall day by day and it is going to be a tough when fuel crisis will reach to its peak and fuel prices are too high .So, we have to concentrate on alternative fuel .As there are enough sugarcane produced in Bangladesh and ethanol is produced commercially so Government may concerned about the production of alcohol for using it as alternative fuel.

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