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Alternative Fuel for I.C. Engine: Review the Effect from Ethanol in Carburetor

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1. Abstract:

We know that Ethanol as a gasoline blend has helped to reduce dependence on oil import and harmful vehicular emission. Due to the globalization impact as well as controlling the automobile exhaust emission, the automobile companies are introducing Multi Point Fuel Injector (MPFI) and Gasoline Direct Injection (GDI) respectively. However, introducing ethanol as alternative automobile fuel (E10, E85), the proper mixture ethanol and air mixture (for oxygenate compound), need of Carburetor for the function of the I C Engine combustion process.

Because, it is of utmost necessity that ethanol (20% ethanol and 80% petrol) supplied to the engine should be completely vaporized before actual combustion. This is possible only when it is broken up into a fine spray, i.e. atomized. The process of atomization takes place normally in the inlet manifold. Carburetion process consists of *vaporizing ethanol*; *mixing thoroughly with air and distributing the ethanol-air mixture evenly into the cylinder.*

Key words: Atomization of fuel, Air Ethanol Ratio, Engine Design, Oxygenate compound, Temperature, Venturi.

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2. INTRODUCTION:

As per experimental study, ethanol fuel can improve urban air quality and reduce emission of green house gases. Ethanol is used in blends with gasoline at 10:85 in volume (E10, E85), which contain about 3.5 percent with of oxygen. Usually, the blends are obtained by 'splash' blending ethanol with unleaded gasoline, already in the distribution systems to meet the requirements for higher-grade gasoline.

As oxygenate (ethanol contains 35 percent oxygen by weight), fuel ethanol enhances the combustion, resulting in a more efficient burn and greatly reduced emissions. If helps minimize oil pollutants, including hydrocarbons. Nitrogen di-oxide (NOx), Carbon di-oxide, and toxic.

2.1. Functions of a carburetor:
2.1.1. *Atomization of fuel.*
2.1.2. Mixing of air and ethanol in correct proportion to get the desired results from the engine.
2.1.3. *Maintaining a suitable reserve proportions to get the desired results from the engine.*

2.2. The requirements of a carburetor as the Ethanol-fuel mixture:
2.2.1. Capacity of supplying correct ethanol-air mixture at different engine loads and speeds.
2.2.2. Ease in starting of the engine in cold or hot conditions.
2.2.3. Economically fuel supply.
2.2.4. Capacity of fast acceleration.
2.2.5. Provision of screws for changing ethanol-fuel ratio in accordance with the engine operating conditions. Etc.

2.3. Air ethanol ratios at the various operating conditions are below:
2.3.1. Starting (from cold) : 1:1

2.3.2. Starting (normal ambient temperature): 9.5:1,
2.3.3. Idling: 12.5: 1,
2.3.4. Acceleration: 13:1.
2.3.5. Maximum Power: 12.5:1,
2.3.6. Economical condition: 17:1,

3. LITERATURE REVIEW:

Idle and Low Speed System, the supply of ethanol fuel mixture between ration of 400 – 600 rpm is controlled by idling circuit. Idle rpm is the speed below which the engine would refuse to run. This dependent on the design parameters of the venture tube and intake manifold.

However, the factors affecting carburetion is consisting by the following:
3.1. Temperature: The vaporization of is better with higher intake ambient temperatures and as result for higher temperature reduces the mass density of ethanol-air mixture resulting in reduced engine power.

3.2. Time: At higher engine speeds, the intake charges per stroke greatly reduces volumetric efficiency in the engine at lower level and as a result, drop the engine power .

3.3. Engine Design: Proper mixing and even distribution of ethanol – air mixture depends greatly upon the design parameters of intake manifold, combustion chamber design and carburetor design. Etc.

Ethanol air- mixture, which the ratio by weight between the amount of air and of ethanol used for combustion.

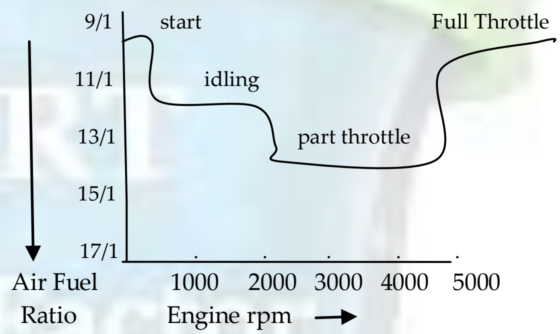

Fig: 3(a) Graph/- Air Ethanol Ratio/Engine rpm

From the above graph, the most economical Air-Ethanol mixture is 17:1 and maximum power is obtained with air fuel ratios between 12.5:1 and 14:1. The carburetor is designed to give the necessary Air Ethanol ratio as desired by the engine operating conditions.

To prevent such icing, many carburetors have special anti-icing systems. During the warm up period, the manifold heat-control valve sends hot exhaust gases from one exhaust manifold to the other. Part of this hot gas circulates around the carburetor idle port is and near the throttle valve shaft. This adds enough heat to prevent icing. Another system has coolant passes through a special manifold in the carburetor throttle body. This adds enough heat to the carburetor to prevent icing.

For Example: the diameter of the jet of a simple carburetor is 1mm. The venture depression is 102 cm of water and the coefficient of discharge of jet is 0.60. The specific gravity of ethanol is 0.77; calculate the weight of ethanol discharge per second.

Solution: Venturi depression

$\Delta P_a = 1000 \times 1.02$

$= 1.020\ kg/cm^2$

Now using the relation x = 0

$W_f = K_f . A_f . \sqrt{2g . \Delta Pa . Pf}$

$= 0.6 \times \frac{\pi}{4}(0.1)^2 \times 10^{-4}\sqrt{2 \times 9.81 \times 1020 \times .77 \times 1000}$

$= \frac{\pi}{4} \times 10^{-3} \times 0.6 \times 3.92\ kg/second$

$= 1.85 \times 10^{-3}$ kg/second

4. METHODOLOGY:

4.1. Simple Carburetor:

A simple carburetor is consisting by two main parts:

4.1. Float chamber, needle valve, metering jet and metering rod.

4.1.1. Float Chamber:

The ethanol reservoir in a carburetor from which the jets are supplied for the engine cylinders and in which the ethanol level is maintained constant by means of float-controlled valve.

4.1.2. Needle Valve:

A valve operated by the float that regulates the flow of fuel from the fuel pump into the carburetor.

4.1.3. Metering Rod and Jet:

Metering rod, a special rod used in certain types of carburetor for the purpose of metering or controlling the amount of ethanol passing through a jet. It is usually connected to the throttle linkage so that as the throttle is opened more ethanol is allowed to pass through the metering jet.

4.2. Mixing chamber containing main nozzle. Throttle and choke valve.

It is ling barrel attached to the float chamber, which contains venture. The outlet of main nozzle opens at an angle in the venture. It contains two butterfly type valves, one fitted in the air horn or upper part of the barrel, known as choke valve and other outlet known as throttle valve.

The various position of a simple carburetor, it is does not matter, if the carburetor vertical tube is vertical or horizontal, but the float chamber have to remain in the vertical direction. The direction of air flow from carburetor to manifold, determines the class of draft a type carburetors:

4.3. Down Draft:

Down Draft carburetor that has the air-ethanol mixture downward through them. This type of carburetor is fitted on the manifold and mostly used in automobiles. The main advantages are:

Fig: 4(a) Down-Draft

4.3.1. These give better volumetric efficiency as the air-ethanol mixture flows down assisted by gravity.

4.3.2. Used for high speed engines.

4.3.3. The carburetor can be fixed at the top of the engine. Etc.

From the above, the critical air velocity, the minimum velocity of air at the throat of venturi at which the ethanol just begins to flow is termed as the critical velocity Ethanol has been widely uses as an additive in gasoline, recent development have made the ethanol diesel blend on interesting new alternative for conventional, unmodified diesel vehicles. A new additive allows ethanol to be splash blended with diesel fuel.

5. RESULT & DISCUSSION:

(SU Carburetor):

Carburetor, it is a device which mixes ethanol and air to feed into the engine. There are two types of carburetor i.e. fixed venture & variable venture.

S U carburetor in Indian car, it is consisting by suction chamber, sliding piston with needle, Float chamber, throttle valve, piston damper, Man jet respectively. The main working principle of SU carburetor that pressure difference between the inlet air pressure and the mixing chamber pressure. The inlet air pressure exceeds that of the disc. The piston rises of this forces is greater than the piston assembly weight. The rise piston assembly increases, the venture throat area and its fall decreases it. Hence it is called variable choke.

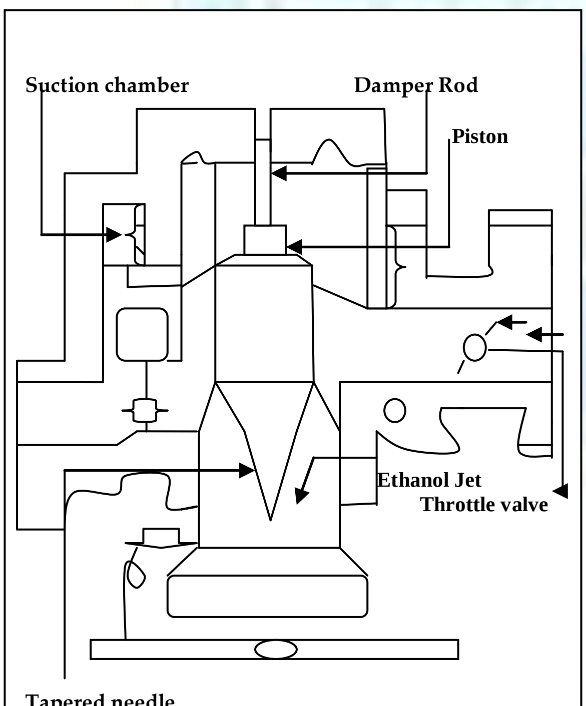

Fig: 5(a) S U carburetor

During engine idle condition, the throttle valve is nearly closed. The piston assembly comes down to its extreme position. This is so because the piston weight is greater than the pressure difference. This rate of flow of air is decreased enabling very little discharge of fuel from the main jet.

At high speeds, the throttle is fully open. Air rushes through the mixing chamber at higher velocity. The piston assembly rises as the pressure difference is greater than its weight. The tapered needle rises along with the piston allowing more ethanol to be discharged by the main jet.

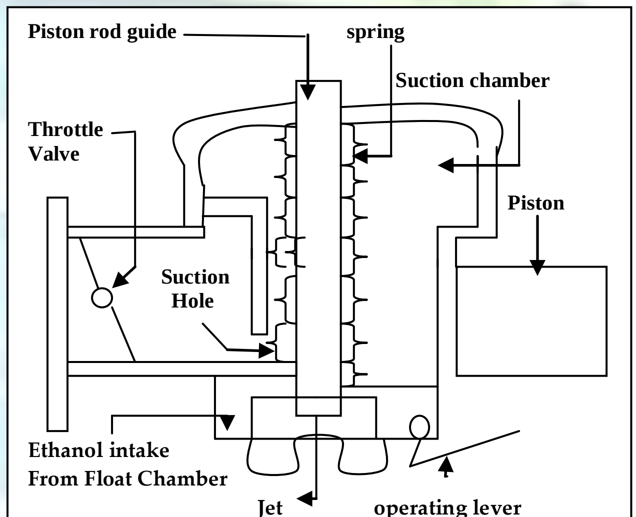

Fig: 5(b) S U carburetor (constant vacuum (type)

For example, in terms of critical air velocity, the minimum velocity of air of the throat of venture of which the fuel just begins to follow is termed as the critical air velocity.

The pressure difference which causes the fuel flow is ($\Delta P_a - P_f$).

If $\Delta P_a - X P_f$, the ethanol will be raised to the top of the jet orifice, but there will be no flow of ethanol.

Ethanol flow will start when $\Delta P_a > X.\ P_f$,

Now, $\therefore U_2 = K_a \sqrt{\frac{2g\,\Delta Pa}{Pa}}$

And, $U_f = K_f\sqrt{\frac{2gf\,(\Delta Pa - X\,Pf)}{Pf}}$

$\therefore \frac{(V_a)^2 . P_a}{(K_a)^2} = \frac{(V_f)^2 . P_f}{(K_f)^2} + 2g. X.P_f$

If, $V_f = 0$, $V_a = K_a \frac{\sqrt{2g \times Pf}}{Pa}$

This is a critical air velocity at which the ethanol just begins to flow.

6. TYPE OF DATA:

At present in India the cities like Delhi, Mumbai and Surat vehicles are operating on CNG in a large scale. More than 30,000 vehicles are running on CNG in New Delhi and 10,000 buses converted to CNG.

Petrol engine can be converted to CNG engines by two methods, i.e.

6.1. Single fuel system: In these system hundred percent gas operations is possible. Conversion can be done on existing engines. As modifications are to be done in cylinders it is expensive.

6.2. Bio-Fuel System: In this systems y using conversion kit vehicle can be run on both fuels by selecting mode of operation on fuel selector switch. Engine can run on 100% CNG or on 100% petrol.

The following schematic diagram of a CNG kit and its sub-system fitted to an engine.

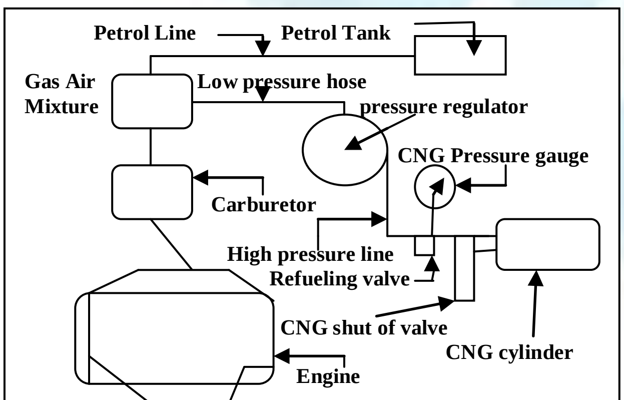

Fig:6(a) Schematic Diagram of CNG.

7. CONCLUSION

Carburetor and Air-ratios:

It is of utmost necessity that ethanol supplied to the engine should be completely vaporized before actual combustion. This is possible only when it is broken up into a fine spray i.e. atomized. The process of atomization takes place normally in the inlet manifold. Atomized, its means to break up a liquid into extremely fine particles.

The fuel systems must vary the air-ethanol ratio to suit different operating requirements. The mixture must be rich mixture for starting and rich mixture 9.5:1. However, atomized ethanol vapor is to be suitably mixed with air as desired by the load conditions of the vehicle. As soon as the valve opens, air is admitted into narrow passages of the carburetor known as venturi. It is not true that the engine itself demands varying air-ethanol ratio for different operating conditions. For example, the mixture must be very rich for starting because ethanol vaporized slowly under starting conditions. The engine and carburetors are cold, the air speed is low and much of the ethanol does not vaporize. Therefore, an extra amount of ethanol must be delivered by the carburetor so that enough will vaporize for starting. However, the rate of evaporation depends upon the pressure below vacuum. Vacuum created due to pistons during suction depends upon the degree of opening of the throttle valve and piston speed.

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