Effects – Mixing Hydrogen

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Abstract

Distillation a Crude Oil we get petrol, kerosene, diesel etc. Petrol was known as Black Gold and was a natural resource. Demand of petrol is on hike; it directly affects its price, and in turn affects the burden on the pockets of vehicle owners. In all over the world many scientists are working on this above topic, but till now nobody has been successful. Expert's decisions are not possible to implement directly because the environmental condition of India is different from developed countries. Presently, about 40% of the total consumption of petrol production of the country is used in road transport sector; while the balance 60%is used in industries including power generation, domestic and for other miscellaneous purposes. Petrol consumption in any developed city is 2.25 to 3 Lakhs of liter /day & near about total 90 to 100 petrol pumps. Hydrogen was discovered in 1766 by the English chemist and physicist Cavendish. It is the first element in the periodic table, consisting of one proton and one electron making it the smallest and lightest of all elements. These can be combined again in a fuel cell, creating power, heat with a less emission.
Keywords – HHV, Viscosity of Petrol, Density measurement, Different form of Hydrogen, A/R ratio.

Introduction

Modern energy enriches our life. Now consider the 7 billion people on earth who use energy each day to make their own lives richer, more productive, safer and healthier. Then you will recognize what is perhaps the biggest driver of energy demand: the human desire to sustain and improve the well-being of ourselves, our families and our communities. Through 2040, population and economic growth will drive demand higher, but the world will use energy more efficiently and shift toward lower-carbon fuels.

Related to the above matter I have presented paper are

- Alternative Fuels (Published in International Journal (IJET) ISSN NO. - 0975-8364)
- Gasoline – I (Published in International Journal (IJATER) ISSN NO. - 2250 – 3536)
- Alternative Fuels – II (Published in International Journal (IJET) ISSN NO. - 0975-8364)
- Gasoline – II (Published in International Journal (IJATER) ISSN NO. – 2250- 3536)
- Effects of Mixing Alcohol (Presented in International Conference)
- Conversion of gasoline engine (Published in International Journal; IOSR-JOR Article id: 32069)
- Reducing Atmospheric pollution (Published in International Journal; IJoRAT Article id: AJ015136)
- Effects – Mixing Hydrogen
- Optimizing Consumption of Petrol (Under Process)
- Optimizing Consumption of Diesel (Under Process)

All fuels need air (oxygen) for combination. Hydrogen is the only common fuel that is not chemically bound to carbon: therefore when hydrogen burns in air it produces only heat energy, water and possibly traces amounts of oxides of nitrogen water and oxides of nitrogen produced thunder storms are natural in our atmosphere.

Why to add Hydrogen

- As a gas or a Liquid, hydrogen can easily be transported, stored and ultimately it can be used in every application where fossil fuels are used today. This makes hydrogen an ideal, non-polluting energy carrier.

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- Hydrogen packs more chemical energy in a pound for pound Comparsion than with any other fuel. Two pounds of hydrogen provides as much energy as a gallon of gasoline. About 2.2 gallons of water can supply enough hydrogen to replace one gallon of gasoline.
- Hydrogen can be used more efficiently than gasoline or other fossil fuel.
- Development of hydrogen energy system would protect us from a possible national security disaster precipitated by a geopolitical approval beyond our control.
- Introducing hydrogen (2 – 20%) into internal combustion engines, that are currently using fossil fuels like gasoline, diesel, or national gas, increase the efficiency of combustion, improves mileage and reduced pollutants to a remarkable degree.
- Importing curde oil costs two billion dollars every week using hydrogen in place of oil could reduce our trade deficient by billions of dollars.
- Socially relevant costs of producing and brining any fuel to market must also include such factors as pollution and other short and long term environmental costs as well as direct and indirect health costs. When these factors are taken into consideration, together with its initial cost economy of scale competitiveness, hydrogen is surely the most logical choice for a worldwide energy carrier.

Effect of Hydrogen in Fuel

Hydrogen has been used extensively in the space program since it has the best energy – to – weight ratio of any fuel. Liquid hydrogen is the fuel of choice for rocket engine, and has been utilized in the upper stages of launch vehicle on many space missions including the Apollo mission to the moon, Skylab, the Viking missions to Mars and the Voyager mission to Saturn.

Hydrogen vs. Gasoline Safety properties

Safety Property	**Hydrogen**	**Gasoline**
Ignition Energy	0.02 MJ	0.24 MJ
Ignition Temperature	520 Degrees Celsius	240 Degrees Celsius
Ignition interval (concentration in air)	4.1 – 72.5 Vol. %	1 – 7.6 Vol. %
Lower detonation level (concentration in air)	13 – 18 Vol.%	1.1 Vol.%
Flame rate (m/sec.)	2.7	0.3
Flame radiation	17 – 25 %	34 – 43 %
Buoyancy (relative density)	0.07	4
Diffusion (cm2/sec.)	0.61	0.05

In Recent years, the concern for cleaner air, along with stricter air pollution regulation and the desire to reduce the dependency on fossil fuels have rekindled the interest in Hydrogen as a vehicular fuel. The effect of introducing these highly combustible gases as a supplement to [status of vehicles pollution (1), Automotive research Asso. (3)] the existing hydrocarbon fuel/air mixture is impressive; fuel economy and horse power increase & harmful polluting emissions are significantly reduced.

Comparing fuel based on Density

Density is another important property of bio-diesel. It is the weight of the unit volume of fluid. Specific gravity is the ratio of the density of a liquid to the density of water. Fuel injection equipment operates on a volume metering system; hence a higher density for bio-diesel results in the delivery of a slightly greater mass of fuel. By density we came to now the viscosity of oil.

The higher heating value (HHVs) of bio-diesel (39 to 43.33 MJ/ Kg) is slightly lower than that of diesel (49.65 MJ/Kg). The oxygen content of bio-diesel improves the combustion process band decrease its oxidation potential. The HHVs is an important property defining the energy content and thereby efficiency of Fuels. Fuel properties for the combustion analysis of bio-diesel blends can be grouped conveniently into physical, Chemical and thermal properties. PP includes Viscosity density cloud point, power point, Flash point, Boiling range, Freezing point and Refractive index.

$$D = K_4 + K_3\gamma + K_2\rho + K_1 Fp$$

Where D is HHVs (MJ/Kg), γ is Viscosity (CST unit). P is Density (g/L), Fp is Flash point (K), K1, K2, K3 ------------Kn (Different Parameter) are coefficient. Coefficient R^2 and calculated HHVs from Liner analysis the measured HHV.

HHVs = 0.4527γ – 0.0008ρ – 0.0003Fp + 40.3662

= 40. 8178 (MJ / Kg) [Original Viscosity of Petrol]

Power fuel; Energy content = 45 (MJ/Kg)

High Auto-ignition Temperature

Hydrogen has a relatively high auto-ignition temperature. This has important implication when hydrogen – air mixture is compressed. The temperature may not exceed hydrogen's auto-ignition temperature without causing premature ignition. Thus, the absolute final temperature limits the compression ratio.

Different form of hydrogen (Liquid Gasoline, Gaseous Hydrogen Pre-Mixed, Liquid Hydrogen Pre-Mixed, High pressure Hydrogen injection), when added with fuel air, Energy & Percentage. We get higher Energy – 1010cal (4.2 KJ) with 120% energy of 420 cc, fuel with a mixture of 1000 cc air. (Higher Pressure gaseous hydrogen injection). If we want 100% energy at 840 cal when air is 983cc & tank fuel capacity 17 cc.

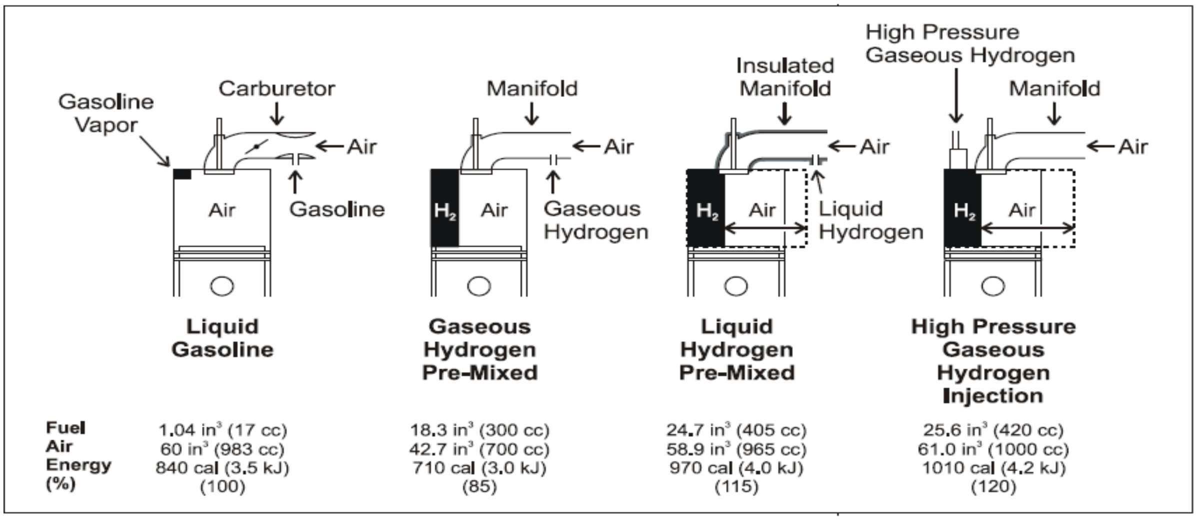

Fig 3(C) : Mixing Proportion of Hydrogen with Gasoline

Air / Fuel Ratio

The theoretical or stoichiometric combustion of hydrogen and oxygen is given as:

$2H_2 + O_2$ = $2H_2O$

Moles of H_2 for complete combustion = 2 moles

Moles of O_2 for complete combustion = 1 mole

Because air is used as the oxidizer instead oxygen, the nitrogen in the air needs to be included in the calculation:

Moles of N_2 in air = Moles of O_2 x (79% N_2 in air / 21 % O_2 in air)

= 1 mole of O_2 x (79% N_2 in air / 21 % O_2 in air)

= 3.762 moles N_2

Number of moles of Air = moles of O_2 + moles of N_2

= 1+3.762

= 4.762 moles of air

Weight of O_2 = 1 mole of O_2 x 32 g/mole

= 32 g

Weight of N_2 = 3.762 moles of N_2 x 28 g/mole

= 105.33 g

Weight of air = weight of O_2 + weight of N **(1)**

= 32g + 105.33 g

= 137.33 g

Weight of H_2 = 2 moles of H_2 x 2 g/mole

= 4 g

Stoichiometric air/fuel (A/F) ratio for hydrogen and air is

A/F based on mass = mass of air / mass of fuel

= 137.33 g / 4g

= 34.33:1

A/F based on Volume= volume (moles) of air/volume (moles) of fuel

= 4.762 / 2

= 2.4:1

The percent of the combustion chamber occupied by hydrogen for a stoichiometric mixture

% H_2 = volume (moles) of H_2 / total volume **(2)**

= volume H_2 / (volume air + volume of H_2)

= 2 / (4.762 + 2)

= 29.6%

Reduction in Atmospheric Pollution

The combustion of Hydrogen with oxygen produces water as its only product:

$$2H_2 + O_2 = 2H_2O$$

The combustion of Hydrogen with air however can also produce oxides of Nitrogen (NOx)

$$H_2 + O_2 + N_2 = H_2O + N_2 + NOx$$

The oxides of nitrogen are created due to the high temperatures generated within the combustion chamber during combustion. This high temperature causes some of the nitrogen in the air to combine with the oxygen in the air. [Energy system (4 & 5)] The amount of NOx formed depends on:

- The air/fuel ratio, The engine compression ratio, The engine speed
- The ignition timing, Whether thermal dilution is utilized

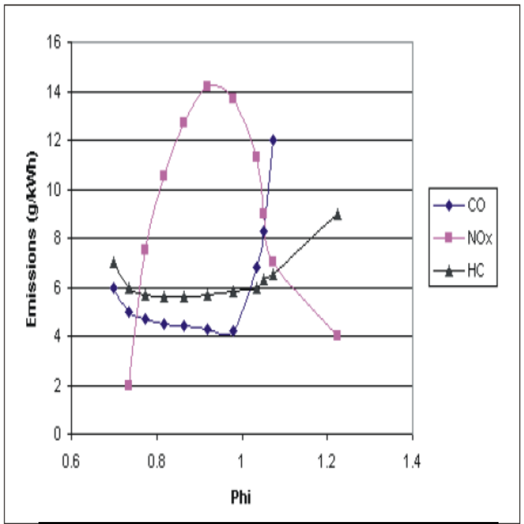

Fig 4(I) - Emissions of NOx, Co, HC

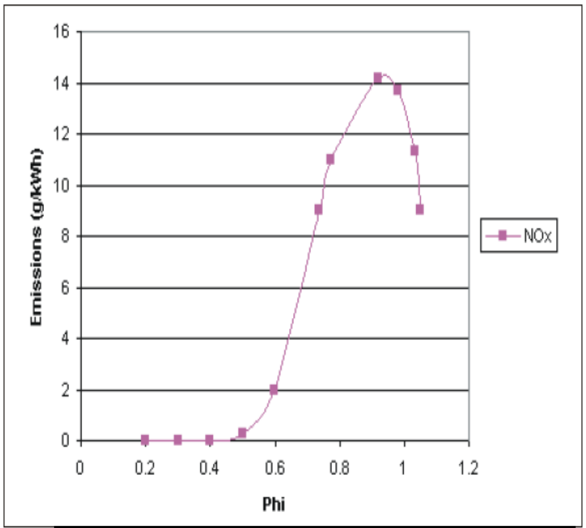

Fig 4(II) - Emissions of Hydrogen Engine

We concluded from diagram – By the mixing of Hydrogen, with Gasoline we are able to save Fuel consumption & Natural Resources. Emission from general Vehicles decreases Fig- 4(I) Showing NOx curve related to phi for a Hydrogen Engine & Fig – 4(II) Showing Reduction in other Emission.

However, in a gasoline engine the reduction in NOx is compromised by an increase in carbon monoxide and Hydrocarbons.

Depending on the condition of the engine (burning of oil) and the operating strategy used (a rich versus lean air/ fuel ratio), a hydrogen engine can produce from almost zero [Carbon trust Facts (6)] emissions (as low as a few ppm) to high NOx and significant carbon monoxide emissions. Emission by 1 Liter Gasoline is 2.3 kg, Hydrogen Emission is zero & Diesel Emission is 2.7 kg.

Conclusions

- Hydrogen in naturally produced by plants and animals, hydrogen is not toxic.
- If liquid hydrogen is spilled it will very rapidly evaporate, leaving no pollution or toxic residue.
- Hydrogen is only fuel whose production and end user can both contribute directly to eliminating many of our most insufferable environmental, economic and health problem.
- Hydrogen holds the potential for a zero emission energy system.
- Hydrogen in Long term can be produced competitive with fossil fuels.
- Hydrogen can remove the dependency of foreign limited fossil fuel.
- Hydrogen can be produced by everybody with access to sun and wind.
- Hydrogen in combination with fuel cells can innovate our energy technology thus creating jobs

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