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Blending Methanol as a Renewable Fuel in Automotive Industries towards Minimizing Vehicular Air Pollution

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Abstract: ***Methanol (CH3OH) and ethanol (C2H5OH) have came to limelight now-a-days because of their property of less polluting emittants and thought of as extremely economical due to its swish operative capacity. Low particulate level and soot free emission can also be obtained due to presence of oxygen in these fuels. We can obtain a considerable fuel efficiency and sound mileage if we double the carbon in ethanol which contains more energy. The structure is more similar to iso-butanol. Iso-butanol is unique in alcoholic fuels due to its equatorial affinity for water. The worldwide energy policy also aims to reduce greenhouse gas emissions occurred due to traditional fuels and thus developing renewable energy became an important part of this policy. Now-a-days transport sector has decreased its reliance on oil which generally contributes to hazardous environmental impact and to achieve this some alternative transport fuels such as biofuels, hydrogen and natural gas emerged up as a helping hand. Blending methanol into diesel and gasoline permits the mixture to possess an entire combustion with the presence of oxygen which increases its combustion efficiency and reduces greenhouse gas emission. Gasohol- a blend of gasoline and 10%methanol is available at plenty of petrol service stations as a regular automobile fuel within the United States. Brazil has successfully implemented and used methanol in terms of spark ignition engine operations as a fuel. Methanol has emerged up as a sustainable fuel for IC engines in past few decades because of its characteristics of soot free burning and higher efficiencies at less cost. The European Union decided to set 10% requirement of renewable energy in transport sector which is to be compiled with by 2020. In 2010, the transport sector utilized 4.70% of renewable energy out of which 91% was covered by biofuels.***

This paper discusses significance of methanol as a fuel for IC engines and its applicability in various sectors.

Keywords: Alcohol fuel, anhydrous ethanol blends, better fuel vaporization, high energy content, higher blending octane, iso-butanol.

I. INTRODUCTION

In the past few years, alternative fuels on internal combustion engine (ICE) recently has attracted the public attention because of the fact of protection concern for environment, and desires on reducing reliance on fossil fuels and meeting the present rigorous regulation.

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Alcoholic fuels are utilized as alternative fuels since these are produced from renewable resources and is oxygenated. To produce better engine operation in spark ignition engine, methanol fuel is a popular substitute alcoholic fuel which could be blended at lower blending ratio with gasoline.

However, there are some problems considering the properties of methanol, the characteristic like vapour lock and its content of energy. Alcoholic fuels having higher carbon molecules like iso-butanol have higher energy content and are capable of displacing more petroleum gasoline compared to the methanol-gasoline blend.

Issues regarding the applicability of methanol and gasoline blends are shown in Table -1**.** Phase separation is the foremost vital problem, that would be resolved by addition of solubility improvisers to blend. Several experimental studies have been done in the United States and European countries.

Table- I : Problems occurred in application of methanol blends and its solutions.

Problems	Solutions
Sturdiness of blend (phase separation)	Adding Additives preventing Phase separation (known as solubility improvers) Dry Handling
Structural Materials not able to resist methanol corrosions	Adding Anti- Corrosive additives
High volatility at the start of evaporation	Performing adaptation of some components of gasoline
Higher Fuel mass flow intensity	Changing the cross sectional areas of nozzles in the fuel system.

Table- II : Fuel properties of various fuels

Property	iso-Butanol	Ethanol	n-Butanol	Gasoline	Methanol
Chemical formula	$C_4H_{10}OH$	C_2H_5OH	C_4H_9OH	C_8H_{15}	CH_3OH
Composition (C,H,O) (mass%)	65, 13.5, 21.5	52,13,35	65, 13.5, 21.5	86,14, 0	37.5,12.5,50
Low calorific no. (MJ/kg)	33.3	27.0	33.1	43.5	20.1
Stoichiometric A/F ratio	11.1	9.0	11.2	14.6	6.4
Density (kg/m^3)	802	790	810	760	796
Flash point (^{0}C)	28	21.1	35	_45 to _38	11.1

Solubility in water (ml/100 ml H2O)	10.6	Fully miscible	7.7	<0.1	Fully miscible
Vapor toxicity	Moderate irritant	Toxic even in small doses	Moderate irritant	Moderate irritant	Poisonous in only large doses
Mass content of oxygen(%)	21.6	34.7	21.6	0.0	49.9
Auto-ignition temperature (^{0}C)	415	434	385	420	470
Saturation pressure at 38 _C (kPa)	2.3	13.8	2.27	31	31.69
Enthalpy of vaporization (kJ/kg)	474.3	725.4	582	223.2	920.7
Boiling point (^{0}C)	108	78.4	117.7	25–215	64.5

II. METHANOL 15 (M15) IN PETROL REDUCES POLLUTION

Methanol is now -a -days being utilized in place of diesel in Railways, marine sector, generator sets, power generation and methanol based reformers may be the best compliment to electric and hybrid mobility. The economy obtained from methanol is a way to achieve the dream of complete hydrogen based fuel systems. Methanol combusted efficiently in all internal combustion (IC) engines, produces very negligible amounts of particulate matter, no soot, almost zero SO_X and NO_X emissions towards near nil pollution. The gaseous version of methanol – di methyl ether blended with Liquefied petroleum gas (LPG) can form an excellent alternative for diesel in giant trucks and buses. Methanol 15% (M15) in gasoline is capable of reducing pollution by 33% and more than 80% pollution can be reduced by sole replacement of diesel by methanol. The production of methanol can be done from Indian high ash coal, municipal solid waste, biomass, natural gas and stranded and flared gases. India can reach the target of producing methanol @ Rs.19 a liter through right technology from Indian coal and all other feedstocks. world is readily moving towards renewable methanol from CO_2 which is the best part and the perpetual recycling of steel plants emitted CO_2, CO_2 into methanol, geothermal energy, effectively air to methanol.

In present situation methanol comprises almost 9% of transport fuel in China. 65% of the overall methanol in world is solely produced by China and they use their own coal to manufacture it. Also the blending program with petrol by methanol 15% has been adopted by Israel and Italy and speeding towards M85 & M100. Japan and Korea extensively use methanol & di methyl ether. Australia also adopted blending mandate of almost 56% methanol in case of gasoline, ethanol & methanol fuels. Methanol became the best option of fuel in marine sector all over the world and countries like Sweden are at the leading step in consent of usage. Now-a-days- massive passenger ships carrying 1500 people are already running on 100% methanol. Eleven African and Caribbean countries are using methanol as a cooking fuel and across the globe generator sets and industrial boilers are running on methanol in place of diesel.

III. PRICE OF PRODUCTION OF METHANOL

Since, India is manufacturing all of its methanol from imported fossil fuels, it uses coal for methanol production that is anticipated to make it economically viable to produce methanol in India. India plans to set up a pilot plant for methanol production which would be followed by a commercial plant. As there is no commercial coal to methanol plant in India, it is troublesome to calculate the precise cost of per unit methanol production, though; there have been pretty fair estimates of the same as coal to methanol technology is a proven technology throughout the world.

It is estimated that 1600 tons per day of methanol plant will require a capital expenditure of ~INR 1200 Crores which would be able to produce methanol at INR 17-19 per liter which is comparable with the cost of imported methanol. Whereas, presently, the per liter cost of methanol production in India is INR 25-27 or even more depending on the volatility in the price of imported natural gas. Apart from using coal as a feedstock, biomass/municipal solid waste and flared natural gas can also be used for methanol production, but the continuous availability of latter would be a challenge. Therefore, coal seems to be a promising fuel for producing methanol in India. Since, Coal to methanol is a proven technology; India must tap its large coal reserves to produce methanol (and DME & Olefins) to use it as a substitute or drop-in fuel for gasoline and (diesel). Weak global coal prices and stricter environmental laws are likely to offer firm coal to methanol margins.

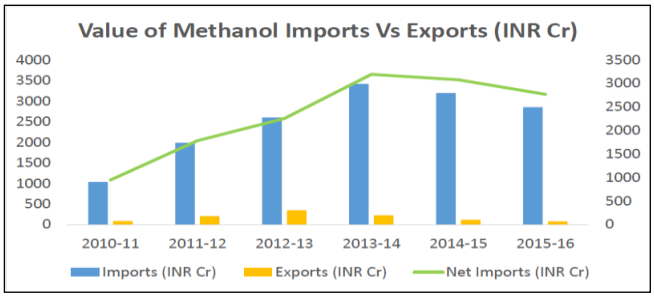

Fig. 1. Worth of Methanol Imports Vs Exports (INR Crores)

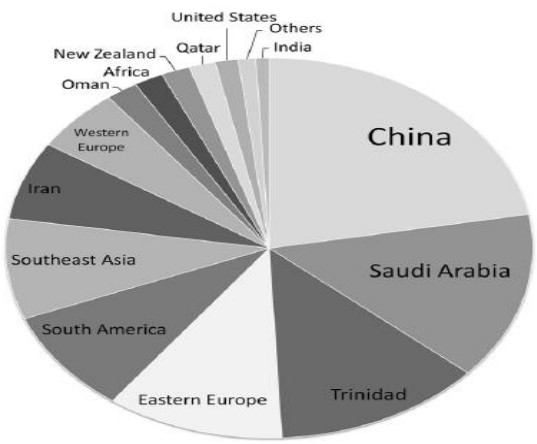

Fig. 2. Global Methanol Production

IV. TECHNICAL MODIFICATIONS MADE FOR THE RTR 200 TO RUN ON ETHANOL

Ethanol is a renewable biofuel obtained by fermentation of crops such as sugarcane and corn. The E100 - 'ethanol 100'. means 100 percent ethanol. if pure ethanol is unavailable , vehicles also runs on E80 – a blend of 80 percent ethanol and 20 percent petrol –. These are the only two types of fuel that can power this bike and it cannot run on just regular petrol. Ethanol is also a non-toxic fuel with 35 percent oxygen content which helps reduce carbon monoxide emissions, particulate matter and sulphur dioxide. It is a far greener fuel than petrol, which makes it kinder on the environment. Few changes TVS had to make to ensure that the bike can run on ethanol. These include a twin port, twin-spray fuel-injection system and a few rubber and plastic bits also have been upgraded to specifications that can resist ethanol's corrosive nature. This bike also gets just a single-channel ABS, against the dual-channel system that is available on the petrol models.

V. CONCLUSIONS

In the U.S., the Environmental Protection Agency (EPA) recommended renewable fuels, with a target of 136 billion liters of renewable fuel to be mixed with gasoline by 2022. Within the U.S. ethanol comprises of the mostly used fuel for transportation. 52 countries around the world participated in such blending mandates. China encompasses a biofuel mandate of 10% by 2020. India is heading towards achieving 20% of its fuel demand to be covered by methanol by 2018. Brazil also assures that 20% of the fuel supply demand of gasoline could be covered with ethanol by 2020. It is remarkable that Brazil already utilized ethanol in different fuel blends since mid 70's. Renewable methanol by capturing carbon dioxide back from the atmosphere is turning into highly regarded and observed by the globe as the abiding solution to energy known to mankind. Methanol is a vital solution to the burning drawback of urbanly pollution worldwide.

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