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EFFECT OF METHANOL-GASOLINE BLENDS AND COMPRESSION RATIO ON PERFORMANCE OF SI (SPARK IGNITION) ENGINES: A REVIEW

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ABSTRACT
In the present day scenario emissions associated with the exhaust of automobiles resulting in global warming is a major menace to the entire world and also detrimental to health. Here an experimental attempt has been made to know the level of variation of exhaust emissions (Carbon monoxide, Hydrocarbons, Nitrus oxides) in S.I. four cylinder engine by adding methanol in various percentages in gasoline and also by doing slight modifications with the various subsystems of the engine under different load conditions. For various percentages of methanol blends (0-15%) pertaining to performance of engine it is observed that there is an increase of octane rating of gasoline along with increase in brake thermal efficiency, indicated thermal efficiency and reduction in knocking. On the other hand exhaust emissions CO and HC are considerably decreased but CO2 and Nox simultaneously slightly increasing. It is notable that for these methanol blends combustion temperature is found to be high and exhaust gas temperature decreasing gradually.

INTRODUCTION
Methanol has been proposed as a **fuel** for internal combustion and other engines, mainly in combination with gasoline. Historically, methanol was first produced from pyrolysis of wood. Presently, methanol is usually produced using methane as a raw material. [1]

Both methanol and ethanol burn at lower temperatures than gasoline, and both are less volatile, making engine starting in cold weather more difficult. Using methanol as a fuel in spark ignition engines can offer an increased thermal efficiency and increased power output due to its high octane rating (114) and high heat of vaporization. However, its low energy content of 19.7 MJ/kg and stoichiometric air fuel ratio of 6.42:1 mean that fuel consumption will be higher than hydrocarbon fuels. The extra water produced also makes the charge rather wet and combined with the formation of acidic products during combustion, the wearing of valves, valve seats and cylinder might be higher than with hydrocarbon burning. Certain additives may be added to motor oil in order to neutralize these acids. Methanol, just like ethanol, contains soluble and insoluble contaminants.[1] These soluble contaminants, halide ions such as chloride ions, have a large effect on the corrosively of alcohol fuels. Halide ions increase corrosion in two ways; they chemically attack passivating oxide films on several metals causing pitting corrosion, and they increase the conductivity of the fuel. Increased electrical conductivity promotes electric, galvanic, and ordinary corrosion in the fuel system. Soluble contaminants, such as aluminum hydroxide, itself a product of corrosion by halide ions, clog the fuel system over time. Methanol is hygroscopic, meaning it will absorb water vapor directly from the atmosphere. Because absorbed water dilutes the fuel value of the methanol and may cause phase separation of methanol-gasoline blends, containers of methanol fuels must be kept tightly sealed.

PROPERTIES OF ALCOHOL
Alcohols such as methanol have high octane number, because of high octane number they can be used at higher compression ratios. As a result higher thermal efficiency can be obtained at the same time alcohols have lean burn properties and good combustion characteristics. Alcohols have higher latent heat of vaporization which leads to denser fuel-air charged. Methanol has same anti-knock effect. However, increasing alcohol content in the blends increases fuel consumption because of lower energy contents in the alcohols. Blending of alcohol with the gasoline reported some of advantages increase Torque, Break power and Thermal efficiency.[2] It has a higher octane number a higher enthalpy (higher heat of vaporization) and broader ignition foundries, implying several advantages over the gasoline. However alcohols has some drawbacks such as lower energy density, its corrosiveness on engine and combustion parts, low flame luminosity and lower vapor pressure which makes cold start, engine efficiency and engine durability more challenging as compared to the gasoline. Blending with gasoline reduces these effects and anti-corrosive compound are also applied to reduce the corrosiveness. It was reported that although vapor pressure of pure ethanol is low, Reid vapor pressure (RVP) of ethanol-gasoline blend rises and it is dependent on the ethanol proportion in the blend.

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EFFECT OF ALCOHOL GASOLINE BLENDS ON ENGINE PERFORMANCE

Many researchers have been studied and effects of alcohol-gasoline blends on engine performance are discussed below.

Exhausts Emission

When alcohol is aided to the gasoline, it provides more oxygen for the combustion process and decreases exhaust emission levels. The most significant reduction in CO and unburned HC was obtained with the use of alcohol gasoline blends at the vehicle speed of 40km/h and 60 km/h respectively. At these vehicle speeds, on average, CO and unburned HC emission decreases by 11% and 33% with the use of alcohol gasoline blends emission compared to those of pure gasoline respectively. But when mean value at all the vehicle speeds tested, it showed that unburned HC decreases 16%, and 10% at , M5 (5% methanol) and M10 (10% methanol). In this study, CO_2 emission with the use of M5 decreases by 6.5%, while CO_2 emission with the use of M10 increased by 0.8% respectively. In this study CO_2 emission decreases with the use of M5 by 6.5%, while CO_2 decreases with the use of M10 by 0.8% respectively. NO_x emission with the use of M5 is decreased by 1.8% and while increased by 2.3% with the use of M10. [3]

Break Power and Break Thermal Efficiency:

The wheel power with the use of alcohol- gasoline blend slightly decreased at 40 km/h and 100 km/h vehicle speed, but it increased at 60 km/h and 80 km/h as compared to gasoline. On average the wheel power increased by 22.9% , M5 relatively, while the wheel power reduced by 0.3% at M10 as compared to gasoline[3,4] .When the methanol (M5 and M10) content in the blended fuel is increased, engine break power slightly increased. This is because of the fact that Oxygenated fuel has better combustion efficiency. When the methanol content (M30 and M50) in the blended fuel increased, the engine break power decreased for all engine speed.

Specific Fuel Consumption:

At all vehicle speed, the fuel consumption rate is increased with the use of alcohol-gasoline blends as compared to the pure gasoline. The fuel consumption for M5,and M10 is increased by 3.4%, and 5.5% as compared to the gasoline. According to these average rates, it can be said that low energy contents of the alcohols affected the fuel consumption rate negatively. In case of using alcohol-gasoline blends, more fuel is needed to achieve same wheel power so that it increases the fuel consumption .[3] The break specific fuel consumption (BSFC) remains constant at low speed when throttle opening is higher than 20% and at high speed with high throttle valve opening greater than 40%.

Exhaust gas Temperature:

The exhaust gas temperature increases as vehicle speed for all test fuel. The maximum exhaust gas temperature noticed for blends M5, M10 and gasoline is 8330C, and 833^0C at the speed of 100 km/h respectively. Methanol has higher latent heat of vaporization than ethanol and gasoline, hence vaporization of M10 blend produces large temperature drop inside the engine cylinder.

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EFFECT OF COMPRESSION RATIO ON ENGINE PERFORMANCE

The effects of compression ratio on various performance parameters like break thermal efficiency, break specific fuel consumption, exhaust gas temperature and exhaust emission discussing here after analyzing some of the researches on compression ratio.

Exhausts Emission:

Alcohols having higher oxygen content than gasoline and hence, unburned hydrocarbons (UHC) and carbon mono oxide decreases due to better formation of combustion. However, at the compression ratio 9.5:1 UHC and CO level increases due to the rise of flame extinction because of increasing surface to *Gas* Volume ratio. It was observed that the minimum UHC emission obtained from the gasoline, ethanol and methanol were 162 ppm, 115 ppm and 97 ppm respectively, and were achieved at a 8.5:1 compression ratio. At the entire compression ratio the UHC emission decreases for methanol by 28.22% on average as compared to the gasoline On the other hand CO emission also diminished to about 29.37%. Methanol has higher heat of vaporization and lower adiabatic flame temperature and this caused to decreasing the peak temperature inside the cylinder, so that the heat loses and NO_x emission are lower. When the CO_2 emission was obtained from all fuel, it was seen that emission value are same at all compression ratio. For all fuels with increasing compression ratio, the CO_2 and NO_x emission increase to the compression ratio 9.5:1, and then went down repeatedly. Moreover, NO_x emission fairly decreased with the increasing alcohol fuel in the SI engine compared to the gasoline[5] . Thermal efficiency improves at higher compression ratio and decreases CO_2 emission which causes to the global warming. By increasing the compression ratio thermal efficiency of engine with HCNG (hydrogen compressed natural gas) improved by 6.5% and NO_x emission by75% as compared to the conventional CNG (compressed natural gas) [14]. Variation of HC and CO depending on the compression ratio, considerable decrease was observed when the higher ethanol content fuel like alcohol.

Specific fuel consumption:
The consumption of fuel is , 3.4%, and 5.5% higher for blends M5, and M10 as compared to the pure gasoline. It shows that the lower energy content of the alcoholic fuel affects the fuel consumption negatively. More amount of fuel is needed to develop same power, it causes for higher fuel consumption at all blends.

Cylinder Gas Pressure:
Earlier there is no effect of alcoholic blends on cylinder gas pressure at all the compression ratios, generally maximum cylinder gas pressure is obtained for alcoholic blends at $0\text{-}30^0$ of crank angle for all compression ratio. At compression ratio 8:1, 8.5:1 and 9:1 maximum cylinder gas pressure is obtained for methanol blended fuel, but at compression ratio 9.5:1 maximum cylinder gas pressure is obtained almost equal for ethanol and methanol blended fuel. As increasing the compression ratio maximum cylinder gas pressure increases from compression ratio 8:1 to 9:1 and maximum cylinder gas pressure slightly decreases further increment in compression ratio .

CONCLUSION
In this study, it was seen that when engine was fueled with methanol–gasoline blend, engine performance parameters such as brake torque, brake power, brake thermal efficiency, volumetric efficiency increases with increasing methanol amount in the blended fuel while bsfc and equivalence air-fuel ratio decreased.

Using methanol–gasoline blends lead to a significant reduction in exhaust emissions by about 24.9% and 23.7% of the mean average values of HC and CO emissions, respectively, for all engine speeds. On the other hand CO_2 and NO_x emissions increases by about 7.5% and 17.5% respectively.

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