International Journal of Research
ISSN: 2348-6848 Vol-3, Special Issue-3
International Conference on Research and Recent Trends in Engineering and Technology. (ICRRTET)
Held on 27th January 2016 organized by **Sai Polytechnic College,** Kinhi Jawade, Yavatmal, Maharastra, India.

A Review on Effect of Blends of Higher Alcohol on Performance Characteristics of Si Engine

Pankaj Kalwade; Bhupendra Bhagat; Ashik Patle; Akash Save & Asst. Prof. Sachin Dinkar Fulzele

ABSTRACT

India is a developing country with an increasing workforce. A large part of transportation, movement etc depends on SI engines. Even agriculture today is largely dependent on SI engines. However in recent past we have witnessed a rapid increase in petrol prices. This price rise has not only affected commuters but also farmers and industries. Today's fuel research is completely based on finding alternative fuel, however more availability of heat from fuel is not acceptable. It is the ability to transform into mechanical work that matters the most. Meanwhile until some substitute is chalked out, researchers are concentrating on petrol blends (generally alcohol blended). A very little work has been done on higher alcohol (butanol, pentanol, propanol) blended with petrol. The objective of this paper is to provide a thorough literature review on the current status of higher alcohol blends on performance characteristics in SI engine and to guide the continuity study of improving performance characteristics techniques using higher alcohol blends with petrol.

INTRODUCTION

The demand of energy is ever increasing for the industries as well as automobiles. Internal combustion engines are the major sources of energy for automobiles. These engines consume mainly petroleum products like petrol (gasoline) and diesel as fuels. Increased consumption and unstable rates of end prices of fuel made us in various troubles resulting in more attraction of alternative and low cost biofuel. The search for alternative fuels, which promise a correlation with sustainable development, energy conservation, efficiency and environmental preservation, has become highly pronounced in the present days. The fuels of bio- origin can provide a feasible solution to this worldwide petroleum crisis. Also, gasoline and diesel-driven automobiles are the major sources of greenhouse gases emission. Scientists around the world have explored several alternative energy resources, which have the potential to quench the ever-increasing energy thirst of today's population and to minimize the emission with higher consumption. It has been anticipated that the petroleum reserve will be exhausted soon if some alternative fuels, at least partially do not replace petrol and diesel. The alternative fuel should have reasonably good thermal efficiency, low pollution level and should be available for a long time. There is an essential need of alternate fuels in a way or other. Today intensive search for the alternative fuels for both spark ignition (SI) and compression ignition (CI) engines and it has been found out that the higher alcohol derivatives are suitable for alternative fuels. They can be blended with petrol over a wide range of percentage according to the

requirement. Another reason for the need of alternate fuels for IC engines is the emission problems. As these fuels cannot be run directly in the engines therefore these are blended with gasoline at various percentage. One of the main reasons for selecting these fuels is the similarity in the properties of these with gasoline and they are miscible with gasoline without any phase separation.

LITERATURE REVIEW

Literature review is a body of text that aims to review the critical points of current knowledge and or scientific methodological approaches on the topic related to the study. In this chapter, literature will give information about the background knowledge in internal combustion engine field and other technologies that being used as references to generate idea to conduct this study.

Mridul Gautam and Daniel W. Martin II [1] conducted experiment to determine the of emission characteristics of higher alcohols and gasoline (UTG96)) blends. While lower alcohols (methanol and ethanol) have been used in blends with gasoline, very little work has been done reported on higher alcohols (propanol, butanol, and pentanol). Comparisons of emissions and fuel characteristics between higher alcohol/gasoline blends and neat gasoline were made to determine the advantages and disadvantages of blending higher alcohols with gasoline. All tests were conducted on a single cylinder Waukesha Cooperative Fuel Research (CFR) engine operating at steady state conditions and stoichiometric A/F ratio.Other fuel parameters, including Reid vapor pressure (RVP) and distillation curve, are affected by the addition of alcohol to gasoline. The lower alcohols (methanol and ethanol) cause the most dramatic increase in RVP and the largest depression of the distillation curve. Addition of the higher alcohols (propanol, butanol, and pentanol) seems to curb the effects of methanol and ethanol on both RVP and the distillation curve.

Furey (1985)[2] investigated RVP changes in gasoline when methanol, ethanol, and higher alcohols were added. His findings showed that very small amounts of alcohol in the blend drastically increased the RVP, and methanol seemed to have a more dramatic effect on RVP than higher alcohols. This was due to the fact that methanol forms low-boiling azeotropes with certain hydrocarbons. However, when methanol was blended in gasoline along with higher alcohols, the increase in RVP was lower compared to methanol alone. Hence, using higher alcohols as co-solvents in alcohol/gasoline blends seems to be a viable option for controlling RVP and, consequently, for controlling evaporative emissions.

Reddy (1986)[3][4]compared the evaporative emissions of blends containing three levels of methanol and tertiary butyl alcohol (TBA) with gasolines of closely matched RVP. Three different fuel metering systems were tested: carburetor, throttle body injection (TBI), and multiport fuel injection (MFI). The alcohol blends generated the same vapor levels as gasolines matched to the same ASTM D 439 volatility.

H S Farkade and A. P. Pathre [5] has studied three alcohols are tried to investigate in two parts. Comparative study of methanol, ethanol and butanol on the basis of blending percentage is first part, followed by investigation of oxygen role on the basis of oxygen percentage in the blend. The result shows highest replacement of gasoline by butanol at 5 % of oxygen content, the performance of same oxygen percentage for

other two alcohols are also better. Presence of oxygen gives you more desirable combustion resulting into low emission of CO, HC and higher emission of CO2 as a result of complete combustion, higher temperature is also favorable for NO emission resulting higher emissions for it.

Alvydas Pikūnas, Saugirdas Pukalskas and Juozas Grabys [6] has investigated experimentally and compare the engine performance and pollutant emission of a SI engine using ethanol–gasoline blended fuel and pure gasoline. The results showed that when ethanol is added, the heating value of the blended fuel decreases, while the octane number of the blended fuel increases. The results of the engine test indicated that when ethanol–gasoline blended fuel is used, the engine power and specific fuel consumption of the engine slightly increase; CO emission decreases dramatically as a result of the leaning effect caused by the ethanol addition; HC emission decreases in some engine working conditions; and CO2 emission increases because of the improved combustion.

Palmer [7] used various blend rates of ethanol–gasoline fuels in engine tests. Results indicated that 10% ethanol addition increases the engine power output by 5%, and the octane number can be increased by 5% for each 10% ethanol added. he also indicated that 10% of ethanol addition to gasoline could reduce the concentration of CO emission up to 30%.

A Y F Bokhary, Majed Alhazmy, Nafis Ahmad and Abdulrahman Albahkali [8] explored the effects of using ethanol-unleaded gasoline fuel blends on engine performance and exhaust gas emissions in a spark ignition engine. The results showed that blending of unleaded gasoline with ethanol increases the brake torque, brake power, brake mean effective pressure, volumetric and brake thermal efficiencies and reduce the brake specific fuel consumption. Also the results showed that when ethanol is added, the carbon monoxide (CO) and carbon dioxide (CO_2) emission concentrations in the engine exhaust decrease, while the nitric oxide (NO) concentration increases. The oxygen (O2) concentration also shows an increasing trend with ethanol substitution. The maximum percentage of ethanol substitution was 15%.

Wei-Dong Hsieh, Rong-Hong Chen, Tsung-Lin Wu, Ta-Hui Lin [9] experimentally investigate the engine performance and pollutant emission of a commercial SI engine using ethanol–gasoline blended fuels with various blended rates (0%, 5%, 10%, 20%, 30%). Results showed that with increasing the ethanol content, the heating value of the blended fuels is decreased, while the octane number of the blended fuels increases. It was also found that with increasing the ethanol content, the Reid vapor pressure of the blended fuels initially increases to a maximum at 10% ethanol addition, and then decreases. Results of the engine test indicated that using ethanol–gasoline blended fuels, torque output and fuel consumption of the engine slightly increase; CO and HC emissions decrease dramatically as a result of the leaning effect caused by the ethanol addition; and CO2 emission increases because of the improved combustion. Finally, it was noted that NOx emission depends on the engine operating condition rather than the ethanol content.

Rupali S.Tupkar et.al [10] work on Experimental Investigation of four stroke spark ignition engine using alcohol petrol blends was studied by Alcohols are an attractive alternate fuel because they can be obtained from number of sources, both natural

and manufactured. Methanol and Ethanol are two kinds of alcohol can be obtained from many sources both fossil and renewable these include coal, petroleum, natural gas, biomass, wood and fills and even the ocean. In his work he prepared different alcohol petrol blends and find out optimum petrol blend for S.I. Engine and hi conclude that ethanol -gasoline blended fuels, the power output, fuel consumption, thermal and volumetric efficiency of the engine increase.CO and HC emissions decrease dramatically as a result of the leaning effect caused by the ethanol addition; and CO2 emission increases because of the improvement of combustion. It shows that ethanol can be used as a supplementary fuel to gasoline in modern spark ignition engines without major changes, and it can help to save our environment from toxic pollutants and to save a considerable part of the available oil.

A Hull et.el. (2006)[11] Studied onAn alternative fuel for spark ignition engines. Alternative fuels have been used for standard spark ignition engines. The fuel which contain generic bio-components, maintain all the advantages of ethanol that is the ability to increase considerably the octane number of gasoline and to reduce the amount of harmful pollutants in the exhaust emissions of engines operating on such blends.. And he found that to reduce the amount of harmful pollutants in the exhaust emissions of engines operating on such blends. .In contrast with ethanol the new fuel components do not increase the vapor pressure of gasoline–ethanol blends, have a better tolerance to water, and do not increase the fuel consumption.

Mr. Hitesh B. Bisen, Mr. Y. R. Suple. (2013) [12] Primary objective of their study is to determine the performance and the exhaust emissions of the engine using LPG as a fuel. The engine used in their study is originally a single cylinder; four-stroke spark ignition engine with certain modifications is to make to permit the experiments to run on LPG fuel. The CO emission is reducing in LPG than Gasoline for same load and rpm In Direct injection. Engine speed and load increases, so increasing percentage of CO in petrol system. As compare to gasoline HC is low in LPG direct injection as load increase HC increases. In HC emission also more in petrol system because hydrogen and carbon contain in petrol (C8H18) is high and low calorific value than LPG. Also Because of carbon contain is less and calorific value is more so LPG is emitted CO2 less than petrol.As Engine speed and load increases. NOx is slightly increases in LPG In Direct injection. In The results regarding NOx also indicate that NOx emission from LPG is higher than petrol.

Suraj Bhan Singh, Atul Dhar, Avinash Kumar Agarwal [13] engine performance, emissions and combustion characteristics of butanol-gasoline blends vis-a-vis baseline gasoline were experimentally evaluated in a medium duty SI engine without any hardware modifications at various engine speeds and loads.Combustion characteristics of 5, 10 and 20% butanol-gasoline blends are similar to gasoline. Heat release for gasoline begins relatively earlier than butanol-gasolineblends. Combustion duration decreases at higher engine loads because the combustion becomes faster for richer mixtures. Combustion duration of butanol-gasoline blends is marginally higher than gasoline.BTE of the butanol-gasoline blends is lower in comparison to gasoline for all speeds and this difference was statistically significantfor lower engine speeds. EGT of butanol-gasoline blends is slightly lower than gasoline. This difference was not statistically significant.

Renhua Feng, Jing Yang, Daming Zhang, Banglin Deng, Jianqin Fu, Jingping Liu, Xiaoqiang Liu [14] conducted experiment on a single cylinder motorcycle engine for two operating modes offull load and partial load at 6500 rpm and 8500 rpm with pure gasoline and 35% volume butanol–gasolineblend. The experimental results showed that enginetorque, BSEC, CO emissions and HC emissions are better than that of pure gasoline at both full load andpartial load with 35% volume butanol and 1% H2O addition, combined with the modified ignition timing. But NOx and CO2 emissions are worse than that of the original level of pure gasoline.

Şehmus ALTUN, Cengiz ONER and Müjdat FIRAT [15] had studied the effect of blends of iso-propanol and unleaded gasoline on exhaust emissions of a spark-ignition engine was experimentally investigated. Exhaust emission tests were conducted on a four-stroke, four cylinder and direct injection spark-ignition engine. The engine tests were performed at three-fourth throttle opening positions at four various speeds in the range of 1000-4000 rpm with 1000 rpm period. The experimental results compared with unleaded gasoline showed that emissions of carbon monoxide (CO) and hydrocarbon (HC) decreased with iso-propanol-unleaded gasoline blends while carbon dioxide (CO2) emission increased.

P. Xyradakis, Th. Gialamas, I. Gravalos, D. Moshou, D. Kateris, Z. Tsiropoulos, A. Augusti, K. Tsatsarelis [16] experimentally conducted investigation of emissions characteristics of pure and high alcohol/gasoline fuelBlends. The exhaust emissions of CO and HC from the pure-high alcohol/gasolineblends are lower than those emissions from neat gasoline, with the reduction being higher thehigher the percentage of ethanol in the blend. The high values of CO and HC emissions are closelyrelated to many design and operating condition of non-road engine. The CO_2 exhaust emissionshave an opposite behavior when compared to the CO exhaust emissions. Emissions of NO fromthe pure and high alcohol/gasoline fuel blends were higher than those from neat gasoline. Thecomparative results of CO, CO_2, HC and NO exhaust emissions between pure-highalcohol/gasoline and pure alcohol/gasoline fuel blends indicate that addition of longer-chainalcohols cause higher emissions except CO.

Jing GONG, Yingjia ZHANG, Chenglong TANGand Zuohua HUANG [17] studied various emission characteristics of the engine, including NOx, CO, CO2, and particulate matter emissions in a spark-ignition engine fueled with variousiso-propanol/gasoline blends. The main results are NOx emission gives the highest value at full load. The introduction of EGR reduces NOx emission and NOx emission indicates a first increase (x = 0, 10, 20%) and late decrease (x = 40%, 100%) trend with the increase of blending ratio.HC and CO emissions show inconspicuous variations at all the loads except L = 10. HC emission indicates no obvious difference in all the blending ratios except pure propanol while CO emission gives the lowest value at x = 40%. Additionally, HC emission presents a sharp increase at pure propanol when EGR rate is up to 5%, while little variation is observed at lager EGR rates. PM number concentration increases monotonically with the increase of load and the decrease of EGR. There exists critical spark timing, lager than MBT timing, generating the highest PM number concentration for all the blending ratios.

CONCLUSION

From the literature review it is concluded that the performance characteristics (brake thermal efficiency and brake specific fuel consumption) of SI engine can be improved by blending higher alcohol with gasoline. A research study can be done on higher alcohol/gasoline blends on variable compression ratio at different torque.

REFERENCES

[1] MridulGautam And Daniel W. Martin II, Chapter 20, EMISSIONS CHARACTERISTICS OF HIGHER ALCOHOL/GASOLINE BLENDS.

[2] Furey, Robert L., "Volatility Characteristics of Gasoline-Alcohol and Gasoline-Ether Fuel Blends," SAE Paper No. 852116, 1985.

[3]Furey, Robert L., "Trends in Gasoline Properties and Their Effects on Motor Vehicles," Air Pollution Control Association Paper GMR-5780 F&L-846, 1987.

[4] Furey, Robert L., and King, Jack B., "Emissions, Fuel Economy, and Driveability Effects of Methanol/Butanol/Gasoline Fuel Blends," SAE Paper No. 821188, 1982.

[5] H S Farkade and A P Pathre, Experimental investigation of methanol, ethanol and butanol blends with gasoline on SI engine, International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 4, April 2012)

[6] AlvydasPikūnas,SaugirdasPukalskas and JuozasGrabys,influence of composition of gasoline – ethanol blends on parameters of internal combustion engines, Journal of KONES Internal Combustion Engines 2003, vol. 10, 3-4.

[7] Palmer, F.H., 1986. Vehicle performance of gasoline containing oxygenates. International conference on petroleum based and automotive applications. Institution of Mechanical Engineers Conference Publications, MEP, London, UK, pp. 33–46.

[8] A Y F Bokhary, MajedAlhazmy, Nafis Ahmad and AbdulrahmanAlbahkali, Investigations on the Utilization of Ethanol-Unleaded Gasoline Blends on SI Engine Performance and Exhaust Gas Emission, International Journal of Engineering & Technology IJET-IJENS Vol:14 No:02

[9] Wei-Dong Hsieh, Rong-Hong Chen, Tsung-Lin Wu, Ta-Hui Lin, Engine performance and pollutant emission of an SI engine using ethanol–gasoline blended fuels, Atmospheric Environment 36 (2002) 403–410.

[10] Mrs. RupaliS.Tupkar, Mrs. Manisha S. Lande, Ms. PrernaS.Borkar, Mr.V.S.Shende "Experimental Investigation of four stroke spark ignition engine using alcohol petrol blends" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 33-37.

[11] A Hull, I Golubkov, B Kronberg, T Marandzheva, and J van Stam (2005)"An alternative fuel for spark ignition engines" DOI: 10.1243/14680874JER02504.

[12] Mr. Hitesh B. Bisen, Mr. Y. R. Suple "Experimental Investigations of Exhaust Emissions of four Stroke SI Engine by using direct injection of LPG and its analysis" International Journal of Modern Engineering Research (IJMER) Vol. 3, Issue. 5, Sep - Oct. 2013 pp-2600-2605.

[13] SurajBhan Singh, AtulDhar, Avinash Kumar Agarwal ,Technical Feasibility Study of Butanol-Gasoline Blends for Powering Medium-Duty Transportation Spark Ignition Engine

[14] Renhua Feng, Jing Yang, Daming Zhang, Banglin Deng, Jianqin Fu, Jingping Liu, Xiaoqiang Liu, Experimental study on SI

engine fuelled with butanol–gasoline blendand H2O addition, Energy Conversion and Management 74 (2013) 192–200.

[15] Şehmus ALTUN, Cengiz ONER and Müjdat FIRAT, EXHAUST EMISSIONS FROM A SPARK-IGNITION ENGINE OPERATING ON ISO-PROPANOL AND UNLEADED GASOLINE BLENDS, Technology, 13(3), 183-188, (2010).

[16] P. Xyradakis, Th. Gialamas, I. Gravalos, D. Moshou, D. Kateris, Z. Tsiropoulos, A. Augusti,K. Tsatsarelis Emissions characteristics of spark ignition engine operating on pure and high alcohol blended gasoline fuels, Efficient and safe production processes in sustainable agriculture and forestry XXXIV CIOSTA CIGR V Conference 2011.

[17] Jing GONG, Yingjia ZHANG, Chenglong TANG, and Zuohua HUANG, Emission Characteristics OfIso-Propanol/Gasoline Blends in a Spark-Ignition Engine Combined WithExhaust Gas Re-Circulation, THERMAL SCIENCE: Year 2014, Vol. 18, No. 1, pp. 269-277