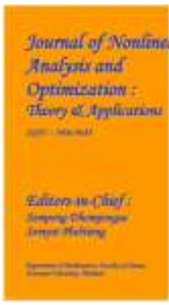
Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 15, Issue. 2 : 2024
ISSN : **1906-9685**



EXPERIMENTAL INVESTIGATIONS ON DICI ETHANOL (WITH ADDITIVES) FUELLED WITH CERAMIC HOT SURFACE IGNITION SYSTEM

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ABSTRACT

The concept of using alcohol fuels as alternatives to diesel fuel in CI engines is a recent one. The scarcity of transportation petroleum fuels leads to the recognition of alcohol as a preferable replacement. is an excellent combustion engine fuel with a high octane rating and clean burning characteristics to be used in SI engines. It is used as a fuel primarily as E85 (a mixture of 85% hydrocarbons) or as neat Ethanol, E100 (100% ethanol. It has poor self ignition characteristic; therefore, its use in diesel engines requires a means for providing ignition. For single fuel engines this entails use of a spark plug or Ceramic hot, fuel additive ignition improvers, or enhanced auto-ignition through the use of exhaust gas re-circulation.The effect of additives mixed in Ethanol is studied in the best suited coating Ceramic hot surface ignition engine, in order to get higher performance.

INTRODUCTION

Ethanol, the primary emission problem associated with Ethanol is the generation of aldehydes, particularly acetaldehyde. Ethanol fueled vehicles also emit unburned Ethanol; however, the unburned Ethanol is less reactive than the complex mixture of unburned hydrocarbons emitted by gasoline and diesel fueled vehicles. The catalyst control technology developed for the control of aldehydes in Ethanol fueled vehicles should be able to be extended to ethanol fueled to solve this problem.

As with Ethanol, Ethanol is not well suited for use in unmodified compression ignition engines. It has poor self- ignition characteristics; therefore, its use in diesel engines requires some means for providing ignition. For single – fuel operations this normally entails use of a spark plug or Ceramic hot, fuel additive ignition improvers, or enhanced auto – ignition through the use of exhaust has recirculation. In dual fuel operation, ignition of the Ethanol is insured by use with a fuel having good self – ignition characteristics, such as diesel fuel.

LITERATURE

So far, no established method is available to run a normal diesel engine with a compression ratio from 14:1 to 20:1 by using alcohol as a fuel. This is because, the properties of alcoholic fuel differ from the properties of diesel fuel. The specific tendency of the alcohols to ignite easily from a hot surface makes it suitable to ignite in a diesel engine by different methods. The advantage of this property of alcohols enables us to design and construct a new type of engine called the surface ignition engine.

Use of Ceramic as hot surfaces

The use of alcohols as fuels for IC engines in future, especially in diesel engines, has evoked considerable interest. Alcohols by their very nature do not make good CI engine fuel. But they have peculiar property of igniting over a hot surface at a low temperature in spite of their high elf ignition temperature. It is this tendency of alcohol that has been exploited, in developing the surface ignition engine. Most of the literature available deals with the use of alcohols in surface ignition engines working at diesel engine compression ratios. Almost all the power plants tested are modified versions of diesel engines with facility to accommodate the hot surface apart from the changes in the fuel system to allow greater flow rates.

EXPERIMENTAL WORK

The details of the experimental setup are presented in this chapter. The informations about various components, the modifications or alterations made to them, the instrumentation – adapted etc., are described.The experimental set –up is designed and fabricated keeping in mind, the objectives of the present work. The capacity of the fuel injection pump is increased to enable operation up to the rated output with Ethanol and Ethanol, whose calorific value is considerably lower compared to diesel oil on volumetric basis [15]. Various components of the experimental set up, including modification are presented in this Figure.

The valves and the hole for fuel injector nozzle occupied about 35 percent of the total area of the combustion chamber surface and the remaining area was coated with PSZ.

Photo Graphic View of Aluminium Piston with Brass Crown and Air Insulation

Photo Graphic View of Experimental Setup

Results & Discussion

Brake Thermal Efficiency

The variation of brake thermal efficiency with brake power out for six additives for copper piston crown material Ceramic hot surface ignition engine is shown in the figure.

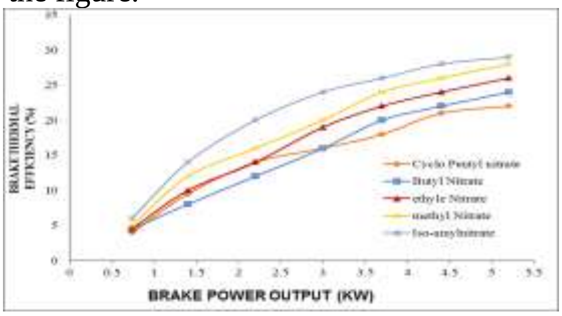

Fig. Comparison of Brake thermal efficiency with power output for five Fuels additives in Copper CHSI Engine.

It is observed that maximum efficiency over a wide range of operation, particularly at higher loads is shown by copper piston crown material Ceramic hot surface ignition engine with Iso amyl nitrate as an additive

Brake Specific Fuel Consumption

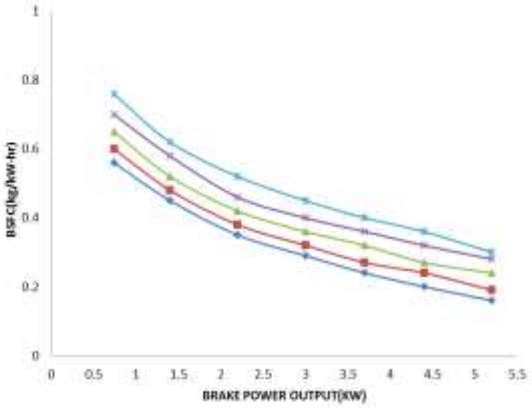

Fig. Comparison of brake specific fuel consumption with power output for five Fuels additives in Copper CHSI Engine.

All the configurations have normal CHSI brake specific fuel consumption compared to base engine. An Copper gives higher bsfc over wide range of operation.

Volumetric Efficiency

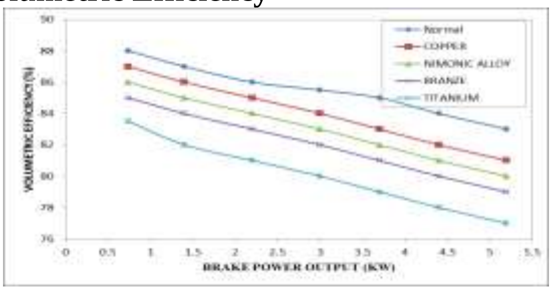

Fig Comparison of Volumetric efficiency with power output for five Fuels additives in Copper CHSI Engine.

The general trend is that the volumetric efficiency drops with increase in power output. At standard condition, the volumetric efficiency varies from 88% at no load to 85% at full load. With copper configuration the volumetric efficiency comes to 82% at no load and to 75% at full load.

Hydrocarbons

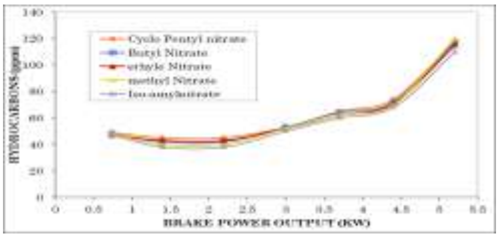

Fig. Comparison of Hydrocarbons with power output for five Fuels additives in Copper CHSI Engine.

A reduction in hydrocarbon level has been observed with all additives with copper piston crown material Ceramic hot surface ignition engine. Copper piston crown material Ceramic hot surface ignition engine with Iso amyl nitrate as an additive is observed to show a maximum reduction in hydrocarbon emissions

Carbon dioxide Emission

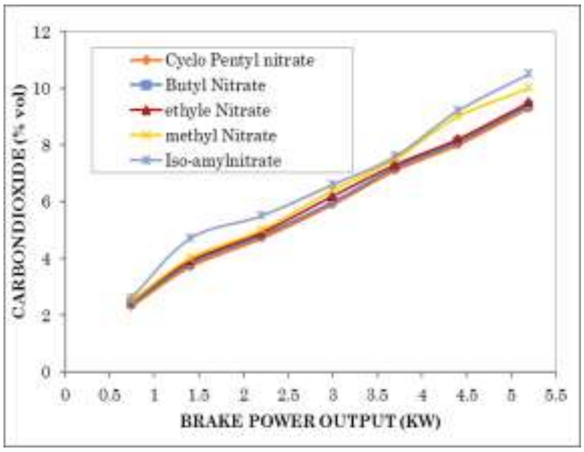

Fig. Comparison of Carbon dioxide with power output for five Fuels additives in Copper CHSI Engine.

Because of better and complete combustion in the insulated engines, Carbon dioxide levels are higher for insulated engines. It indicates that the level of Carbon dioxide in the exhaust is highest for Copper piston crown configuration. Higher Carbon dioxide in the exhaust is an indication of complete or better combustion.

Carbon Monoxide Emission

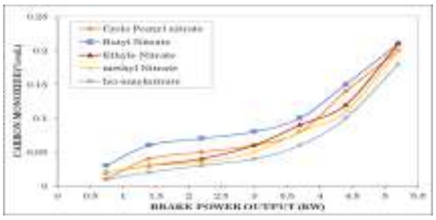

Fig. Comparison of CO emission with power output for five Fuels additives in Copper CHSI Engine.

The lowest carbon monoxide emission is given by engine with copper piston crown material Ceramic hot surface ignition engine, with Iso amyl nitrate as an additive and the highest carbon monoxide emission is given by engine with copper piston crown material.

Nitrogen Oxide Emissions

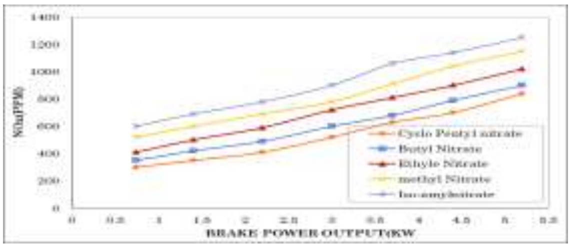

Fig. Comparison of NOx emission with power output for five Fuels additives in Copper CHSI Engine.

Because of better and complete combustion in the insulated engines, Nitrogen oxide levels are higher for insulated engines. It indicates that the level of nitrogen oxide is highest for Copper CHSI configuration. Higher nitrogen oxide in the exhaust is an indication of complete or better combustion

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Exhaust Gas Temperature

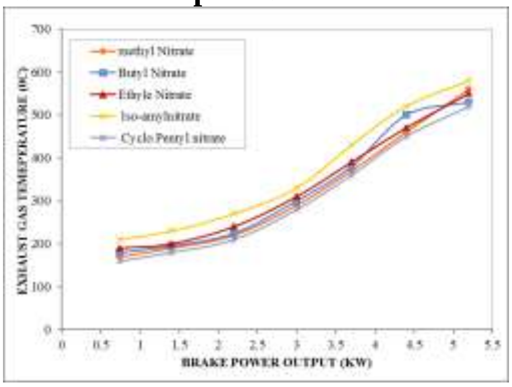

Fig Comparison of Exhaust gas temperature with power output for five Fuels additives in Copper CHSI Engine.

It clearly indicates that with the degree of insulation increasing the exhaust gas temperature progressively increases. Exhaust temperatures increase with the engine load. Because of better insulation for the Copper CHSI configuration, the exhaust temperature is higher compared to all other configurations. There is a 210^0C rise in the exhaust temperature for this configurations compared to base engine.

Ignition Delay

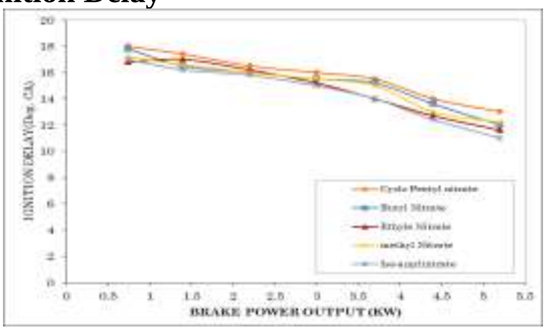

Fig. Comparison of Ignition delay with power output for five Fuels additives in Copper CHSI Engine.

The lowest ignition delay among all the additives tested is shown by the copper piston crown material Ceramic hot surface ignition engine with Iso amyl nitrate as an additive

Indicated Mean Effective Pressure

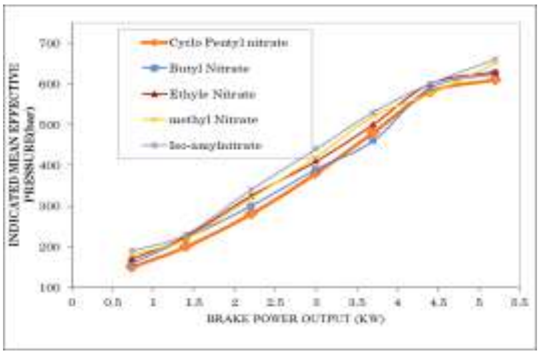

Fig. Comparison of Indicated mean effective pressure with power output for five Fuels additives in Copper CHSI Engine.

The increase in the Indicated mean effective pressure is normally expected because of higher temperatures in these configurations. Highest Indicated mean effective pressure is obtained for the Copper CHSI configuration compared to other configurations. The increase in the Indicated mean effective pressure depends upon the level of insulation applied

Peak Pressure

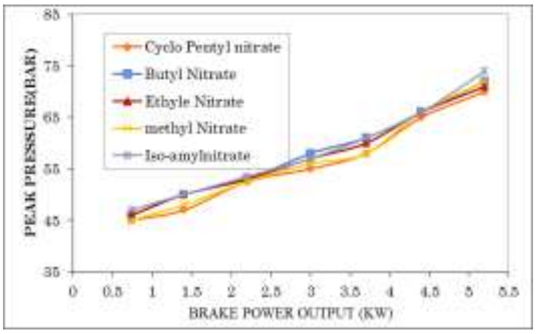

Fig. Comparison of Peak Pressure with power output for five Fuels additives in Copper CHSI Engine.

At higher outputs particularly where the gas temperatures accelerate the combustion process, the peak pressure will increase with the addition of additives to the copper piston crown material Ceramic hot surface ignition engine. The peak pressure developed by copper piston crown material Ceramic hotsurface ignition engine is found to be higher and about 56 bar with Iso amyl nitrate as an additive

Maximum Rate of Pressure Rise

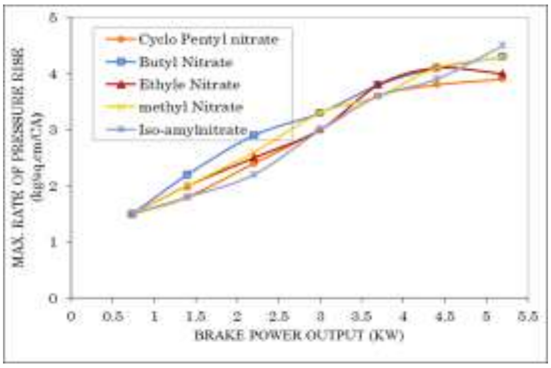

Fig. Comparison of maximum Rate of Pressure Rise with power output for five Fuels additives in Copper CHSI Engine.

with the addition of different additives with copper piston crown material Ceramic hot surface ignition engine, the maximum rate of pressure rise has been observed to be higher. For the copper piston crown material Ceramic hot surface ignition engine with Iso amyl nitrate as an additive it is highest and is about 25% by volume at rated load.

RESULTS

The following conclusions are drawn with ethanol operating CHSI engine with different additives. It sis concluded that among the six additives tested to the copper piston crown material CHSI engine with ethanol as fuel, Iso amyl nitrate gives the best results.

1. It is found that copper piston crown material CHSI engine with Iso amyl nitrate as an additive shows maximum efficiency over a wide range of operation and is about 32.98%.
2. The maximum reduction in HC emission is for copper piston crown material CHSI engine with Iso amyl nitrate as an additive .
3. It is found that the maximum reduction in CO emission with copper piston crown material CHSI engine with Iso amyl nitrate as an additive is 20% by volume.
4. At rated load, it is found that, the combustion duration of copper piston crown material CHSI engine with Iso amyl nitrate as an additive is shorter by 4.5^0CA
5. It is found that the maximum rate of pressure rise is highest for copper piston crown material CHSI engine with iso amyl nitrate as an additive and is about 25% by volume.

REFERENCES:

1. Balasubramanian, V. et al – Development and performance testing of a Surface ignition engine to run on alcohols – Fifth int. Confs. On alcohols – 1982.
2. V. Balasubramanian, et al., ‘Development and performance Testing of a surface Ignition engine to run on alcohols; V Int. Symp. On Alcohol Fuels Technology, Auckland, New Zealand, 1982.
3. W.Bande, ‘Problems in Adapting Ethanol Fuels to the Requirements of Diesel Engines’, Int.Symp.OnAlcoholFuelsTechnology,Brazil,October1980,Vol.3,pp.1083-1089.
4. Barnes, R.D., Effect of as supplementary fuel in turbo charged diesel engine – SAE 750469, 1984.
5. Barnescu,r.,hilger,U.,Bartunek,B., Scheld,E.,Pischinger,F.andRogers ,G.,‘ConversionofaNavistardT-466DieselEngineto EthanolOperation’,VIIIInt.Symp. On Alcohol Fuels Technology, Tokyo, japan, 1988, pp.553-558.
6. Barsic,N.J.andhumke,A.L.‘PerformanceandEmissionCharacteristicsofaNaturally Aspirated Diesel Engine with Vegetable Oils Fuels’, SAE Paper 810262, 1989.
7. ‘BasicConsiderationintheCombustionofHydrocarbonFuelswithAir’,NACAReport No. 1300, pp. 102-108.
8. Bernherdt, W., - Ethanol as automotive fuel – Problems and expectations – Academy ofScience report – Sweden, 1980.
9. Bernherdt,W.,-Alternatefuelsandhowtoapplythemtoworld’stransportindustry– Second Montreuxe energy forum – 1980.

10. BertrandD.Hsu,‘HeatRelease,CycleEfficiencyandMaximumCylinderPressureinDiesel Engine – The Use of an Extended Air Cycle Analysis’, SAE Paper 841054.
11. F.W.BowditchandT.C.Yu,‘SurfaceIgnition’,SAEJournal,October1960,pp. 58-61.
12. F.w.BowditchandT.C.Yu,‘AConsiderationoftheDepositIgnitionMechanism’,SAE Transactions, 1961, pp. 435 – 679.
13. Bowditech,F.W.,&YU–AconsiderationofdepositIgnitionSystem SAE1960.
14. W.L.Brown,‘MethodsforEvaluatingRequirementsandErrosinCylinderPressure Measurement’, SAE Paper 670008.
15. Browing,L.H.,&Pefly,R.K.,-Thermokineticmodelingof EthanolcombustioninaSI engine – Third Int. Confs. On Alcohols – 1979.
16. L.H.BrowningandR.K.Pefley,‘ThermokineticModellingof EthanolCombustion phenomena with Application to Spark Ignition Engines’, III Nt. Symp. On Alcohol Fuels Technology, Asilomar, California, USA, 1979, Vol. 1.