Experimental Investigation of Performance, Emission and Combustion Characteristics on CI Engine using Karanja Biodiesel with Acetylene (Welding Gas) Blend

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Abstract— In the present study the concept of using acetylene gas like other gases used with biodiesel blend in various investigations. In a dual fuel mode acetylene was used as an alternative fuel blended with karanja oil methyl ester (KOME) and its performance in a compression ignition engine was investigated. Experimental investigation has been carried out on a single cylinder, direct injection, and compression ignition engine run on dual fuel mode with diesel is injected as primary fuel and acetylene inducted as secondary gaseous fuel to obtain data on engine performance with different flow rates of pressure at 0.5kg/cm^2, 0.8kg/cm2 is drawn to intake air manifold. In Dual fuel operation at 0.5kg/cm2 flow rate of acetylene thermal efficiency obtained is nearer when compared to neat diesel operation in the internal combustion engine such that it reduces the demand of the petroleum products that is going to be extinct in near future. It includes about the emissions of harmful gases that can be reduced by the use of acetylene instead of petroleum products. Due to the increasing demand for fossil fuels and environmental threat, a number of renewable sources of energy have been studied worldwide. The performance, combustion and emission characteristics of the diesel were evaluated and compared with dual fuel operation (KOME + Acetylene) at compression ratio 17.5:1. Based on the performance, combustion and emission parameters the flow rate of induction was optimized which were 0.5kg/cm2. The acetylene blend reduces in CO & HC emissions compared to diesel.

Key words: Acetylene, Dual Fuel Mode, Flow Rate Pressure, Engine Performance

I. INTRODUCTION

In the last years, the awareness of environmental problems encouraged biodiesel produced from different Non-edible oil. Karanja is one of non-edible oil available in huge source, From the literatures numerous research projects on the utilization of biodiesel as well as its blends in engines have been done. The search for an alternative fuel promises a harmonious correlation with energy conservation, sustainable development, efficiency, management and environmental preservation. The increase in world's population from day to day during the last decade, Technical developments and increase in standard of living in the developed nations led to the twin crisis of fossil fuel depletion and environmental degradation resulting local air pollution to global warming, climatic changes and sea level rise. Therefore, another efficient and cheap energy source needs to be found quickly. Ideally, this energy source should be unlimited in its supply and also environment friendly. Hence, it is necessary to look for alternative fuels, which can be produced from materials available within the country.

In an agricultural country like India use of vegetable oil would be economical because of large productivity and reduced dependability on import of petroleum products. Hence fuels which are renewable, clean burning and can be produced easily are being investigated as alternative fuels. Over few decades, a lot of research has gone into use of alternative fuels in IC engines. Vegetable oils seem to be a forerunner as they are renewable and easily available But because of poor atomization and high viscosity of straight vegetable oils and causes improper combustion due to improper mixing. Further to reduce viscosity problem researchers went for biodiesels of Non-edible oils. Other alternative to use gaseous fuels as alternative fuels in IC engines due to cost of production and performance losses.

The promising alternative fuels for internal combustion engines are hydrogen and acetylene gas, LPG (liquefied petroleum gas), CNG (compressed natural gas), many of the gaseous fuels can be obtained from renewable sources. They have a high self-ignition temperature; hence they cannot be used directly in diesel engines. In dual fuel mode, gaseous fuel called primary fuel is either inducted along with intake air or injected directly into the cylinder and compressed but does not autoignite due to its very high self-ignition temperature Ignition of homogeneous mixture of air and gas is achieved by timed injection of small quantity of biodiesel called pilot fuel near the end of the compression storke. Diesel engines however can be made to use a considerable amount of gaseous fuels in dual fuel mode without incorporating any major changes in engine construction. It is possible to trace the origin of the dual fuel engines to Rudolf Diesel, who patented an engine running on essentially the dual fuel principle.

In a dual fuel mode combustion the pilot biodiesel fuel auto-ignites first and acts as a deliberate source of ignition for the primary fuel–air mixture. The combustion of the gaseous fuel occurs by the flame initiation by auto-ignition of biodiesel pilot injection at unspecified location in the combustion chamber. This ignition source can develop into propagation flame, similar to spark ignition (SI) engine combustion. Thus, dual fuel engine combines the features of both SI and CI (compression ignition) engine in a complex manner.

So using of gaseous fuel in CI engine means the engine is running on dual fuel mode. This work proves the use of acetylene gas as an alternative fuel without a large investment. This method involves burning of acetylene gas of little quantity along with karanja oil methyl ester(KOME) in engines.

II. LITERATURE REVIEW

Nakul aggarwal [1] conducted an experiment on analysis of engine performance by using acetylene in ci engine operated on dual fuel mode. They carried out the experiment on a single cylinder, air cooled, direct injection (DI), compression ignition engine designed to develop the rated power output of 4.4 kW at 1500 rpm under variable load condition. Acetylene induction results in the peak pressure are increasing with increased flow rate of acetylene due to instantaneous combustion of gaseous fuel. Exhaust gas temperatures are increasing with increasing acetylene flow rates as peak pressures are increasing and heat input also increasing with increasing flow rate. And CO,UHC emission levels are increasing with acetylene induction flow rates.

G.Nagarajan and T.Lakshamanan [2] conducted experiments on a diesel engine aspirated acetylene along with air at different flow rates without dual fuel mode. They carried out the experiment on a single cylinder, air cooled, direct injection (DI), compression ignition engine designed to develop the rated power output of 4.4 kW at 1500 rpm under variable load condition. Acetylene aspiration results came with a lower thermal efficiency reduced Smoke, HC and CO emissions, when compared with baseline diesel operation.

S.K. Mahla [3] An experimental investigation has been carried out on a single cylinder, direct injection (DI), and compression ignition (CI) engine tested with pure diesel and diesel-Acetylene dual fuel mode with diethyl ether (DEE) as oxygenated additive. Experiments were conducted to study the performance characteristics of DI diesel engine in dual fuel mode by aspirating Acetylene gas in the inlet manifold, with diesel- diethyl ether blends (DEE) as an ignition source. Fixed quantity of Acetylene gas was aspirated and Blend of diethyl ether with diesel (DEE10, DEE20 and DEE30) was taken and then readings were taken at various loads. From the detailed study it has been concluded that the blending ratio of DEE20 gives better performance. Dual fuel operation along with addition of diethyl ether resulted in higher thermal efficiency when compared to neat diesel operation. Acetylene aspiration reduces smoke and exhaust temperature.

Kapil Dev Choudhary, Ashish Nayyar [4] conducted an experiment on "Optimization of Induction Flow Rate Acetylene in CI Engine Operated on Duel Fuel Mode" acetylene was inducted with various flow rates viz 5lpm, 6lpm, 7lpm and 8lpm to the intake air manifold of the engine and diesel injected conventionally in the cylinder. The combustion, performance and emission distinctiveness of the diesel were evaluated and compared with dual fuel operation (Diesel + Acetylene) at compression ratio 18:1. The peak cylinder pressure increases with increase in the induction flow rates of acetylene up to 7 lpm and again decreases. The peak cylinder pressure for acetylene induction of 7 lpm at compression ratio 18:1 is 63.96 bar and it is highest among that of all induction flow rates and the base line diesel operation. The heat release rate is increasing with increasing the induction flow rates of acetylene. By induction of acetylene results show less CO & higher NO_X emissions at all loads when compared to base line diesel operation.

Pritinika behera, Abhishekh kumar Jha & S. Murugan [5] conducted an experiment on "Dual Fuel Operation of Used Transformer Oil with Acetylene in a DI Diesel Engine" dual fuel mode was attempted in the presented investigation. Acetylene was inducted as secondary at three different flow rates along with the air, to study the performance and emission behavior of a four-stroke, 4.4 kW diesel engine, while UTO was injected as the pilot fuel with the optimized injection timing. The acetylene flow rates used in the study are 132 g/h, 198 g/h, 264 g/h and 330 g/h. The experimental results were compared with diesel with acetylene in the dual fuel operation in the same engine. Higher thermal efficiency and reduction in exhaust gas temperature by about 24 % was observed at full load. Smoke was reduced by about 13.7%, in comparison with the UTO operation at full load.

Swami Nathan [6] had conducted experiment in CI engine by using acetylene as a fuel in HCCI mode along with preheated take charge heating. The efficiencies achieved were very near to diesel. NO*x* and smoke level were reduced drastically. However, HC level was increased.

Karim [7] has done extensive research to understand the nature of the combustion process in the dual fuel. He has used variety of gases like methane, ethane, propane, butane, hydrogen, ethylene, and acetylene as primary fuel. It is generally accepted that performance of dual fuel engines, irrespective of the type of gaseous fuel employed, is better at medium and high loads. However, it has been reported that at low outputs efficiency is slightly inferior to the base line diesel engine. Researchers have stressed the need to control the quantity of both pilot and gaseous fuel depending on load conditions for better performance.

Ashok Kumar [8] studied suitability of acetylene in SI engine along with EGR, and reported that emission got drastically reduced on par with hydrogen engine with marginal increase in thermal efficiency.

Wulff [9] used mixture of acetylene and alcohol to burn in spark ignition engine and in compression ignition engine in a controllable way in dual fuel mode. It exhibited higher efficiency than conventional engine, with cleaner burning better than that of fossil fuels. The combustion was under lower temperature, and this prolonged the life expectancy of the engine.

III. ACETYLENE PRODUCTION & PROPERTIES

The main reason behind preferring Acetylene (C_2H_2) in this project is due to its very wide flammability range and minimum ignition energy is required for ignition since the engine can run in lean mode with higher specific heat ratios leading to increased thermal efficiency. It has higher flame speed and hence faster energy release And at stoichiometeric mixtures, acetylene engines could closely approach thermodynamically ideal engine cycle. High self-ignition temperature of acetylene allows larger compression ratios than diesel engines. Acetylene is not an air gas, but a synthesis gas generally produced from the reaction of calcium carbide with water. and produces a very hot flame over 3000°C when combined with oxygen. A gaseous hydrocarbon, it is colorless, has a strong garlic odor, is highly combustible, unstable, It was burnt in "acetylene lamps" to light homes and mining tunnels in the 19th century. Acetylene is conventionally produced by reacting calcium carbide with water. The reaction is spontaneously occurring and can be conducted without any sophisticated equipment or apparatus. Such produced acetylene has been utilized for lighting in mine areas, by street vendors, etc. Acetylene

Due to lower quenching distance similar to hydrogen, flame cannot be quenched easily in the combustion chamber. Due to lower ignition energy, high flame speed, wide flammability limits, and short quenching distance lead to premature ignition and also lead to undesirable combustion phenomenon called knock, the primary problems that have to be encountered in operation of acetylene engines.

In the present work, a single cylinder, direct injection air, and cooled diesel engine were modified to work in the dual fuel mode with acetylene as the secondary inducted fuel and karanja oil methyl ester as the primary injected fuel. The performance and emission at different output with fixed quantity of aspirating acetylene are presented in this work.

Properties	Acetylene
Formula.	C_2H_2
Density kg/m^3(At 1 atm & 20^{0}C)	1.092
Auto ignition temperature (^{o}C)	305
Stoichiometeric air fuel ratio, (kj/kg)	13.2
Flammability Limits (Volume %)	2.2 - 81
Flammability Limits (Equivalent ratio)	0.3 - 9.6
Lower Calorific Value (kJ/kg)	48,225
Lower Calorific Value (kJ/m^3)	50,636
Max deflagration speed (m/sec)	1.5
Ignition energy (MJ)	0.019
Lower Heating value of Stoichiometeric mixture (kJ/kg)	3396

Table 1: Acetylene Properties

IV. TRANSESTERIFICATION PROCESS

Some known quantity of crude oil was taken in a conical flask. The oil in the flask was then heated on a heating plate upto a temperature of 60°C. A mixture of known quantity of sulphuric acid (H_2SO_4) as acid catalyst and methanol was then mixed with the preheated crude oil. The preheated oil mixture was then subjected to 1 hour constant stirring at a constant temperature of 60°C inside a water bath shaker. After 1 hour of constant stirring the mixture was poured into a separating funnel for impurities to settle down. After 4-5 hours the settled down impurities are separated from the remaining oil.

Remaining oil quantity was measured and again heated upto 60°C. A mixture of known quantity of Potassium hydroxide (KOH) as base catalyst and methanol was then mixed with the remaining preheated oil. The preheated oil mixture was then again subjected to 1 hour constant stirring at a constant temperature of 60°C inside a water bath shaker. After 1 hour of constant stirring the mixture was poured into a separating funnel for glycerol to settle down. After 2-3 hours settled down glycerol is separated and removed. Remaining is methyl ester (biodiesel) of crude karanja oil(Yield 80%) which is further purified through washing and drying for removal of excess KOH, methanol and water

V. EXPERIMENTAL SET UP & METHODOLOGY

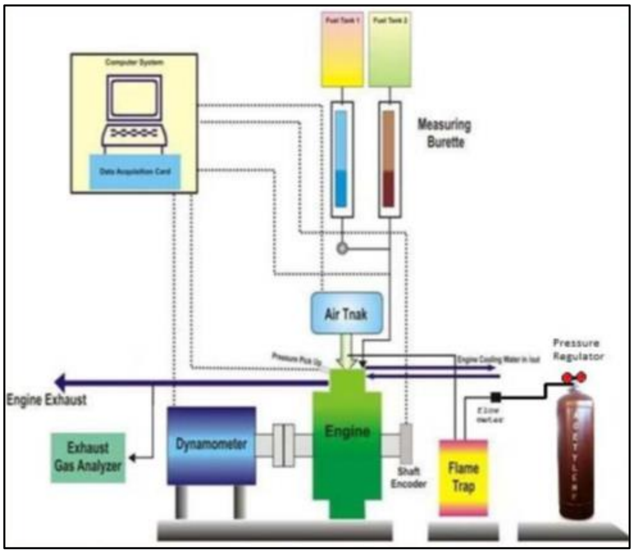

Fig. 1: Schematic of the experimental set up

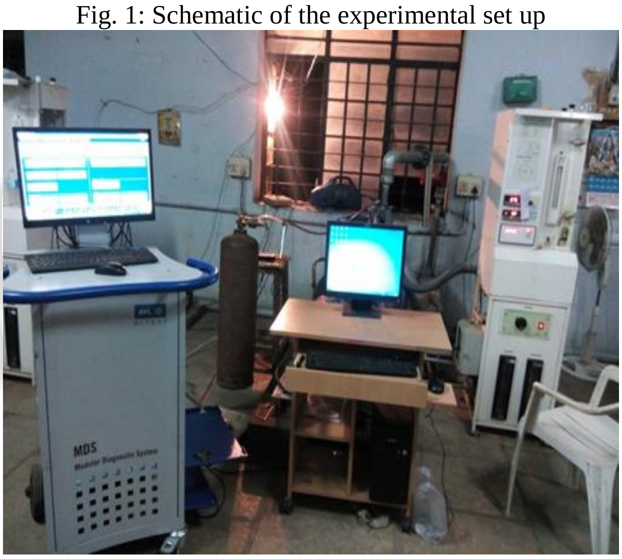

Fig. 2: Photograph of experimental set up

A single cylinder four stroke air cooled naturally aspirated direct injection diesel engine developing 4.4 kW at 1500 rpm, fueled with diesel fuel was utilized for acetylene dual fuel operation. The specifications of the engine are given in table below. The experimental set up is shown in Figure. Acetylene was introduced into intake manifold at a point closer to the intake valve by a non-return valve arrangement through a flame trap. The flow of acetylene was controlled by valve and was measured by a calibrated gas flow meter. Air flow was determined by measuring the pressure drop accurately across a sharp edge orifice of the air surge chamber with the help of a manometer. The diesel flow was measured by noting the time of fixed volume of diesel consumed by the engine. A water-cooled piezoelectric pressure transducer was fixed on the cylinder head to record the pressure variation on the screen of a cathode –ray oscilloscope along with crank angle encoder. Chromel-alumel K-type thermocouple was used for exhaust gas temperature measurement. The exhaust gas constituents CO, CO_2, HC, NOx, and smoke were measured by a Qurotech

QRO-401 gas analyzer, and Bosch smoke meter was used for the measurement of smoke.

Manufacturer	Kirloskar Oil Engines Ltd., India
Model	TV_SR II, naturally aspirated
Engine	Single cylinder, direct injection diesel engine
Bore/stroke/compression	Ratio 87.5 mm/110 mm/17.5:1
Rated power	5.2 kW
Speed	1500 RPM, Constant
Injection Pressure/Advance	200bar/23 degree before TDC
Dynamometer	Eddy current
Type of start in Manually	Air Flow Measurement Air Box with 'U' Tube
Exhaust gas temperature	RTD Thermocouple
Fuel flow measurement	Burette with Digital Stopwatch
Governor	Mechanical Governing (Centrifugal Type)
Sensor response	Piezo Electric
Time sampling	4 micro seconds
Resolution crank	1 degree crank angle
Angle sensor	360 degree encoder with resolution of 1 degree
Compression ratio	17.5:1

Table 2: Engine Specification

Property	Unit	KOME	DIESEL
Calorific value	kj/kg	36470	42000
Ash Content	In %	0.084	0.07
Cetane number	--	42	50
Density	kg/m^3	900	830
Fire point	^{o}C	165	65
Flash point	^{o}C	160	57
Specific gravity	--	0.9	0.83
Viscosity	CST	6.93	5.0

Table 3: Properties of KOME

VI. Result and Discussion

A. Performance Characteristics

1) Variation of brake thermal efficiency with brake power

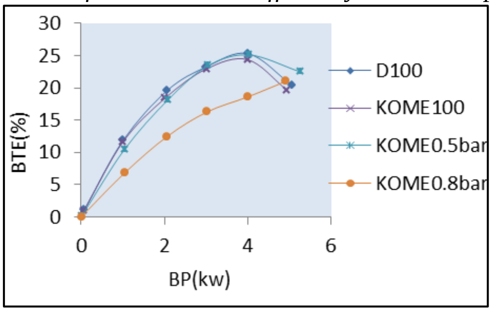

Fig. 3: Different Flow Rate of pressure between the brake power & brake thermal efficiency

The graph is drawn at different flow rate of pressure between the brake power & brake thermal efficiency from the results obtained it shows decrease in Brake thermal efficiency when the acetylene is inducted as secondary fuel.

The brake thermal efficiency for diesel and the KOME is 25.31% and 24.37% respectively at 4kw load. In dual fuel mode for KOME at different acetylene flow rates of pressure 0.5kg/cm^2 & 0.8kg/cm^2 the maximum thermal efficiency obtained is 23.76% at 4kw & 20.99% at full load. Due to wide flammability limit and high combustion rate of acetylene, with high loads & at different flow rate the brake thermal efficiency falls because of faster heat release and high diffusion rate. Dual fuel operation normally encounters the problem of low efficiency at part loads. This is because of the incomplete combustion of the inducted fuel and air. The use of fuels with wide flammability limits and high flame velocity can reduce this effect. The thermal efficiency of KOME is slightly nearer to baseline diesel, from the results the flow rate of 0.5kg/cm^2 of pressure is slight decrease in the thermal efficiency & for 0.8kg/cm^2 of pressure the thermal efficiency is very poor, since 0.5kg/cm^2 of acetylene flow rate is optimum.

2) Variation of Brake Specific Energy Consumption with Brake Power

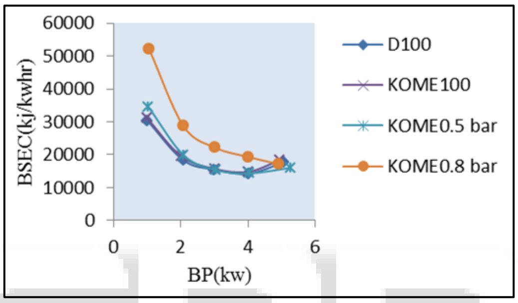

Fig. 4: Variation of Brake Specific Energy Consumption with Brake Power

The variation of exhaust gas temperature with brake power for different flow rate of acetylene with KOME is shown in figure. This graph shows that exhaust gas temperature of the acetylene blends are higher than the diesel fuel at full load, Exhaust temperature is a measure of combustion efficiency of an engine. Lower exhaust temperature is an indicator that complete combustion has taken place and converted energy from the fuel has been maximised into useful work.

The EGT of KOME is nearly equal to diesel. For KOME blend with acetylene at flow rate of pressure 0.5kg/cm^2,0.8kg/cm^2, from 0-2kw of load the EGT is high, for 3 & 4kw of load it is low i.e good combustion is achieved & at full load again high compared to diesel. The exhaust gas temperature variation depends upon the flash point temperature and the viscosity of the fuel. EGT for diesel (502.04 ºC) at 5.07kw, KOME(493.3 ºC) at 4.95kw of load. For different flow rate of acetylene at 0.5kg/cm^2, 0.8kg/cm^2. KOME (582.82 ºC at 5.26kw, 509.82 ºC at 4.91kw) respectively The exhaust gas temperature gives an indication the amount of waste heat going with exhaust gases. The exhaust gas temperature increased with increase in load, The reason for raise in the exhaust gas temperature may be due to ignition delay and increased quantity of fuel injected. The exhaust gas temperature can be reduced by adjusting the injection timing/injection pressure in to the diesel engine.

B. Combustion Characteristics

1) Variation of Pressure with Crank Angle

Figure shows the variation of cylinder pressure with crank angle. Acetylene has a very wide flammability range, and minimum ignition energy is required for ignition since the engine can run in lean mode with higher specific heat ratios leading to increased thermal efficiency. The maximum pressure is for diesel 69.9bar, KOME 70.54bar at 370^0 CA and different flow rate of acetylene for KOME at $0.5kg/cm^2$,$0.8kg/cm^2$ is 74.07, 73.78bar at 370^0CA respectively.

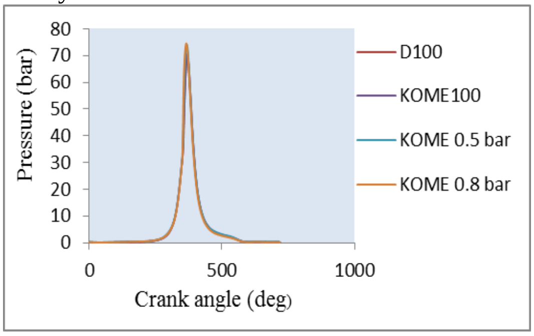

Fig. 5: Variation of Pressure with Crank Angle

The cylinder peak pressure is highest with KOME 0.5bar blend at crank angle 370^0 with cylinder pressure 74.07bar. it is observed that the occurrence of peak cylinder pressure run away with KOME 0.5 bar compared to diesel. The high pressure of is due to high EGT & uncontrolled combustion, heat release rate during the premixed combustion is responsible for the cylinder peak pressure.

2) Variation of Net Heat Release Rate with Crank Angle

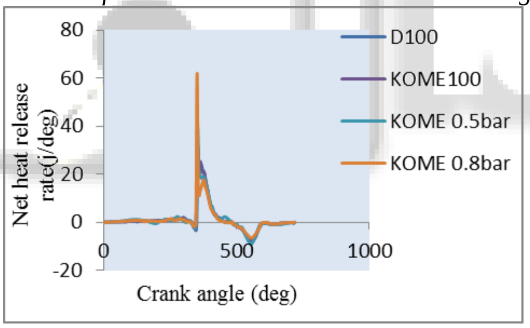

Fig. 6: Variation of Net Heat Release Rate with Crank Angle

Figure shows the variation of net heat release rate with crank angle. The net heat release for diesel is 31.38j/deg at 355^0 CA & KOME is 25.34j/deg at 364deg the flow rate of acetylene, for KOME 0.5bar is 39.48j/deg at 356^0 CA, KOME0.8 bar is 61.88j/deg at 354^0. It can be observed that net heat release rate is high for KOME0.8 bar at 354^0 CA, biodiesel fuel experiences the rapid premixed combustion followed by diffusion combustion. The premixed fuel burns rapidly and releases the maximum amount heat followed by the controlled heat release. With acetylene induction the NHRR is high compared to diesel due to wide flammability limit & higher combustion rate of acetylene. The heat release rate during the premixed and uncontrolled combustion is responsible.

3) Variation of Cumulative Heat Release V/S Crank Angle

Figure shows the variation of cumulative heat release with respect to crank angle. The cumulative heat release rate is low in the beginning, increases exponentially and shows down at the end. In general, the availability of oxygen in the biodiesel fuel itself increases the combustion and thus increases the net heat release. In this investigation, the acetylene gas which is highly combustible, and produces a very hot flame (over 3000°C or 5400°F) when combined with oxygen. the cumulative heat release for diesel is 1.3kj, KOME is 1.3kj at 478^0 CA. for KOME 0.5bar, KOME 0.8bar is 1.33, 1.19kj at 478^0 CA respectively. the acetylene flow rate with KOME have low heat release at 0.8bar & at 0.5bar it is slightly nearer to diesel, this shows combustion is good & KOME with 0.5bar is optimum.

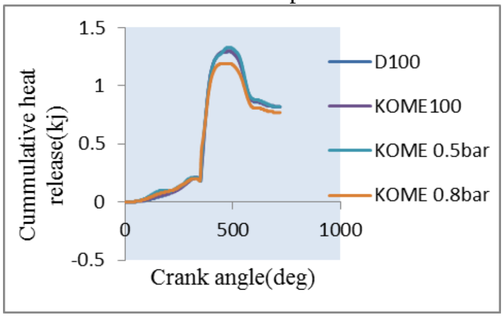

Fig. 7: Variation of cumulative heat release with respect to crank angle

4) Variation of Mass Fraction Burned with Crank Angle

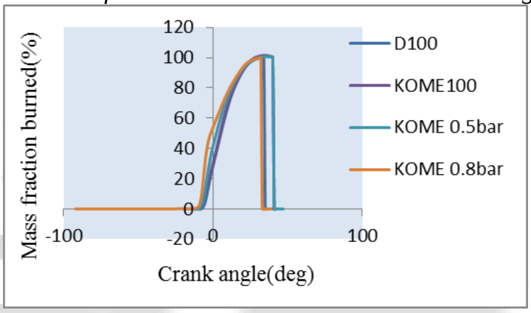

Fig. 8: variation of mass fraction burned with crank angle for diesel, biodiesel

The figure shows the variation of mass fraction burned with crank angle for diesel, biodiesel at different flow rate of acetylene, in pure diesel the mass fraction burned is about 100% at crank angle of 34deg. for KOME 101.51 at 34deg & for different acetylene flow rate, KOME 0.5bar is 100.59 at 35^0, 0.8bar is 99.94 at 32^0 respectively. Higher mass fraction burned by acetylene due to higher flame speed and hence faster energy release. High self-ignition temperature of acetylene allows larger compression ratios, also due to high viscosity & lower calorific value than diesel engines. It is observed from the result the mass fraction burned with acetylene is relatively higher than that of diesel.

C. Emission Characteristics

1) Variation of Carbon Monoxide with Brake Power

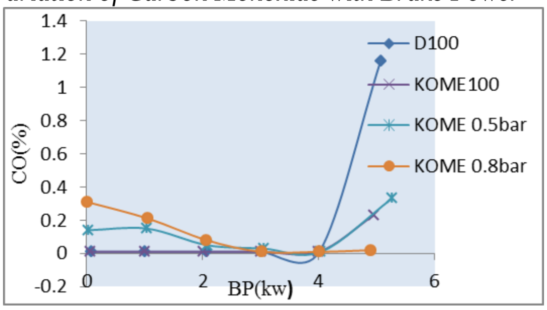

Fig. 9: Variation of carbon monoxide with brake power

The fig above shows the variation of CO emissions with BP for KOME at a different flow rate of acetylene. The formation of CO takes place when the oxygen present during combustion is insufficient to form CO_2. Carbon monoxide emissions occur due to the incomplete combustion of fuel. The emissions of carbon monoxide are toxic. The emission for diesel (1.16%) & KOME (0.23%) at full load condition. At zero load both have the same emissions i.e. (0.01%), This shows that reduction in CO emission by KOME, when acetylene is inducted at 0.5bar & 0.8bar the CO emissions for KOME (0.33%, 0.02%) at full load. the KOME with different blend have higher emissions in zero load & when the load on blend increases, CO emissions decreases at full load condition compared to diesel. The decrease in CO emission may be due to the cylinder heat transfer reduction, increase in combustion duration and more oxygen content present in the biodiesel. It is also observed that the carbon monoxide emission increase as the fuel air ratio becomes greater than the stoichiometric value.

2) *Variation of carbon dioxide with brake power*

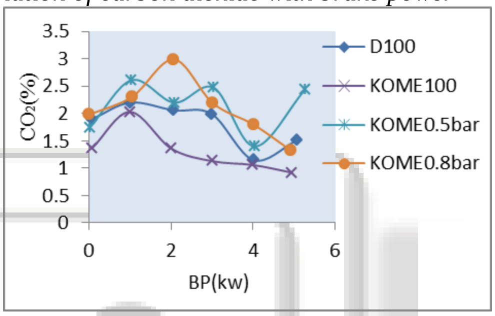

Fig. 10: Variation of carbon dioxide with brake power

shows the variation of carbon dioxide emission with BP at different flow rate of acetylene with KOME, The CO_2 emissions at full load are diesel(1.51%), KOME(0.92%) & KOME(2.43%, 1.33%) at the flow rate of 0.5bar, 0.8bar respectively. From the acetylene flow rate the CO_2 emission for KOME are high at full load compared to diesel. increase in CO_2 emission is due to complete combustion of the fuels, higher combustion temperature and there by reduction in cylinder heat transfer.

3) *Variation of Hydrocarbon Emissions with Brake Power*

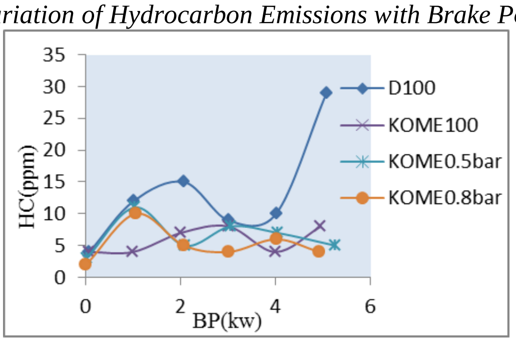

Fig. 11: Variation of Hydrocarbon Emissions with Brake Power

The variation of HC emission with BP is an important parameter for determining emission behaviour of the engines. Figure shows the variation of HC emission for different flow rate of acetylene with KOME It is observed that HC emission of the various blends was lower than diesel, As a result of oxygen present in the biodiesel, the oxygen availability during the combustion process increases and results in better combustion which releases low HC compared to diesel It is also observed from the Figure that, the HC emission for diesel (29ppm), KOME (8ppm) & KOME (5ppm, 4ppm) at flow rate of 0.5bar, 0.8bar respectively at full load.

4) *Variation of nitrogen oxide emissions with brake power*

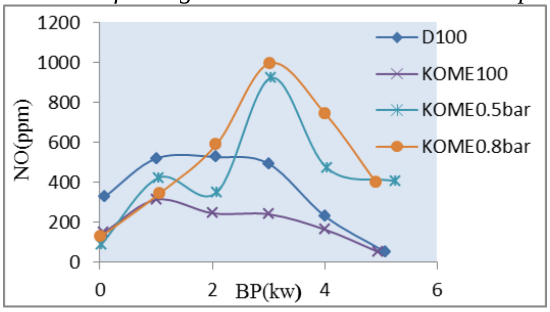

Fig. 11: Variation of nitrogen oxide emissions with brake power

The variation of NO_X with BP is also an important parameter for determining emission to protect the environment & also the human being, NO_x is one of the main emissions in diesel engine. The Oxides of nitrogen (NO_x) formation is highly depends on gas temperature inside cylinder and availability of oxygen. Three conditions which favour NO_x formation are higher combustion temperature, more oxygen content and faster reaction rate.

The NO_X emission for diesel (54ppm), KOME (53ppm) & for the different flow rates of acetylene, KOME (407ppm, 401ppm) at 0.5bar, 0.8bar respectively at full load. It is observed from figure, the emissions found higher by introducing acetylene than that of pure diesel. NO_x emissions are extremely undesirable. NO_x is more likely to cause respiratory problems such as asthma, coughing, etc.

VII. Conclusion

The performance, combustion and emission characteristics of a single cylinder, four stroke, air-cooled, direct injection diesel engine having a power output of 5.2 kW, at compression ratio 17.5:1, at a constant speed of 1500 rpm, fueled with diesel, KOME & acetylene at different flow rate of pressure were analyzed and compared with diesel operation of the same engine.

The conclusions are given below.

- Brake thermal efficiency in dual fuel mode is lower than diesel operation for KOME-0.8bar and for KOME-0.5bar it is slightly nearer to diesel at 4kw load, as a result of continuous induction of acetylene in the intake.
- BSEC is decreases with increase in engine load, for KOME-0.5bar the energy consumption is less than diesel(i.e diesel at 5.07kw is 17652kj/kw.hr, KOME-0.5bar at 5.26kw is 16008kj/kw.hr) and for KOME-0.8bar at 4.91kw is 17149kj/kw.hr it is nearer to diesel
- The EGT of KOME is nearly equal to diesel. for KOME blend with acetylene at flow rate of pressure 0.5kg/cm^2,0.8kg/cm^2, From 0-2kw of load the EGT is high, for 3 & 4kw of load it is low i.e good combustion is achieved & at full load again high compared to diesel. EGT for diesel(502.04 ºC) at 5.07kw, KOME(493.3 ºC) at 4.95kw of load. For different flow rate of acetylene at 0.5kg/cm^2 & 0.8kg/cm^2, KOME (582.82 ºC at 5.26kw & 509.82 ºC at 4.91kw) respectively

- The peak cylinder pressure increases with increase in the induction flow rate of acetylene with KOME at different flow rates of acetylene. The peak cylinder pressure for acetylene induction of 0.5kg/cm^2, 0.8 kg/cm^2 at compression ratio 17.5:1 is 74.07bar, 73.78bar at 370^0 CA and it is highest among that of all induction flow rates & the base line diesel operation.
- Dual fuel operation of acetylene exhibits higher exhaust gas temperature about 2 to 8% at full load as compared to diesel operation.
- For KOME-acetylene at 0.8bar the variation of net heat release rate is high with crank angle i.e 61.88j/deg at 354deg compared to the pure diesel i.e 31.38j/deg at 355deg
- The acetylene blend reduces in CO & HC emissions compared to diesel.

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