Review Paper on Performance and Exhaust Gas Analysis of Agricultural Diesel Engine by Using Neem Oil and CNG-A Comparative Analysis

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Abstract—*In the time of oil crisis urgent need for alternate fuel is necessary, vegetable oil and CNG both can be seen as a future alternate fuels. Vegetable oil is a renewable source and heat release rate is similar to diesel and also its emissions rate is relatively low. CNG produces less emissions compare to conventional fuels. Biodiesel, derived from the transesterification of vegetable oils or animal fats, is composed of saturated and unsaturated long-chain fatty acid alkyl esters. In spite of having some application problems, recently it is being considered as one of the most promising alternative fuels in internal combustion engine. Existing diesel engines are under stringent emission regulation particularly of smoke and particulate matter in their exhaust. Compressed Natural Gas and Diesel dual fuel operation is regarded as one of the best ways to control emissions from diesel engines and simultaneously saving petroleum based diesel fuel. This paper collects experimentally investigated records and results of engine performance parameters like brake specific fuel consumption, thermal efficiency and emission parameters like HC, CO, NOX of diesel engine with biodiesel and CNG compared to conventional diesel.*

Keywords: - Diesel engine, Biodiesel, CNG, Engine performance, Emission

I. Introduction

In the modern world, non-renewable energy source such as oil, coal and natural gas has limited resources that are expected to end in near future. The increasing demand for petroleum based fuels has led to oil crisis and fuel price hike in recent times. India is a country, which is facing highest fuel price hike and projections show that over 2011-2025; demand for crude oil is likely to increase by about 90 percent under likely future growth scenarios.[11] Another concern is carbon footprint which is constantly increasing in India. Therefore; there is an urgent need of suitable alternative fuel for use in diesel engines. In view of this, vegetable oil like Neem oil, Jatropha oil, Sunflower oil is considered as alternate fuels. Compressed natural gas can also be considered as clean and non-polluting alternate gaseous fuel in internal combustion engine. Biodiesel derived from the esterified vegetable oil appears to be the most promising fuel for diesel engine due to following reasons.

- Biodiesel can be used in existing engine without any modifications.
- Biodiesel obtained from vegetable sources does not contain any sulphur, aromatic Hydrocarbons, metals or crude oil residues.
- Biodiesel is oxygenated fuel; emissions of carbon monoxide and soot tend to reduce.
- The use of biodiesel extends the life of diesel engines because it is more lubricating than the diesel fuel.

Neem (Azadirachta indica) is a tree in the mahogany family Meliaceae which is abundantly grown in varied parts of India. The Neem grows on almost all types of soils including clayey, saline and alkaline conditions. Neem seed obtained from this tree are collected, de-pulped, sun dried and crushed for oil extraction. The seeds have 45% oil which has high potential for the production of biodiesel.The advantages of Neem oil is eco-friendly and can be produced easily in rural areas. If Neem oil serve the purpose of the diesel to some extent it will be useful in rural area for agricultural energy needs.

Natural gas is produced from gas wells or tied in With crude oil production. Natural gas (NG) is made up primarily of methane (CH4) but frequently contains trace amounts of ethane, propane, nitrogen, helium, carbon dioxide, hydrogen sulphide, and water vapour. Methane is the principal component of natural gas. Normally more than 90% of natural gas is methane. Natural gas can be compressed, so it can stored and used as compressed natural gas (CNG).CNG requires a much larger volume to store the same mass of natural gas and the use of very high pressure on about 200 bar. Natural gas is safer in many respects. The ignition temperature for natural gas is higher than gasoline and diesel fuel. Additionally, natural gas is lighter than air and will dissipate upward rapidly if a rupture occurs. Gasoline and diesel will pool on the ground, increasing the danger of fire. [10] Compressed natural gas is a largely available form of fossil energy and therefore non-renewable. CNG has some advantages compared to gasoline and diesel from an environmental perspective. It is a cleaner fuel than either gasoline or diesel as far as emissions are concerned. Compressed Natural Gas (CNG) is attractive for following reasons.

- It is cheaper than gasoline or diesel fuel.
- It has inherently low air pollutions.
- Its use extends petroleum supplies.
- It is easily available.

II. Literature Survey

Mohamed Y.E. Selim, M.S. Radwan and H.E. Saleh used jojoba methyl ester (JME) as a pilot fuel in dual fuel engine running on a natural gas or liquefied petroleum gas (LPG) at part load. In this experiment they evaluated in their performance test, the new fuel derived from jojoba proved to be promising as diesel engine and dual engine fuel in terms of its properties. The Cetane number of the jojoba fuel

is higher than that for diesel fuel which affected the combustion process positively. The maximum pressure rise rate generally decreases as the engine speed and the mass of pilot fuel increase the carbon monoxide and HCs are highest for JME/LPG case followed by JME/CNG, then Diesel/LPG and minimum for diesel/CNG case. [1]

S. Naga Sarada, M.Shailaja, A.V Sita Rama Raju and K. Kalyani Radha used cotton seed oilin asingle cylinder direct injection type, 4 stroke, water cooled vertical diesel engine and they evaluated in their performance test, Quieter operation of the engine is observed when cotton seed oil is used as fuel. Performance of engine with cotton seed oil as fuel is better at an IP of 210 bars. An increase in the Brake thermal efficiency from 25.02% to 28.02% was observed with increase in injection pressure from 180bar to 210 bar; due to better atomization and improved combustion of the fuel. HC emissions are lowered from 1720 ppm to 1480 ppm. [2]

R.Senthia, M. Kanna, A. Santhoshkumar and P. Lawrence used palm oil in a four stroke, single cylinder, water cooled, direct injection diesel engine and evaluated in their performance test, Biodiesel blends produce lower brake thermal efficiency and higher specific fuel consumption than diesel because of the low calorific value. Biodiesel produces higher oxides of nitrogen than diesel because of the higher temperature inside the combustion chamber. However at full load biodiesel produce less HC and CO compare to neat diesel. S. [3]

S. Ghosh and D. Dutta used pongomia oil in a four stroke, water cooled, single cylinder, direct injection diesel engine and evaluated in their performance test, At full load condition brake thermal efficiency of the biodiesel blends were marginally lower than the neat diesel fuel Specific fuel consumption for B25 blend was close to neat diesel fuel at full load condition. There was 4% reduction of CO emission of B25 than neat diesel at full load condition and 2% reduction of NOx of B25 blend than neat diesel at full load condition. [4]

Lohith.N, Dr. R.Suresh and Yathish.K.V used Karanja Oil and blends of Karanja Methyl Esters with diesel in a single cylinder, 4-stroke, water-cooled diesel engine and evaluated in their performance test, The existing diesel engine performs satisfactorily on biodiesel fuel without any significant engine modifications. Engine performance with biodiesel does not differ greatly from that of diesel fuel. The B20 shows good brake thermal efficiency in comparison with diesel. A little increase in fuel consumption is often encountered due to the lower calorific value of the biodiesel. Most of the major exhaust pollutants such as CO, CO2 and HC are reduced with the use of neat biodiesel and the blend as compared to neat diesel. [5]

G.Sucharitha and A.Kumaraswamy used Neem Oil and Neem Oil Methyl Ester in a single cylinder 4-stroke water-cooled diesel engine and they evaluated in their performance test, at normal temperature and full load The break thermal efficiency of Neem oil is 24.9%, Neem oil ester is 26.39% and that of diesel is 31.4% .When Neem oil operating with fuel temperature at 160°C the brake thermal efficiency obtained is 29.1% which is very near to diesel brake thermal efficiency. The smoke number of Neem oil is 4.1 BSU, Neem oil ester is 3.6 BSU and diesel is 2.8 BSU. When Neem oil operating with fuel temperature at 160°C the smoke number of Neem oil is 3.1 BSU.So reduced emission.[6]

Ranbir Singh and Sagar Maji used single cylinder, four-stroke variable compression ratio, direct injection diesel engine and converted it to CNG-Diesel dual fuel mode to analyze the performance and emission characteristics of pure diesel first and then CNG-Diesel dual fuel mode. In this experiment they evaluated in their performance test, For the two CNG substitution rates of 30% and 60%, brake thermal efficiency of dual fuel engine is more than that of pure diesel operation from no load to full load and BSFC with 30%CNG dual fuel mode is less than pure diesel mode by 59.49%, 69.04%, 57.14%, 61.54% at 1, 2, 3 and 3.5kW engine loads respectively at compression ratio of 15. The same trend is observed for 60% CNG substitution rate. CO emissions for 30% and 60% CNG substitution rates are lower than pure diesel mode in the range of 33.3%-61.9% for different engine loads. HC emissions are lesser for dual fuel mode than pure diesel mode by 14.55% at 1kW load and by 18.30% at 3.5kW load and by 28.16% at 1kW load and by 30.72% at 3.5kW load for 30% and 60% CNG substitution rates. In dual fuel mode NOX emissions are drastically reduced by 12.5% and 18.75% at low loads for 30% CNG and by 42.36% and 76.94% at high engine loads for 60%CNG. [7]

E. Ramjee, K. Vijaya Kumar Reddy and J. Suresh Kumar used a single-cylinder, 4-Stroke, water-cooled, vertical, stationary diesel engine of 3.7 kW rated power. Engine is tested for performance and emission parameters by using compressed natural gas (CNG) for the following conditions. (i) At constant speed by varying injection pressure and load (ii) Dual fuel combustion phenomenon. In this experiment they evaluated in their performance test, the Brake Thermal Efficiency is decreased with increase in Brake Power, when the engine is operated beyond 75.67% rated load. Prior to 75.67% load the Brake Thermal Efficiency is also increased with increase in Brake Power.The emissions of NOX is increased with increase in brake power for both (diesel and dual) the fuels at all injection pressures. The un-burnt hydro carbons are increased with increase in brake power for both (diesel + dual) fuels. [8]

III. CONCLUSION

From the above review it is concluded that the blend of Neem oil and diesel and preheated Neem oil improve engine performance and emission characteristics. The Neem oil has an ability to use as a blending. The properties of Neem oil are Calorific Value 35,125kj/kg,Flash point 178°c, Viscosity 1,864 poise, Density 928 kg/m3,and CNG can be used as a CNG/diesel dual fuel mode with different CNG substitution rates for improve engine performance and emission characteristics.

REFERENCES

[1] Mohamed Y.E. Selima, M.S. Radwanb, H.E. Sale "Improving the Performance of Dual Fuel Engines Running On Natural Gas/LPG by Using Pilot Fuel Derived From Jojoba Seeds", 2008

[2] S.Naga Sarada, M.Shailaja, A.V Sita Rama Raju, K.Kalyani Radha"Optimization of Injection Pressure For a Compression Ignition Engine with Cotton Seed Oil as an Alternate Fuel", 2010.
[3] B. Deepanraj, C. Dhanesha, R. Senthia, M. Kannaa, P. Lawrence "Use of Palm oil Biodiesel Blends as a Fuel for Compression Ignition Engine", 2011.
[4] S. Ghosha, D. Dutta b "Performance and Exhaust Emission Analysis of Direct Injection Diesel Engine using Pongamia Oil." 2012.
[5] Lohith.A,Dr.R.Suresh,Yathish.K.V"Experimental Investigation of Compressed Ignition Engine Using Karanja Oil Methyl Ester (KOME) as Alternative Fuel." 2012.