Experimental Investigations On Performance Of A LPG Gas-Diesel Dual Fuel C I Engine

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Abstract - The CI engine was modified to run on the dual-fuel mode, using diesel as the pilot fuel and LPG gas as the main fuel. For this purpose, a separate air –LPG gas mixing junction has been incorporated on the intake side of the engine. The quantity of diesel fuel injected is also altered in proportion to LPG gas inducted, for the same power output for given operating conditions of the engine. The experiments have been conducted on the dual-fuel mode with diesel - LPG gas. The experiments conducted to compare the performance and emissions of the dual fuel engine with different combinations of diesel and LPG gas at No Load, 25%, 50%, 75% and Full engine loads. All the experiments have been carried out under the same operating °conditions at 1500 rpm speed, keeping the fuel injection timing constant at 280 BTDC. Experimental results indicated that, amongst the dual fuel combinations considered, the combination of fossil diesel and LPG gas observed to have more brake thermal efficiency at all engine operating conditions and at all fuel s considered. Dual fuel combination of fossil diesel and LPG gas on the engine observed to have higher exhaust gas temperature at all engine operating conditions. The CO emission level is high in all cases of dual fuel modes of operation. the HC emission is less compared to that of other modes of operation. The dual fuel combination of fossil diesel and LPG gas generates lesser NOx emissions compared to that of all other dual fuel combinations considered at all engine operating conditions. Smoke density is found to be reduced for all dual fuel operations compared to that of fossil diesel mode. It is also found that the smoke density is decreased with for all modes of operation.

Keywords: LPG, Diesel, Emission, Performances

I. INTRODUCTION

Demands of petroleum-based fuels are Increasing industrialization and motorization of the world. These fuels are obtained from certain regions of the world are highly concentrated due to limited reserves. Countries which do not have these resources are facing foreign exchange and energy crisis, because of the import of the crude petroleum oil. Urgent needs are crude petroleum oil demanding to carry alternative fuels for I.C. Engines due to Fast depletion of fossil fuels. Environmental degradation and fossil fuel depletion are presently confronted with the twin crisis. Lavish consumption of fossil fuels and indiscriminate extraction leads to reduction in underground-based carbon resources. Alternative fuels which promise energy conservation, environmental preservation, efficiency and sustainable development are become highly prominent for search. Industrialization and modernization of the world, led demand for the petroleum based fuels every year in the consumption, steep to raise any strategic plan for economic development and energy security of a nation. Developed countries are solely depend on their oil requirements to meet today imports due to their limited reserves of petroleum deposits get exhausted. India is imports 80 % of the required fuel by spending 30 % of its total foreign exchange earnings on oil imports. Indian automotive industry are grow at 13 % per annum, imports of fuel cause serious economic consequences in the form of budget deficit due to 1.6 % energy demand and fossils fuel account for more than 80 % of the average annual growth rate. A finite resource of petroleum concentrated in certain regions of the world, creates uncertainties and disruptions in its supply because of limited reserves stock of oil. Combustion of fossil fuel continually LPGs harmful toxic emissions and air pollution into the atmosphere. Due to these disastrous effects alternative fuels are identified in the past and performed successfully in the existing engines with and without engine modification in the intake system, still research is going on to find out the best alternative fuel for the existing IC engine. Many researchers suggested various alternative fuels, each one has one or few undesirable compositional fuel characteristics, need to change

modification with existing engine system. Which are prevents the complete substitution of alternative fuel in the place of existing one, which are promise a harmonious correlation with sustainable development, energy conservation, efficiency and environmental preservation caused by their combustion inside the combustion chamber. Many researchers are proved that the identified biofuels as an alternative fuels are partial substitute for the existing fuels due to their undesirable fuel characteristics. However, the various fuel intake techniques experimented are giving good solution to apply larger fraction of alternative fuel in the existing engines with blend or without blending of petroleum fuel. Alternative fuels are divided into two categories one is as mineral based oils and other biological based oils. The mineral based alternative fuels are non renewable type, but biological based fuels are renewable and ecofriendly type. Biofuels which are formed on biological based has having similar properties with the petroleum fuels promising best alternative fuels. Biofuels are derived from plants and trees, plants and trees are consisting of two types of oils namely triglyceride oil (TG oils) and terpene oil (light oil). Triglyceride oils (TG) are obtained from the plant seeds and terpene oils (essential oils or light oils) are obtained from all parts of the plant. The TG oils are highly viscous (10 to 20 times greater than diesel fuel) and less available when compared to terpene oils. Terpene oils are largely available in some plant species like eucalyptus tree, pine tree etc. International Energy Agency (IEA) expects that India will become emitter of green house gas by 2020,the fourth largest importer of the oil in the world by 2025 and third largest energy-consuming nation in the world by 2030, behind the United States, China and Japan.

Conventional fossil fuels resources are depleting at an alarming rate. And extensive usage of conventional fuels is also leading to the environmental problems like pollution, global warming and carbon trading. To mitigate associated problems lot of research work is in progress to find the alternate fuels. Many of such research works suggested a shift in usage of fuels from liquid fuels to gaseous fuels. Use of gaseous fuels is one of the prominent approaches, since gaseous fuels are abundantly available and clean burning fuels. They also reduce the menace of environmental pollution. Gaseous fuels have been in use in fully dedicated mode as well as in the dual-fuel mode. Dual-fuel mode of operation calls for minimal alterations in the engine and is proved to be more effective. Diesel-CNG and Diesel-LPG engines are widely used in various applications. But gaseous fuels like CNG, LPG are also under the threat of rapid depletion along with other conventional fuels derived from fossil fuels. In the present scenario of fuel crisis LPG is one of the promising technology, as the LPG is also compatible to the existing technology. India has a large potential for renewable energy, about an estimated aggregate of over 100,000MW. In addition, the scope for generating power and thermal applications using solar energy is huge. However, only a fraction of the aggregate potential in renewable energy resources has been utilized so far. LPG as a source of Energy is most important in view of its sustainability as well as economic viability in respect of its use both for rural electrification and Industrial application. In this chapter, some of the important research papers related to diesel engines, gas engines and dual-fuel engines performance under various operating conditions and emissions are reviewed.

II. ENGINE SPECIFICATION AND MODIFICATION

Introduction

To use LPG in Diesel engine we have to make some modification to the Diesel engine. We to install LPG kit on the engine.

The engine used for the investigation was double cylinder, water cooled Diesel engine and the LPG kit used was of Lovato Company.

Engine Specifications

1. No. of cylinder – 2
2. Cooling system – water cooled
3. Bore diameter – 80mm
4. Stroke length – 110mm
5. Maximum BHP – 10BHP
6. D.C. Generator- 7.5 kW

Engine Modification

LPG is very useful but it is difficult to use as a fuel for CI engine. Since LPG have very low cetane number it can be used in two ways as an alternative fuel for CI engine.

1. By increasing cetane number

2. By modification of engine.

Here the main modification to the diesel engine was the introduction of nozzle in the intake manifold system and the LPG kit was mounted on it.

LPG kit

Figure No.1

This LPG kit is used in auto-rickshaws, which is mounted on the engine. The LPG kit used for this experiment is of Lovato Company, and high pressure regulator was used. Gas vaporizer, LPG cylinder and nozzle were connected by hose pipe. The nozzle was introduced in the intake manifold.LPG was introduced in the intake manifold where LPG was mixed with air.

III. EXPERIMENTAL SETUP

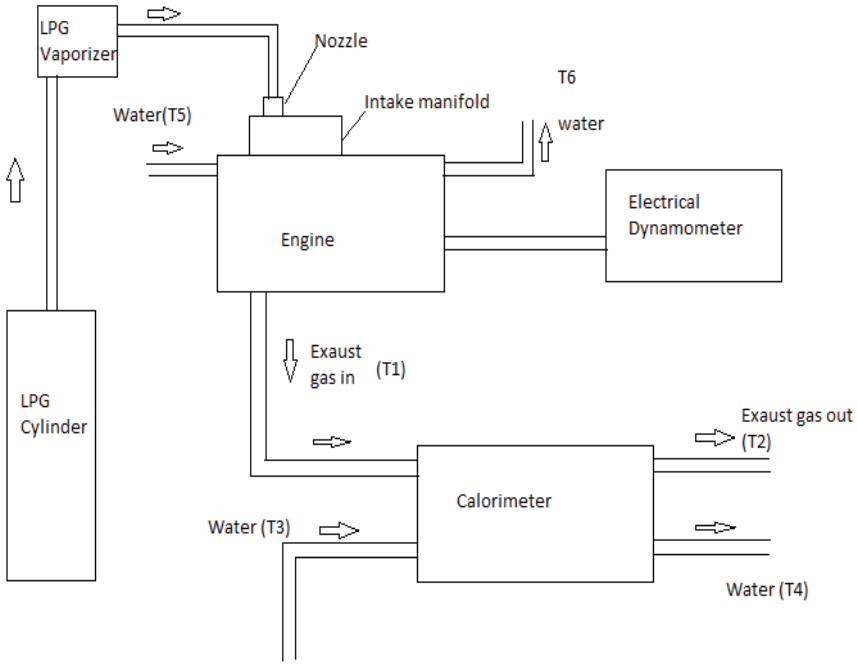

Figure No.2

The experimental setup consists of a double cylinder, four strokes, direct injection, and water-cooled diesel engine coupled to governor for loading of the engine were used for experiment. It is provided with necessary instruments for measuring air flow rate, fuel flow rate, various temperatures and engine load. The engine was modified to work in the dual fuel mode by introducing nozzle in intake manifold which was connected to LPG kit. A digital type platform weighing machine having an accuracy of three digits was used to measure the LPG fuel flow by weight difference method. Air flows rate are controlled with a manually operated valve installed on the pipe system before air mixing tee. As the LPG gas and exhaust gas contain harmful gases the whole set up is arranged in a well ventilated room. The air flow line is kept open to atmosphere through a control valve. The engine sucks both air and gas simultaneously, the gas and air ratio can be controlled by operating the air control valve. The LPG gas passes through the security filter before air mixing tee so that any possible residual particulate matter is held back preventing possible deposition at the valve seating condition. The dual fuel operations are aimed to reducing the diesel consumption at any fixed load. This is controlled by the governor fitted on the engine. In dual-fuel mode of operation, the diesel replacement is achieved by reducing the air flow into the engine by controlling the air control valve. The engine runs in a specific flow rate through the air inlet manifold. Hence the sum of air and LPG gas flow rate is constant and when air flow is decreased the LPG gas flows through the system is also increases. This increases the contribution of energy from the LPG gas. Hence, the engine governor comes into operation and cuts down the diesel to maintain the speed. Reducing the air flow rate will reduce the diesel flow only as long as the gas air mixture remains lean. If the mixture becomes richer, the engine stalls. Therefore, one has to keep away from such a condition.

IV. CONCLUSION

Comparison of Diesel mode and with Dual-Fuel Mode of operation by varying loads at constant speed. In this phase of experiments, the engine test rig is attached with LPG cylinder. Experiments has been conducted on Fossil Diesel (FD) mode and on dual-fuel mode i.e. Fossil Diesel and LPG Gas (FD+LPG), in which, keeping the fuel injection timing fixed. The fuel injection pressures selected are 180 bars. The effect of varying loads at constant speed on the engine performance and emissions characteristics are investigated at different engine loads. The summary of the outcome is as following.

The brake thermal efficiency is increased with increase in load for diesel alone mode of operation and for all combinations of dual fuel operation. At all engine loads viz., 25%, 50%, 75% and full load, the brake thermal efficiency of the engine on fossil diesel alone mode is higher compared to all dual fuel modes viz., FD+LPG babul mode, FD+LPG mode and FD+LPG. The brake thermal efficiency increased with increase at all engine operating conditions on dual fuel (FD+LPG) mode. The exhaust gas temperature of fossil diesel (FD) is decreased drastically compared to the all dual fuel operations. The exhaust gas temperature is high for fuel at all engine operating conditions for fossil diesel (FD) alone mode of operation. The exhaust gases all engine operating conditions for dual fuel (FD+LPG) mode. The exhaust gas temperature is high. In fossil diesel (FD) mode, the CO emissions at different fuel s show insignificant change up to 75% engine load. At full load the CO emission is high In dual fuel (FD+LPG babul) mode, the CO emissions the CO emissions are increased up to 50% engine load, then decreased up to 75% load and then increased at full load conditions. The HC emissions decreased with in dual fuel (FD+LPG) mode. Similar trend of slight decrease in HC emissions are increase in fuel in fossil diesel (FD) mode. There is insignificant change in NOx emissions with In dual fuel (FD+LPG babul) mode, there is insignificant change in NOx emissions with change in fuel . Similar insignificant change in NOx emissions are observed in case of dual fuel modes of FD+LPG mango and FD+LPG However the NOx emissions are increased with engine load for all In fossil diesel (FD) mode, the smoke density decreased with increase dual fuel (FD+LPG babul) mode at all engine operating conditions. Less smoke density is observed at fuel for dual fuel FD+LPG modes of operations compared to fossil diesel fuel. However from no load condition to 25% engine load, the smoke density increased with engine load after 25% engine load up to full load. The brake thermal efficiency is higher in fossil diesel (FD) mode compared to all dual fuel (FD+LPG) modes. At all engine operating conditions break thermal efficiency of dual fuels is less. In dual fuel (FD+LPG mango) mode is having low brake thermal efficiency. At all operating conditions the exhaust gas temperature with fossil diesel (FD) mode is lesser compared to all dual fuel (FD+LPG) mode of operations. Among all dual fuel combinations, at all operating conditions the exhaust gas temperature with fossil diesel (FD) mode is higher compared to all dual fuel (FD+LPG) modes of operations.

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