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Performance and Emission Characteristics of a Diesel-LPG Duel Fuel in Greeves Engine

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Abstract

The main perspective of this paper is to analysis the performance and emission of the diesel engine where diesel is used as primary fuel and LPG is used as subsidiary fuel. In this LPG is attached to the inlet manifold of the engine in which LPG combines with the molecules of oxygen and it barges into the combustion chamber of the engine. Inside this combustion chamber, diesel is injected by an injector during the end of the compression stroke, after this atomization of the fuel takes place eloquently. By this immediately after the combustion of the fuel, heavy loads of power is produced inside the combustion chamber and this is followed by the liberation of exhaust gases such as Hydrocarbon (HC), Nitric oxide (NO_x), Carbon monoxide (CO), Carbon dioxide (Co_2), Oxygen (O_2) etc., As a result of this experiment the emission and the specific fuel consumption of the engine was reduced and brake thermal efficiency was increased. Thus this experiment shows that using LPG as an additive fuel with diesel which is an injecting fuel will increase the efficiency with respect to the traditional diesel fuel operation mode in the diesel engine.

Keywords: *Diesel, fossil fuels, TDC, BDC, Nitric oxide*

INTRODUCTION

We know that most of our earth is comprised of natural resources which are classified as renewable and non-renewable resources such as solar energy ,wind energy, tidal energy, fossil fuels etc., From this most of the automobile fuels like petrol, diesel, LPG, kerosene etc., are obtained from fossil fuels. Awareness about fossil fuels is increasing day by day due to high fuel cost, lack of fuel in the earth [1-3]. This leads to creation of alternative fuel sources in IC engines. In this experiment dual fuel engine is used where diesel is used as an elementary fuel and LPG (Liquefied Petroleum Gas) is used as a subsidiary fuel to check whether this will reduce the emission of pollutants with increase in brake thermal efficiency and reduce the specific fuel consumption [9]. In this experiment, LPG which is in the LPG tank is sent into the inlet manifold at a rate of 0.25 kg/hr using LPG valve with the help of pressure regulator. LPG combines with the molecule of oxygen in the LPG valve in a suitable ratio and then barges into the dual fuel engine. After this, atomization of LPG and molecules of oxygen along with diesel takes place. Diesel from the diesel tank is sent into the injector via the pump, pressure regulator etc., and then diesel from the injector is injected into the engine. This atomization leads to release of exhaust gases and heavy loads of power. Exhaust gases are sent out through the exhaust valve. A gas analyzer is used to measure the amount of exhaust gases let out to the surrounding and to know whether this dual fuel engine is fit for the surroundings. The power produced in the engine is used for the motion of the vehicle. The perspective of this work is to check the performance and emission of a

dual fuel engine with the help of modified IC engine to work with LPG and diesel and the gas analyzer. The result of this work shows that the engine performance with this alternative fuel was good compared to the diesel engine and this is shown by the plotted graph below for the brake thermal efficiency (which is the correct heat to the mechanical energy in the engine for the vehicle motion), specific fuel consumption and for the exhaust gases such as Hydrocarbon(HC), Nitric oxide (NO_x), Carbon monoxide (CO), Carbon dioxide (CO_2), Oxygen(O_2) etc., Thus this dual engine is better than diesel engine for locomotive purpose and other purpose.

Line Diagram

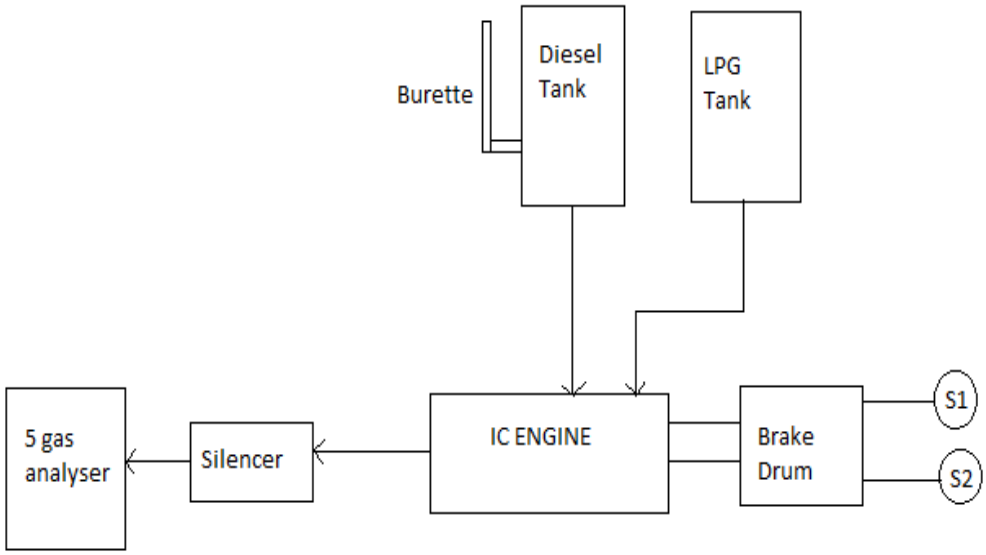

Fig: 1. *Engine Setup*

Table: 1. *Engine Specification*

Engine	**Kirloskor**
Injector type	Direct injection
Engine type	Single Cylinder, Four-Stroke, Compression Ignition Diesel Engine
Compression ratio	17.5:1
Injection timing	23deg before TDC
Method of cooling	Water cooling
Rated speed	1500 rpm
Stroke length	110mm
Bore	87.5 mm

Experimental Setup

The experimental setup consist of

1) Modified CI engine to work with LPG and Diesel.
2) Rope brake dynamometer to measure brake power.
3) Burette to measure diesel consumption .
4) Weighing scale to measure LPG consumption.
5) Five gas analyzer to analyze exhaust gas.

WORKING

An engine which operates on a dual cycle with a slightly additional graded performance and emission. This dual cycle

comprises of following operations: suction (process 0-1), isothermal compression (process 1-2), constant volume heat addition (process 2-3), constant pressure heat addition (process 3-4), isothermal expansion and constant volume heat rejection (process 5-1). The two fuels used in dual fuel engine are diesel and LPG. LPG in the LPG tank is sent to the inlet manifold at correct rate with the help of pressure regulator through the LPG valve. This LPG sent to the inlet manifold combines with the molecules of oxygen at suitable ratio. When this LPG and molecules of oxygen mixture get into the inlet valve it will be sucked by the piston inside the engine, where the piston moves from Top Dead Centre (TDC) to the Bottom Dead Centre (BDC) and this process is the suction process. After the suction process the gas mixture is forced to the compression process due to the movement of piston from BDC to TDC where the gas mixture gets compressed at high pressure temperature. At the end of the compression process the diesel is injected into the engine with the help of injector, which receives diesel from the diesel tank through the pump and pressure regulator at a correct rate and the amount of diesel is constantly measured by the burette in the diesel tank. After the diesel is injected to the compressed gas mixture, the gas- fuel mixture gets ignited at the end of the compression stroke which results to the power stroke where the power is produced. During the power stroke, the piston moves from TDC to BDC. The power which is produced in form of heat is converted into mechanical energy (i.e.) high brake thermal efficiency is produced for low specific fuel consumption. Due to the ignition of gas-fuel mixture the exhaust gases are produced. These gases are sent out through the exhaust valve during the exhaust stroke when the piston moves from BDC to TDC. The exhaust gases produced are Hydrocarbon (HC), Nitric oxide (NO_x), Carbon monoxide (CO), Carbon dioxide (CO_2), Oxygen (O_2) etc., these exhaust gases are sent to the gas analyzer which measures the amount of exhaust gases produced.

Brake Thermal Efficiency

Brake thermal effiicency for LPG-diesel is lower then compare to pure diesel at low load condition and finally its gradutually increses as load increses due to complete combution of hydrocarbon in fuel. Since LPG-diesel gives more than 3% of better performance compare to the pure diesel engine.

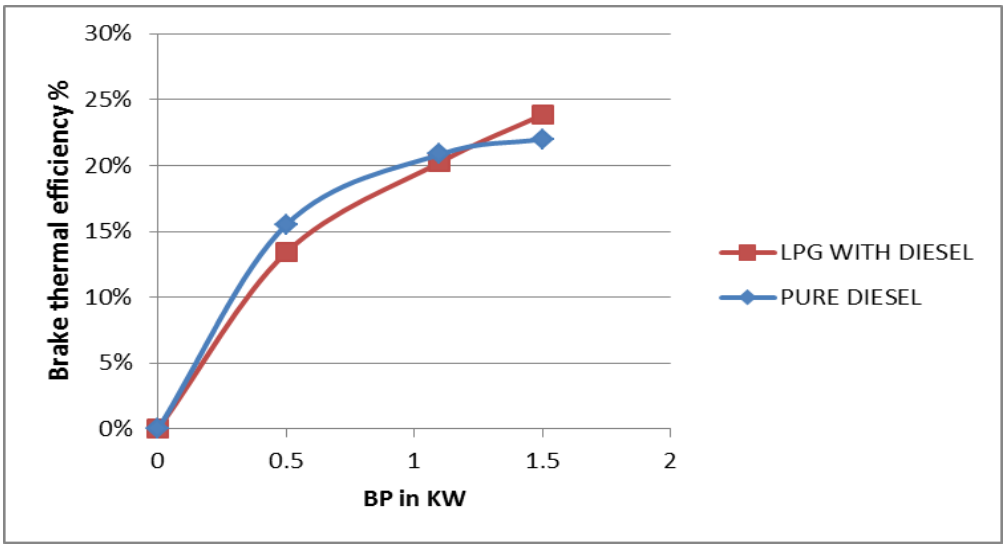

Fig: 2. *Brake power Vs Brake thermal efficiency*

Specific Fuel Consumption

Specific fuel consumption is compareteley reduced when compared to the pure diesel. Because the mixture of LPG-diesel gives the effective utilisation of fuel in the combustion chamber. The pure diesel consume of 0.8kg/Kwhr, the blend fuel consume fuel 0.78Kg/Kwhr

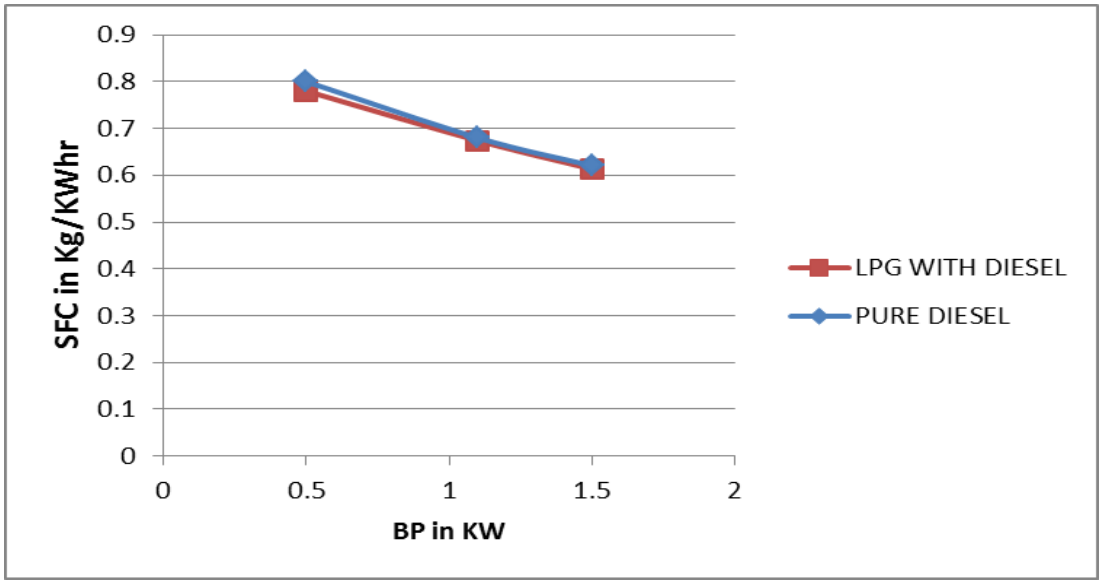

Fig: 3. *Brake power Vs Specific fuel consumption*

Unburned HC Emission

HC emission for LPG with diesel is higher at low load due to incompleted combution and lowers as load increses due to complete combution and HC emission is comparitively lesser then pure diesel operation

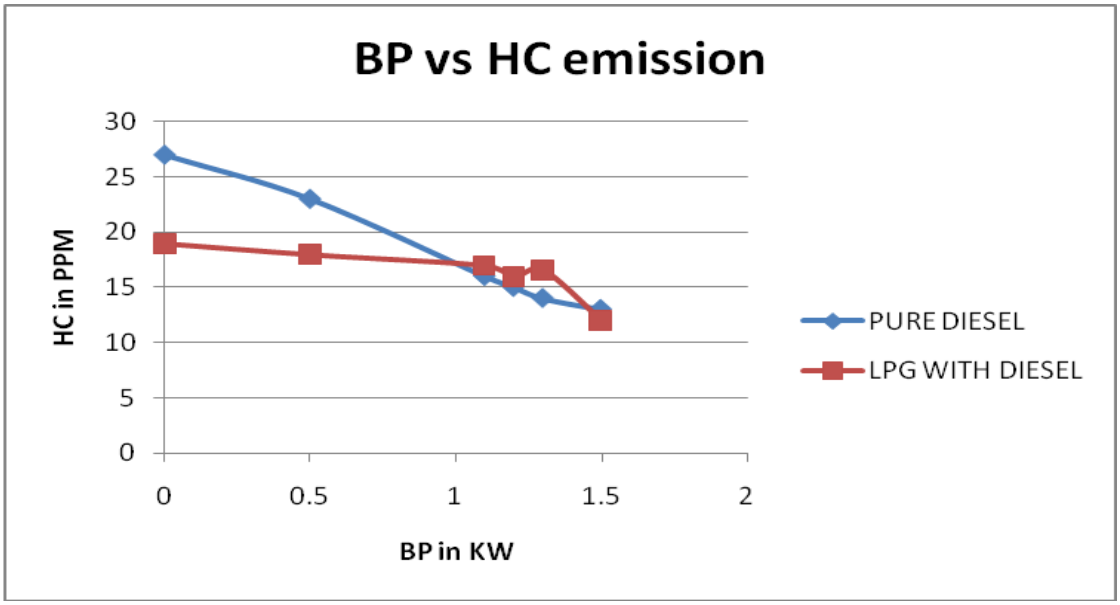

Fig: 4. *Brake power Vs Unburned Hydro carbon*

Effect of load on CO

Carbon monoxide which is the combination of one carbon atom and one oxygen atom is a poisonous gas which causes harmful hazards to the environment hence its emission from the dual fuel

engine should be limited. The emission of CO from LPG of dual fuel engine is same as compared to the pure diesel at low brake power but at maximum brake power running condition of the engine, the emission of CO in LPG diesel decreases than pure diesel operation.

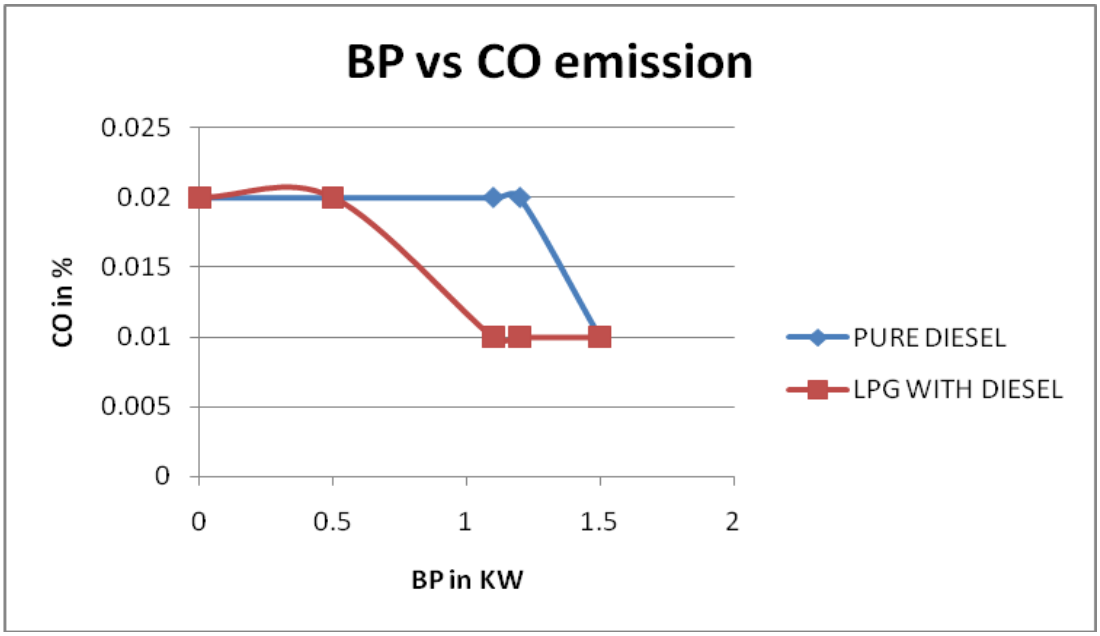

Fig: 5. *Brake power Vs Carbon monoxide*

Effect of load on O_2

Oxygen is the most abundant element on the earth. The emission of O_2 from LPG of dual fuel engine is same as compared to the pure diesel at low brake power but at maximum brake power running condition of the engine, the emission of O_2 in LPG diesel decreases than pure diesel operation.

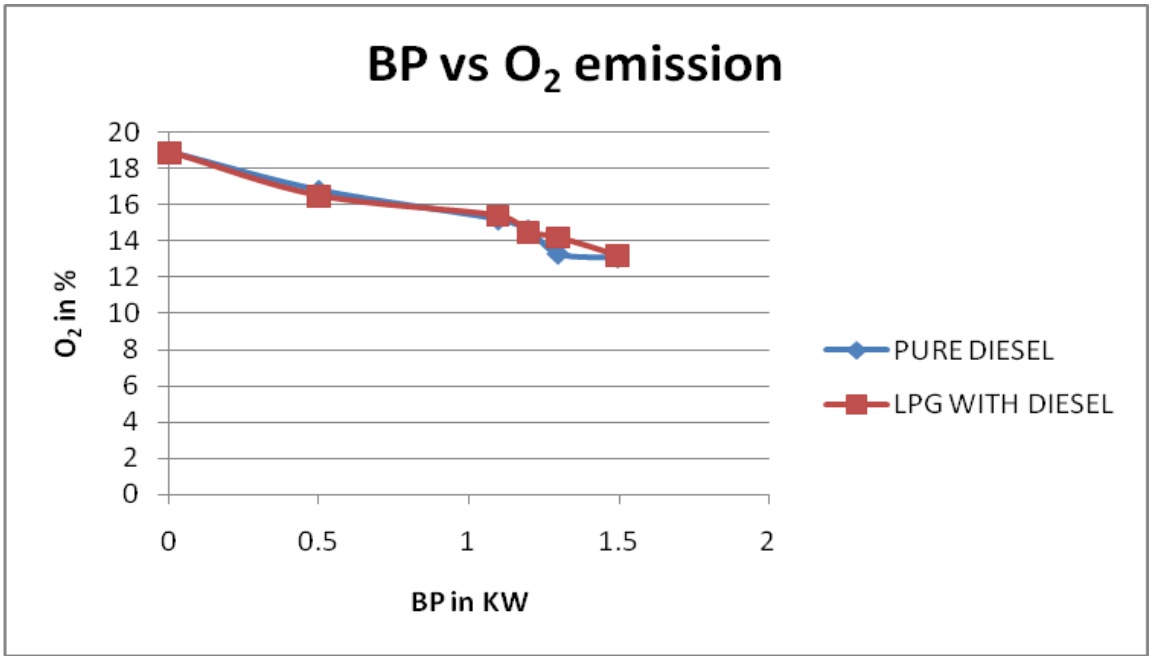

Fig: 6. *Brake Power Vs Oxygen*

Effect of load on CO_2

Carbon dioxide is a poisonous gas which causes harmful hazards to the environment hence its emission from the dual fuel engine should be limited. The emission of CO_2 from LPG of dual fuel engine is lower than that compared to the pure diesel at low brake power but at maximum brake power running condition of the engine, the emission of CO_2 in LPG diesel is greater than pure diesel operation.

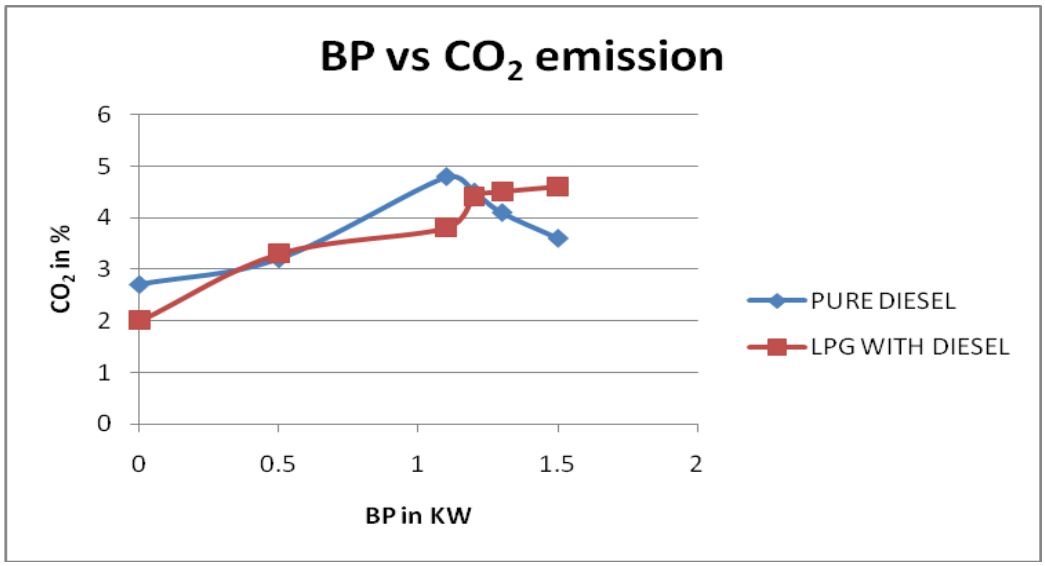

Fig: 7. *Brake power Vs carbon dioxide*

Effect of load on NO_x

Nitric oxide is a colorless, toxic gas which causes harmful hazards to the environment hence its emission from the dual fuel engine should be limited. The emission of NO_x from LPG of dual fuel engine is higher than that compared to the pure diesel at low brake power but at maximum brake power running condition of the engine, the emission of NO_x in LPG diesel is lower than pure diesel operation.

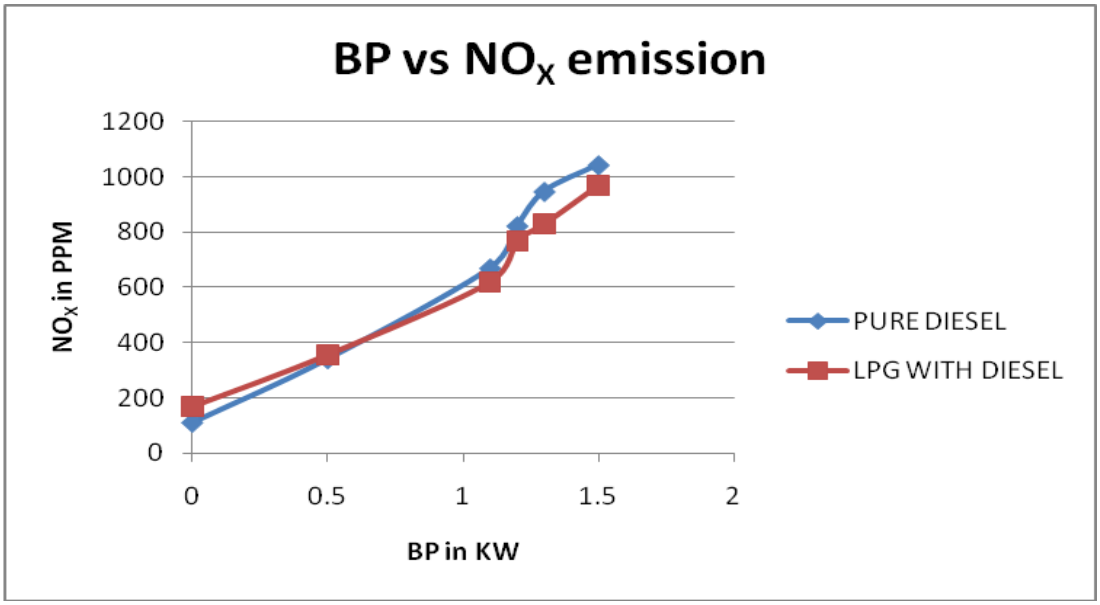

Fig: 8. *Brake Power Vs Nitrogen Oxide*

CONCLUSION

The result of this work shows that by using dual fuel engine with LPG and diesel as fuel gives a scope for reduction of Hydrocarbon (HC), Nitric oxide (NO_x),Carbon monoxide(CO), Carbon dioxide(CO_2), Oxygen(O_2) emission than the diesel engine. Increase of CO emission at low brake power and fuel consumption will produce high efficiency with low exhaust gas emission [11-12]. So it is concluded that, the dual fuel engine is effective to incorporate in vehicles than the diesel engine.

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