International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 3 | March -2017 www.irjet.net p-ISSN: 2395-0072

STUDY AND EXPERIMENTATION ON REDUCTION OF EMISSION IN DIESEL ENGINE

Mr. Shubham Tandel[1], Mr. Sudhakar Nakka[2], Ms. Mary florence[3]

[1] PG Student in Automobile Engineering Department, Chhotubhai Gopalbhai Patel Institute of Technology, Uka Tarsadia University, Bardoli, Gujarat, India.
[2,3] Assistant Professor in Automobile/Mechanical Engineering Department, Chhotubhai Gopalbhai Patel Institute of Technology, Uka Tarsadia University, Bardoli, Gujarat, India.

Abstract - *The recent issue to the world is regarding emission control of vehicle to protect the environment. In order to conquer this problem development of new emission control strategies are required, so the work presented in this paper is to develop the Oxygen Augment Combustion Technology to fulfill ultra-low exhaust emission standards & to serve better atmosphere to the world. By implementing the experiment on vehicle, The Effect of Oxygen Augmentation on the vehicle is measured with smoke meter in which reduction in emission is noticed.*

***Key Words*: Emission Reduction, oxygen augment combustion technology, smoke meter, catalytic converter, passenger vehicle.**

1.INTRODUCTION

Diesel engine passenger vehicles are expected to increase in popularity. They represent approximately 57.8 % of the new cars sold. [1] Their popularity is due to their high fuel efficiency, which is 30 to 50% higher than that of a gasoline engine with comparable power output. Diesel engines are also used for other application such as generator sets, transportation vehicle, agriculture equipment & other industrial uses. Indian consumption pattern of diesel by transport and non-transport sector for retail sales from 2000 retail outlets in 150 districts across 16 states in each four rounds, spanning a period of 18 months has been presented in the following graph shown in figure 1:

The major emission sources of diesel engines are their high nitrogen oxide (NO_x) and particulate matter (PM) emissions as diesel engines emit low levels of carbon dioxide (CO_2) and hydrocarbon (HC) pollutants due to engine operation on lean air fuel ratio in terms of the stoichiometry for complete combustion. In order to achieve reduction in emission oxygen augment combustion technology is used.

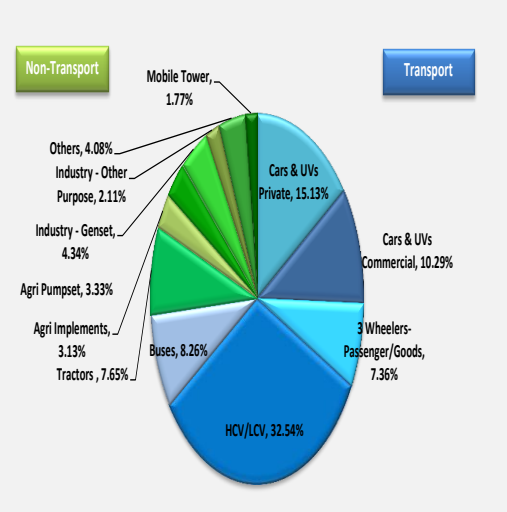

Fig 1: All India End-use Share (%) of Diesel in Retail [1]

1.1 Existing techniques

The main existing emission control techniques to reduce emissions for diesel engine passenger vehicles are Diesel oxidation catalysts (DOCs), Diesel particulate filters (DPFs), Selective catalytic reduction (SCR) & Catalytic converter. From above technologies, catalytic converter is used in more than 90 % of passenger vehicle worldwide & the use of catalytic converter in U.S is 100 % as per survey. The catalytic converter was first invented by Eugene Houdry in 1950 for gasoline engine & later on further developed by John J. Mooney and Carl D Keith at the Engelhard Corporation creating the first production catalytic converter in 1973 for both gasoline & diesel engine. [2,3] Catalytic converter has proved that it is pure example of invention, innovation, globalization & pioneering due to its emission control ability with high efficiency & long life since 1950, but still it has some negative aspects like Warm up time period, restriction to flow leads to negative effect in vehicle performance, drivability and fuel economy, Catalyst poisoning, Fouling,

Thermal degradation, Vapor formation, Attrition (crushing), Vapor-solid and solid-solid reactions, sintering of active metals, the collapse in pore structure & most important issue is high cost, so in order to deal with exhaust emission different technologies are required to replace catalytic converter.

1.2 Literature review

Fredrik Norman et al [4] investigated the possibility of high-temperature reduction of nitrogen oxides (NO_X) in oxy-fuel combustion. They concluded that an efficient high-temperature reduction of NO_X was achieved with high-purity oxygen, presence of a sub stoichiometric Combustion zone and relatively long residence time. To reach the high temperature, suggested in this work the fuel has to be burnt in high fractions of O_2, at least locally. Except higher temperature, the primary effect of higher oxygen concentration is decrease in recycles ratio and mass flow through the combustor.

Abhishek Waghmare et al [5] illustrated that oxygen enriched air helps in proper combustion with reduction in the volume of flue gases and greenhouse effect. For performance analysis, various experiments were carried out on multi cylinder spark ignition engine at different flow rate of oxygen in the intake air. Oxygen enrichment results in rapid combustion of fuel which increases break power, mechanical efficiency and volumetric efficiency with increased amount of heat generation. Fuel consumption decreases with increase in oxygen flow rate. The optimum results found at 6 LPM oxygen flow rate.

Sandeep. J. Desai, Dr. S. Shivkumar [6] illustrated the technology for abatement of exhaust emissions by analyzing the current understanding of oxygen augment combustion technology in which whole setup was used to study the performance of engine by providing oxygen during combustion or enhancement of charge by oxygen & due to augmentation loss of heat through the exhaust gases were reduced. It was observed that percentage increase of oxygen in intake air reduce exhaust emission and efficiency of engine increase satisfactorily.

Harry C. Watson, Eric E. Milkins [7] of Australia applied for the patent, which states the oxygen augmentation of fuels. They claimed the method of operating a diesel or spark ignition engine by augmenting the combustion air supply with oxygen while simultaneously adjusting the fuel injection or ignition timing of the engine to compensate for advanced combustion caused by increased oxygen content in the combustion air.

Martin E. Gerry [8] Explained Three methods of supplying pure oxygen to an internal combustion engine in his patent. It is possible to create pure oxygen by performing electrolysis of water and the pure oxygen, which was supplied to intake air to enhance the performance of an internal combustion engine. The pure oxygen, which was stored in oxygen cylinder under high pressure, might be supplied directly from the oxygen cylinder to the combustion chamber of an internal combustion engine. Heating the chamber, which consists of oxygen releasing chemical compound like zeolite, can create pure oxygen. So, by implement this three oxygen enrichment techniques could achieve, which can help in reducing emission.

1.2.1 Summary of literature survey

Literature survey suggests that the oxygen augment combustion technology is effective if implemented with proper oxygen ratio. Its having an issue regarding to control the combustion, if oxygen augmentation is Implemented at higher oxygen rate. So, in order to overcome this issue, proper flow control device and proper oxygen flow measurement are required. The implementation with changing various parameters of oxygen ratio & combining different emission control technology, we can get better results in order to reduce emission.

2. MATERIALS AND METHODS

2.1 Methodology of Experiment

(a) Selection of diesel vehicle for experimental setup

(b) Selecting & purchasing relevant components such as hose pipe, pressure regulator, oxygen cylinder key, hose pipe clip & oxygen cylinder for experimentation.

(c) Making actual setup by attaching each component in proper manner & by attaching one end of hose pipe with pressure regulator & other with vehicle's air intake line.

(d) Checking whether all the components are tightened properly or not if all components are attached properly then attach exhaust measurement probe with exhaust line.

(e) Starting the vehicle by turning ignition key in "ON" position. Keep vehicle in free acceleration condition till the test is performed.

(f) Test is performed by taking reading with and without

using oxygen augmentation technique by smoke meter DSM5050 device.

(g) Compare both results by checking hartridge smoke unit (HSU) value and check the effect of oxygen enrichment level on the emission.

2.2 Oxygen Augment Combustion Technology

In the first phase of experimental work, oxygen augment combustion technology (OACT) was implemented on four-stroke diesel internal combustion engine of Mahindra & Mahindra vehicle.

For intake air, low levels of oxygen enrichment were used; as literature review shows that if intake of oxygen exceed 24% than in order to protect the engine special provision need to be taken, higher oxygen enrichment levels need special engine modifications because of the expected higher output temperature, which is expected to be produce. Injecting pure oxygen from a cylinder directly to the mixing chamber increased the intake air oxygen concentration.

To ensure effective oxygen enrichment, the pure oxygen was injected directly through the mixing chamber in its inlet. Also, the data measurements were taken after 30 seconds on inserting the analyzer probe into the exhaust emissions to ensure data measurements stability, as the objective of this experiment is to analyze the effects of using higher intake air oxygen concentrations on internal combustion engines using high emission fuels such as diesel. A smoke meter DSM5050 was used to analyze the exhaust gases; the analyzer can measure the concentration of smoke in HSU value.

2.3 Different Components Used in Experiment

2.3.1 Oxygen tank

An oxygen tank is an oxygen storage vessel, which is either held under pressure in gas cylinders, or as liquid oxygen in a cryogenic storage tank. Oxygen tanks are used to store gas for:

- Medical breathing gas at medical facilities and at home
- In Oxygen first aid kits
- For Industrial processes, including the manufacture of Steel
- For Oxy acetylene welding equipment
- For Glass lampworking torches

2.3.2 Pressure regulator

A pressure regulator is a controlling valve that reduces the input pressure of gases or fluid to a desired value at its output. Regulator can be an integral device with an output pressure setting, a restrictor and a sensor all in the one body, or consist of a separate pressure sensor, controller and flow valve.

A pressure regulator's primary function is to match the flow of gas through the regulator to the demand for gas placed upon it, whilst maintaining a constant output pressure. If the load flow decreases, then the regulator flow must decrease also. If the load flow increases, then the regulator flow must increase in order to keep the controlled pressure from decreasing due to a shortage of gas in the pressure system.

2.3.3 Smoke meter DSM5050

Smoke Meter is a device, which is capable of measuring Smoke opacity of diesel vehicle exhaust in % Opacity & K-value with measurement of RPM & Engine oil temperature. It is used for free acceleration test. While test, we got emission results in the form of HSU, which implies the results of HC & CO concentration. The state of art technology used in DSM5050 combines a great flexibility in use with remarkable precision and reliability.

2.3.4 Hose pipe

A hosepipe is a flexible hollow tube designed to carry fluids or gas from one location to another. It consists of three layers, the middle layer being the steel wire braiding, which prevents rodent attacks, the inner and outer layers being of special rubber materials. Wire-braided construction eliminates various deficiencies of rubber tube and provides a superior alternative to the flexible rubber tube and is guaranteed for 5 years.

Other Features of hosepipe: (1)Rats can't bite through Steel wire (2).Abrasion, ozone & weather resistant hence no cracks (3).Leak proof (4).Flame resistant (5).Strong grip on the regulator (6).Maximum ambient temperature of 65°C and a maximum working pressure of 2.5 MP.

3. RESULT AND CONCLUSIONS

This research was undertaken to test the emissions reduction of a compression ignition engine fueled by both liquid and gaseous fuel using oxygen Augment air. An

attempt was made to examine the practicality of using oxygen augment air in experiment. So, in order to validation of result the experiment was done on both with and without oxygen augment combustion technology. So, difference between both gives us the exact idea about reduction of emission. The results of experiment are given below.

1. Substantial reduction in smoke were achieved it means HC & CO reduced. This is one of the most important benefits of the oxygen augment combustion technology.

2. Reduction in combustion noise is also noticed.

In addition to the above effects, the formation of NO_x may increase with increased oxygen percentage. This is because the NO_x formation is increased at higher temperatures. Using NO_x reducing techniques can solve this problem. With current and future developments in the area of air separation technology and development of ceramics for automotive engines, it would be possible to use of oxygen augment combustion technology in the near future.

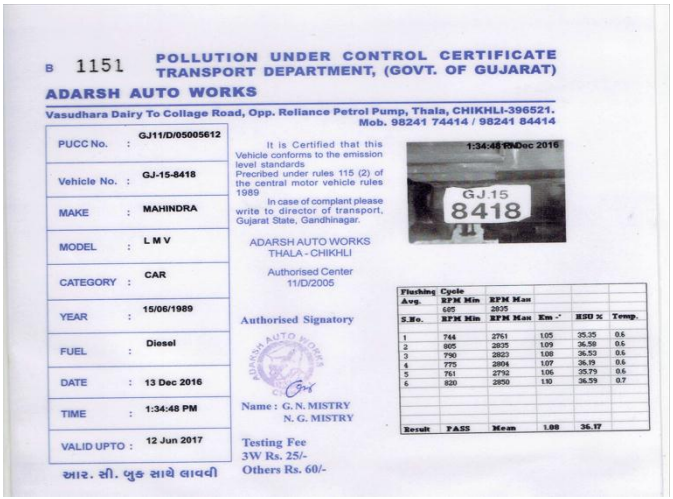

Fig 8: phoographic view of puc result without OACT

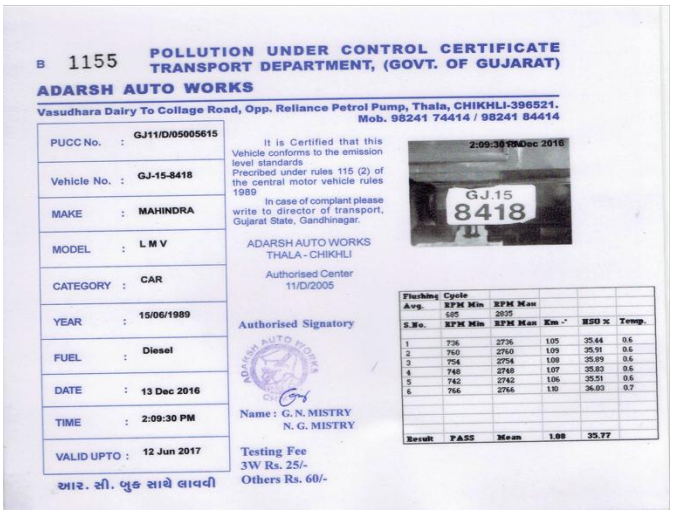

Fig 9: phoographic view of puc result with OACT

ACKNOWLEDGEMENT

My deepest gratitude goes to Late Dr. jatin desai sir for providing me the blessings to complete this work.

I cannot forget moral support and love from my mom Mrs. Kamlaben Tandel and my dad Mr. Bhgawanbhai Tandel.

I would like to express the deepest appreciation to my best friend Ms. Minal rathod, for her faith, encouragement, and mental support throughout difficult time.

I would like to thank Ms. Mary Florence for her guidance and knowledge during this research work. I would also like to thank Mr. Sudhakar Nakka for all his support and motivation throughout the research work.

I would like to express my appreciation and gratitude to Mr. Abhishek Patel for all his support throughout my studies; I would not have been able to do this without him and At last I would like to thank my other family Members, my classmates & All the CGPIT faculty members for being supportive & helpful.

REFERENCES

[1] All India Study on Sectorial Demand of Diesel & Petrol, “Petroleum Planning & Analysis Cell (PPAC)”,2011-12.

[2] US Patent 2,674,521: Catalytic converter for exhaust gases by Eugene Houdry, April 6, 1954. In this very readable patent, Houdry explains why he developed catalytic conveters and the various technical problems he

had to solve in the process (such as tackling the gases produced by widely varying driving conditions).

[3] US Patent 3,896,616: Process and Apparatus by Carl D Keith and John J Mooney, July 29, 1975. Another very readable patent, this one describes the improved three-way catalytic converter found in most modern vehicles.

[4] Fredrik Normann ,KlasAndersson, Bo Leckner, FilipJohnsson. "High- temperature reduction of nitrogen oxides in oxy-fuel combustion", Department of Energy and Environment, Chalmers University of Technology, SE-412 96 Göteborg, Sweden,2008.

[5] Abhishek Waghmare, Peeyoosh Tekale, Abhijeet Padolkar, Ravikiran Panchal, P.P.Patunkar."Performance Analysis Of Oxygen Enriched Multi Cylinder S. I. Engine", International Journal Of Advanced Research.

[6] Sandeep.J.Desai, Dr.S.Shivkumar (28 November 2015) Impact of oxygen enriched air intake on the exhaust of a single cylinder petrol", DAV institute of management, Faridabad.

[7] Harry C.Watson, Eric E.Milkins and Geoffrey R.Rigby"Oxygen enrichment of fuels" United states patent office, 2nd June, 1992.

[8] Martin E. Gerry, "Pure oxygen supply to an internal combustion engine" United States patent office, 8th June, 1976.