Emission Control of Engines Using Limestone and Water Mixture

P. Sylvester Selvanathan and R. Govindaraj

Abstract--- Diesel power inevitably finds a very important role in the development of the plant's economy and technical growth. In spite of their high thermal efficiency, one cannot ignore the fact about the effect of their exhaust, in the atmosphere. Due to high cost of petrol, diesel engines are more in use. Anticipating the use of diesel engines, even more in the near future; this system developed can be used to control the toxic gases, coming out of the diesel engines. Objective of this project is to design & fabricate a system, where the toxic levels are controlled through chemical reaction to more agreeable level. This system is made as an alternative arrangement for the catalytic converter. The whole assembly is fitted in the exhaust pipe. In this project we have made a emission test with the composition of oil, water and an alkali solution. The system we have designed is just a prototype which can further made to be a working model depending upon the vehicle criteria. Since this makes the system to be very cost effective and more economical.

Keywords--- Engine, Pollution Control, Economical, Alkaline Solution.

I. INTRODUCTION

Diesel engines are playing a vital role in Road and sea transport, Agriculture, mining and many other industries. Considering the available fuel resources and the present technological development, Diesel fuel is evidently indispensable. In general, the consumption of fuel is an index for finding out the economic strength of any country. In spite, we cannot ignore the harmful effects of the large mass of the burnt gases, which erodes the purity of our environment every day. It is especially so, in most developed countries like USA and Europe. While, constant research is going on to reduce the toxic content of diesel exhaust, the diesel power packs find the ever increasing applications and demand. This project is an attempt to reduce the toxic content of diesel exhaust, before it is emitted to the atmosphere. This system can be safely used for diesel power packs which could be used in inflammable atmospheres, such as refineries, chemicals processing industries, open cost mines and other confined areas, which demands the need for diesel power packs. Since diesel engine more toxic materials like Nox, Hydrocarbons etc., than petrol it is mandatory to reduce this effect. For this purpose, we have designed a prototype which may reduce the pollutant vastly. It is possible to reduce global warming and the gases which causes greenhouse effect can be reduced. The tests were made and the results have been plotted, which portrays the working of the system.

P. Sylvester Selvanathan, UG Scholar, Department of Mechanical Engineering, SNS College of Engineering, Coimbatore, India. E-mail: sylvesterpselvanathan@gmail.com

R. Govindaraj, Assistant Professor, Department of Mechanical Engineering, SNS College of Engineering, Coimbatore, India.

II. DESIGN SPECIFICATIONS

Diameter of inlet : 1 inch

Diameter of outlet : 2.5 inches

Outer casing : 8 inches cube structure

Material used : M.S Sheet Metal

Above measurements were done for the prototype, this may vary depending upon the vehicle. The diameter of the inlet should be lesser than the exhaust so that it offers necessary velocity to send out the gases completely out of the tank.

The above measurements have taken for the prototype model, this may vary for the vehicle concern. Once after completion of the design the manufacturing process are to be done. The processes includes machining, drilling, welding, etc,

III. WORKING PRINCIPLE

The high temperature high pollutant exhaust gas is allowed to pass through the Setup. Which is the mixture of water and lime stone container. After expansion, the emission comes in contact with oil; (which could be otherwise being any alkaline solution) where the obnoxious products of combustion are scrubbed when bubbled through it. The bell – mouth also allows for more contact area with water, so that effective cooling takes place within the short span of time available for the gas to pass through the oil. The length of bubbling can be increased by the oil level in the scrubber tank.

After bubbling through the oil, it comes in contact with bubbles, which encourage turbulence of the exhaust gas within and below the oil surface without unduly increasing the back pressure of the exhaust. This allows for the thorough scrubbing of the emission, so that more obnoxious product is absorbed in the allowed time.

The baffles are of invaluable help to reduce the carryover of oil particles which are converted into steam, which otherwise will escape out of the system.

A lime stone container, which is provided above the baffles, allows the exhaust emission to pass through limestone radially.

IV. TESTS PERFORMED

There were four tests have been carried out which carries three reactants. The tests are as follows:

- Normally operated test
- Water as a reactant
- Alkali solution
- Engine oil

Normally Operated Test

This test have been carried with the catalytic converter as already present. From this test it is possible to obtain the margin value how the pollutants have to be reduced.

Water as a Reactant

This test has carried out with water as a reactant inside the scrubber tank. This test does not favor to any changes in the amount of pollutants of the exhaust. Since the pressure from the exhaust makes the reactant to be inactive.

Alkali Solution

The test performed by alkali solution offers betterment of results since the alkali (limestone) is reactive towards the pollutants. This makes the idea to be effective one on comparing with the above two tests.

Engine Oil

The test through engine oil does not perform its operation as like alkali solution, but offers some considerable values than water. Since the viscosity of oil is low its offers better scrubbing action and enable to reduce the particulates which is a resultant of the exhaust.

V. TEST RESULTS

From the three tests which we have carried out, it possible to reduce emissions for certain amount through the Alkali solution and some considerable amount with the engine oil. Since these tests offers results in the value of "1/m", for the corresponding values we have created a table and the corresponding graphs for the better understanding of the purpose of project.

Table I: For Limestone and Water Mixture

FREE ACCLERATION	K VALUE – 1/m	RPM
T1	1.73	2150
T2	1.72	2160
T3	1.77	2100
T4	1.74	2110

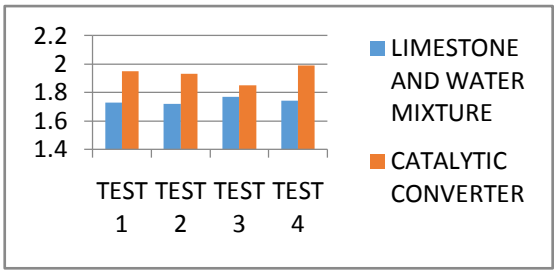

Fig. 1: Comparison of Limestone and Water Mixture and Catalytic Converter

Table II: For Water

FREE ACCLERATION	K VALUE – 1/m	RPM
T1	3.62	2140
T2	3.74	2170
T3	3.67	2120
T4	3.7	2100

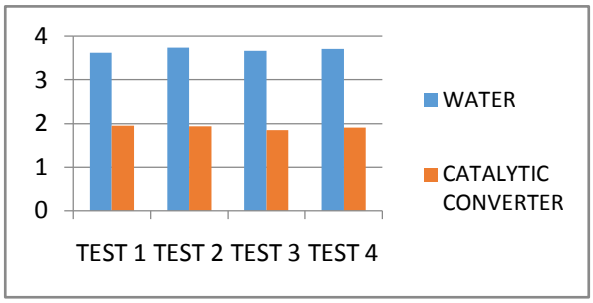

Fig. 2: Water and Catalytic Converter

Table III: For Enigne Oil

FREE ACCLERATION	K VALUE – 1/m	RPM
T1	1.86	2140
T2	1.89	2170
T3	1.88	2120
T4	1.90	2100

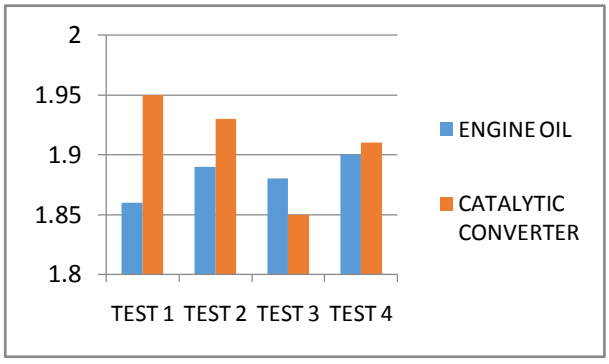

Fig. 3: Comparison Chart for Engine Oil and Catalytic Convertor

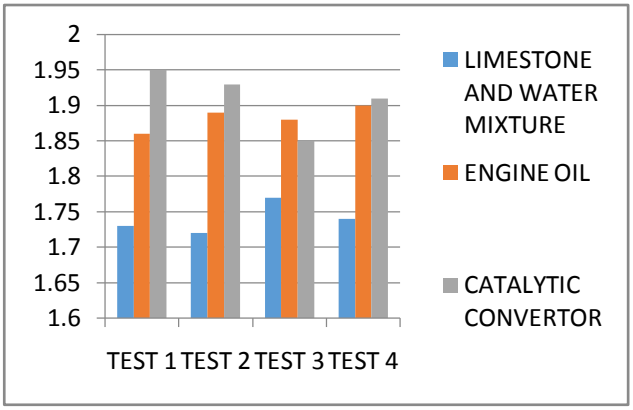

Fig. 4: Comparison Chart for Limestone water Mixture, Engine Oil and Catalytic Convertor

VI. ADVANTAGES

- The toxic emissions are very much reduced.
- This is one of the simplest forms of emission control system.
- The cost of the project is less.
- Highly reliable.
- Very good performance.
- Easily Attachable with the Exhaust

VII. DISADVANTAGES

- Alteration must be made in order to implement this system.
- For implementing in the heavy vehicles, the components selection must be done accordingly.
- Refilling the solution must be made at particular interval to get efficient control of Emissions.
- Not flexible as other emission control systems.
- Maintenance is need.

VIII. CONCLUSION

Thus “Reduction of the diesel engine emission using oil and limestone “system is working with satisfactory conditions which helps reduce toxic emissions that are released into the atmosphere. This project will also be highly useful for reducing environmental pollution. They can be modified and developed according to the application.

Thus we have developed a new arrangement as alternative one for catalytic converter which in turns reduces certain level of pollutants and helps reduce toxic emissions that are released into the atmosphere. By using more techniques, it can be modified and developed according to the application.

From this prototype model it is possible to develop a new component which in turn reduces the emissions than the present one. Depending upon the environment it is possible to do further works to make this to be more efficient.

REFERENCES

[1] W. Adaileh and A. Alahmer, "Reduction Of The Spark Ignition Engine Emissions Using Limestone Filters", Canadian Journal of Pure and Applied Sciences, Vol. 8, No. 1, Pp. 2761-2767, 2014.

[2] S. Hosokawa and A.Tomiyama, "Turbulence Modification Due To Bubbles And Particles in Dispersed Two Phases", 7th international conference on Nuclear Engineering Tokyo,1999.

[3] J.E. Staudt, "Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal", Fired Power Plants, 2011.

[4] Geogre Swiatek and Roan, "Catalytic Exhaust Control Of Small Ic Engines", Small Engine Technology Conference, 1989.

[5] Tim Johnson, "Diesel Enigne emissions and their control", Platinum Metals Rev., Vol. 52, No.1, Pp. 23–37, 2008.

[6] Jack Mcdonald, "Lovel-Diesel and Gasoline Engine Emissions: Characterization of Atmosphere Composition and Health Responses to Inhaled Emissions", Ace Respiratory Research Institute.

[7] Dr. John C. Wall, Evolution of Diesel Engine Emission Control Technologies and Characteristics of New Technology Diesel Exhaust", CARB Chairman's Research Seminar Series, 2012.

[8] Dr. Jack Mcdonald, "Diesel and Gasoline Engine Emissions: Characterization of Atmosphere Composition and Health Responses to Inhaled Emissions", Lovelace Respiratory Research Institute.

[9] M. Rozpondek and M. Siudek, "Pollution Control Technologies Applied to Coal-Fired Power Plant operation", act a montanistic a slovacaročník, Vol. 14, No. 2, Pp. 156-160, 2009.