

NO_x Emission Control Techniques by Using Venturi and Urea

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Abstract

Nowadays, there is an increase in the number of vehicles releasing pollutants in the environment that are hazardous for human being. Till now, EGR, SCR and catalyst converters have been used to reduce percentage of NO_x in the environment. This paper presents a new technique to reduce emissions from CI Engines. This paper presents a design of venture, a principle on which EGR system works. An exhaust reduction technique by using venture and urine solution is also suggested.

Keywords: CI Engine, NO_x, ERD, Venturi, Hydro carbon, ammonia.

INTRODUCTION

Diesel and petrol are the most widely used fuel for individual and mass transportation vehicles. Cost of fuel increases constantly due mainly to an increase in number of vehicles. People are turning towards low expensive fuel, such as kerosene that is used in different applications by mixing with petrol, diesel etc. The result is release of a high amount of pollutants such as CO₂, NO_x, CO, SO₂, soot particles, etc.

Nowadays, NO_x reduction is the first aim to achieve emission controls. There are many methods to reduce emission, but the ERD system scores over other systems in comparison. If this system is adopted, then low expensive fuels can be used much more efficiently.

We have not just the problem of high expensive fuel, but increase in pollution too. To control this type of pollution; we have to find best solutions to solve it. For

that reason we have to introduce an EMISSION REDUCER DEVICE, which is a green mechanism.

It reduces the percentage of toxic gases and constituents i.e. CO, HC, CO₂, and NO_x other foreign materials and dust particles contained in smoke. This system does not have any visible effect on engine performance.

NECESSITY

Large amount of pollution causes very high environmental damages and greenhouse effect. Various pollutants are released in the atmosphere due to burning of fuel from engines.

LITERATURE SURVEY

There are different techniques to reduce emission.

Exhaust Gas Recirculation (Egr)

The exhaust gas recirculation system's purpose is to reduce NO_x emission that contributes to air pollution. The first EGR system was added to engine in 1973, and today, most of the engines have EGR systems. As long as EGR functions properly, it should have no noticeable effect on engine performance. But if EGR system starts leaking, it can cause derivability problems, including

detonation, a rough idle, stalling, hard starting, elevated NO_x emission and even elevated hydrocarbons' emission in exhaust.

Function of EGR

The function of EGR reduces the formation of NO_x by allowing small amount of exhaust gases to leak into intake manifold.

Catalytic Convertor

It is the device used into exhaust system of an automobile that reduces amount of pollution in the automobile exhaust gases. Catalytic convertors are used to reduce amount of NO_x, carbon monoxide and untreated HC in automotive emission.

Function of Catalytic Convertor

1. Function of catalytic convertor is to complete the oxidation process for HC and Co.
2. Reducing NO_x back to simple nitrogen and carbon dioxide.

CONSTRUCTION OF ERD

For testing we need 4 stroke engine which runs on kerosene, diesel and petrol. Venture is fitted in silencer correctly. Common silencer of any vehicle is considered which is suitable for construction. Venturi is manufactured after considering various factors of designing.

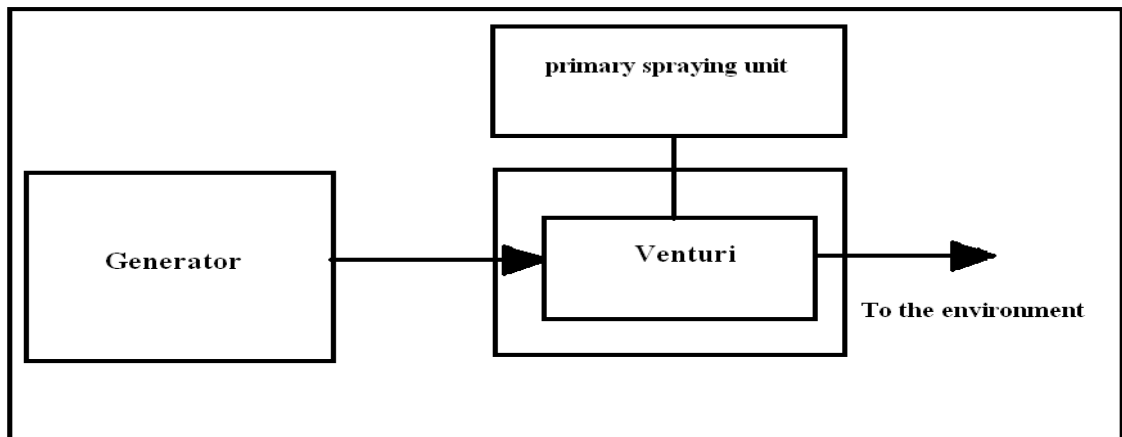


Figure 1

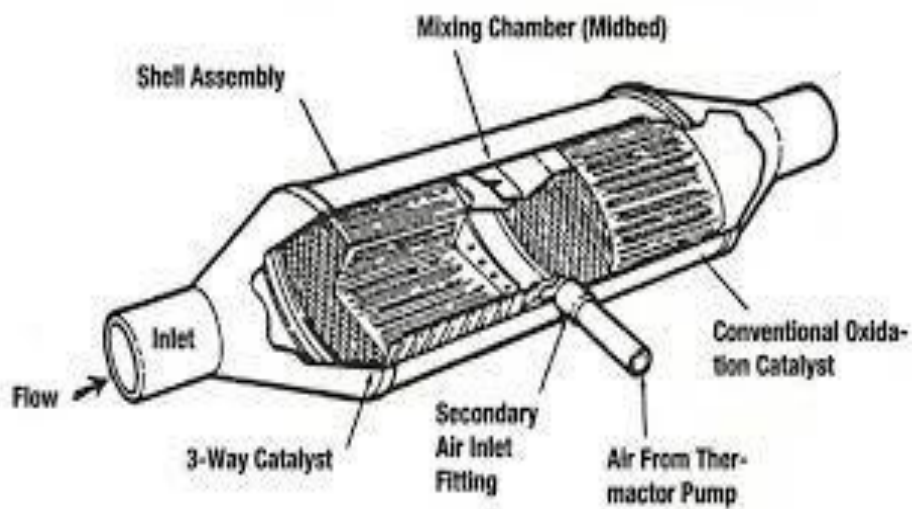


Figure 2

DERIVATION

Venturimeter is a device used for measuring rate of flow of a fluid flowing through a pipe. It consist of three parts:

1. Convergent
2. Throat
3. Divergent

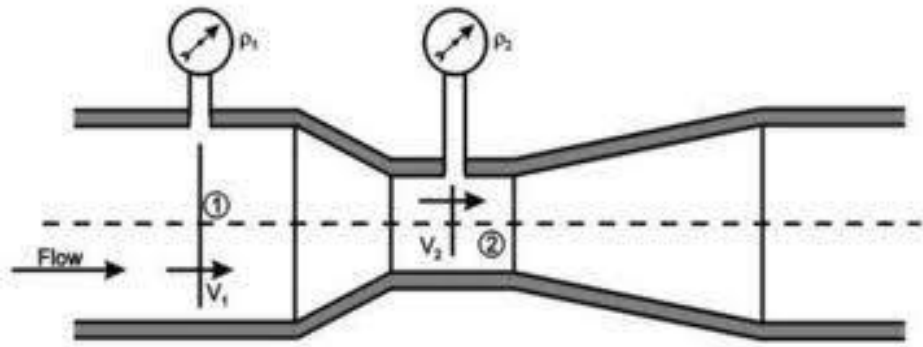


Figure 3

Let d_1 = diameter at the inlet (section 1)

=

p_1 = pressure at section 1

v_1 = velocity at section 1

Hence

A_1 = area at section 1

— —

d_2, p_2, v_2, A_2 are the corresponding values

at the throat (section 2)

— — —

— — — —

Discharge

$$Q = A_1 \cdot v_1 = A_2 v_2$$

$$Q = \frac{A_1 v_1}{\sqrt{1 - \left(\frac{A_1}{A_2}\right)^2}}$$

As pipe is horizontal $z_1 = z_2$

— = —

=

Note that the above expression is for ideal condition and is known as theoretical discharge.

Where — difference of pressure heads at sections 1 and 2.

Actual discharge will be less than theoretical discharge.

$$Q = \frac{A_1 v_1}{\sqrt{1 - \left(\frac{A_1}{A_2}\right)^2}}$$

From the continuity equation at sections 1 and 2, we obtain

C_d is the coefficient of venturimeter and its value is always less than 1 (ref.5)

$$A_1 \cdot v_1 = A_2 v_2$$

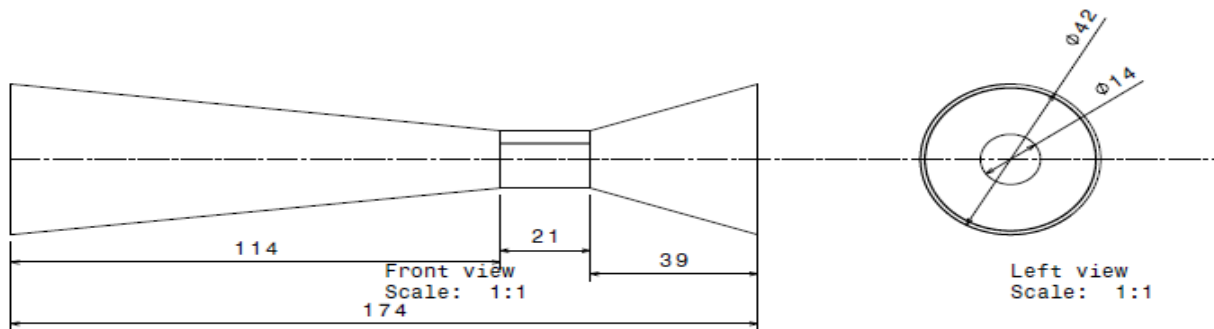


Figure 4

TESTING PROCEDURE

For conducting the test we used water cooled four stroke compression ignition engine. For this experiment, we used a silencer of diesel engine. We designed a venturi that almost fitted in silencer, and due to this setup, we get constant temperature and velocity of exhaust gases. The main thing is to reduce the carbon emission using natural urine.

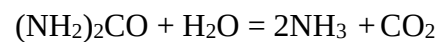
Emission of carbon is measured with the help of pollution under control unit (PUC). For this we can take exhaust gases from the engine. Only assumption is that natural urine need to be mixed homogenously in exhaust gases.

Reaction of urea-water solution with present smoke pollutants

This technology is used for reducing NO_x of exhaust gases which passed out from engine exhaust manifold, so the model of

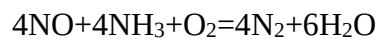
UCC is located after the exhaust manifold and before silencer.

When engine is started, it creates various toxic gases such as CO₂, NO_x, CO, PM, SO₂. This toxic gas then passes through the chamber where urea is injected by means of injector that is connected to reservoir. Adequate quantity of urea is injected to the exhaust gases due to make it react with them and lead to the following reaction:



The above equation shows hydrolysis reaction taking place in which urea (NH₂)₂CO is mixed with water (H₂O) and generates ammonia (NH₃) and carbon dioxide (CO₂). This reaction is formed before the SCR catalyst.

After this, gases pass through the SCR which is used to separate the toxic gases from the exhaust gases i.e. filtering the gases and after it, release clean gases into the environment. When untreated gases come into the SCR, the following reaction takes place in which nitrogen dioxide (NO) is reacted with ammonia (NH₃) and oxygen (O₂) and the result is nitrogen (N₂) and water droplets.

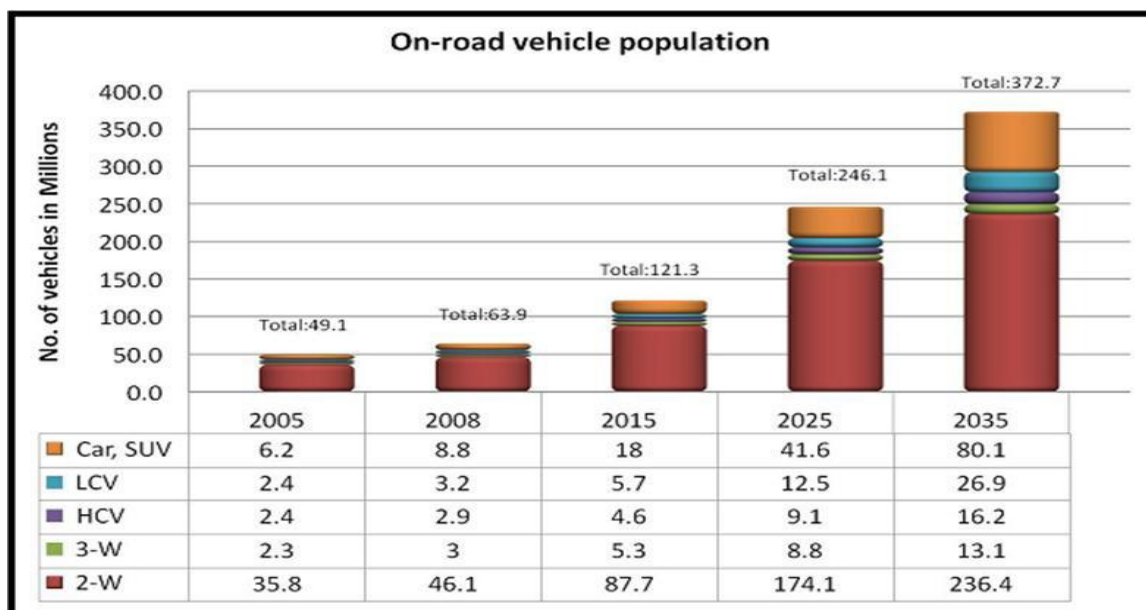


In this way, NO_x is converted into nitrogen and small water droplets and then released into the environment. By this treatment, pollution due to NO_x is reduced as the particles that are generated are not so harmful to human health. So, this

technology is efficient to reduce pollution. See the Graph 1.

FUTURE SCOPE

Nowadays, there are many more methods or systems to reduce the emission, but EGR system is more reliable to control the emission as it costs less. It can be adopted in any kind of vehicle to reduce emission. In future, the number of vehicles plying on roads worldwide is likely to increase. Due to this, pollution may reach record high levels, and it will be very difficult to control. So, we need to be proactive in fixing this global problem by adopting the proposed technique.



Graph 1: On road vehicle pollution upto 2035

If this system is used in future, it can be constructed as following mechanism:

For two wheeler vehicles:

A figure is shown for the future planning of two wheeler. Many two wheeler vehicles are running on roads producing a lot of pollution that has a dangerous environmental impact.

So following methods will be very effective. This method will be adopted in two wheelers. For this we consider exhaust manifold i.e. silencer of two wheeler.

Construction:

Following are the main parts of the mechanism:

- i. Liquid tank (min. 2 lit.)
- ii. Tubes

- iii. Motor with fan constructed and two wheeler casing
- iv. Fuel injector
- v. Venture develop silencer

As shown in figure, a small tube (tube "C") is fitted to tank and the end injector is fitted. Injector sprays solution in finned spray which helps to mix it properly with the exhaust gases.

Working:

When engine starts, exhaust gases start to pass through silencer. When they pass through the venture, velocity increases and pressure drops. Due to pressure drop, vacuum is created at the venture section, which sucks the solution from the tank that is kept at the level above the silencer.

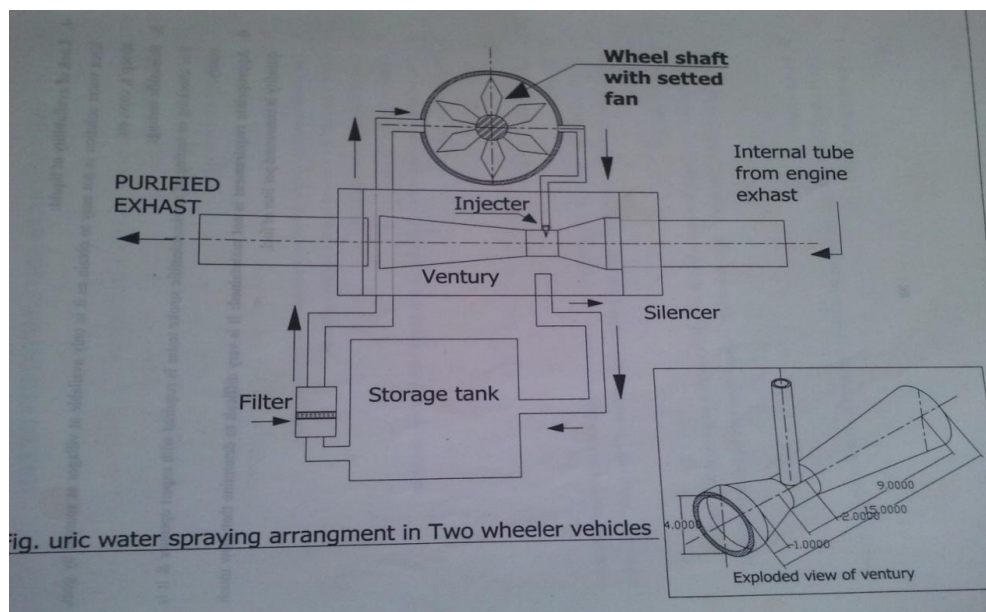


Figure: 5

CONCLUSION

Results of the experiments presented in this paper lead us to conclude that:

1. We achieve the EURO IV norms with the help of ERD.
2. ERD reduces the percentage of CO₂ about 0.024 in volume and also reduces percentage of CO, HC about 0.47 in volume and 826 ppm in volume.
3. It works better and gives better results than that of other systems such as EGR.
4. ERD system is a more efficient and reliable method for reducing emission.

level Carbon-dioxide emissions of India”.

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