

# EMISSION REDUCTION BY COMBINATION EFFECT OF PERMANENT MAGNETS AND UREA INJECTION

Suyog Khillare<sup>1</sup>, Kiran Hiware<sup>2</sup>, Sandeep Imale<sup>3</sup>, Chirag Patil<sup>4</sup>

<sup>1,2,3</sup>Student, Dept. of Mechanical Engineering, Jawaharlal Nehru Engineering College, Aurangabad, Maharashtra, India

<sup>4</sup>Student, Dept. of Master of Business Administration and Engineering, Hochschule für Technik und Wirtschaft, Berlin, Germany

\*\*\*

**Abstract** - Atmospheric pollution is one of the major problems that whole world can be facing. Large air pollution is produced by manmade activities like burning of combustible gases, inorganic or organic waste, recyclable materials etc. In last few years, the problem of environmental pollution is raised to significant level because of increase in usage of vehicle throughout the world. Having high thermal efficiency is one of the best advantages of using Diesel Engine, but along with this it has a serious drawback of emitting larger amount of harmful exhaust gases when compared with gasoline engine. The half of total nitrogen oxides and more than two thirds of particulate matter can be emitted by vehicle using diesel as a fuel. Nitrogen oxides emitted by diesel engine results into the formation of ground level ozone, which irritates the respiratory system, causing coughing, choking, and other lung disorder. When nitrogen oxides and hydrocarbon emissions combine in the presence of sunlight gives ozone pollution which results into a health hazards both for adults and individuals suffering from respiratory problems. The emission of large particulate matters due to incomplete combustion of fuel causes health problems like irritation in the eyes, throat and lungs which leads to various disorders.)

**Key Words:** Magnetic emission filter, Urea injection, Emission Reduction, Diesel Engine

## 1. INTRODUCTION

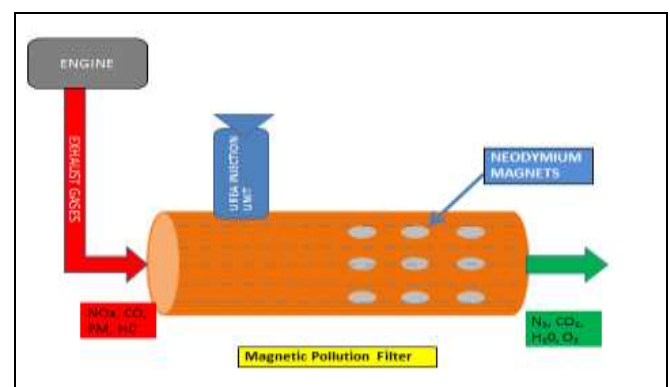
Nowadays, automotive catalytic converter has been used to reduce the automotive vehicles emissions. Exhaust catalytic converters were introduced, because most of the countries recognized restricting laws related to emissions of carbon monoxide, hydrocarbons and nitrogen oxides by the engines. These emissions generated by the combustion process of internal combustion engines are very harmful to health and the surroundings. The CO emissions join with hemoglobin in the bloodstream promotes the reduction of oxygen-active sites which arises asphyxia. Nitrogen oxides (NO<sub>x</sub>) contribute to acid rain and photochemical smog which give irritation to the eyes and skin. The Three-Way Catalysts are advanced system for emission treatment of gasoline vehicles that significantly reduce the emissions of carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxides (NO<sub>x</sub>) in atmosphere.

Main aim is to reduce the emissions like CO, NO<sub>x</sub>, and HC from exhaust of diesel engine using combined effect of

magnetic emission filter and urea injection. Environmental pollution is one of the biggest problems faced by human beings in the past decades and in generations to come. Approximately 1/3 of the air pollution is from by automobile fleet. It is substantial to control automotive pollutions to achieve the goal of cleaner air, which should help for reduction of greenhouse gases. Exhaust pollutants from the automobile's engines have negative impact on air quality as well as on human health. Current study focuses on newly developed setup of magnetic emission filter and urea injection as a catalytic converter, because existing available catalytic converters suffer from various problems like; poisoning, fracture, melting & higher cost. The objective of this paper is to develop cost effective magnetic emission filter as a catalytic converter to be used on a diesel engine.

## 2. EXPERIMENTAL SET-UP

A magnetic emission filter with urea injection unit schematic diagram



**Fig -1:** Schematic Diagram of Magnetic emission filter with Urea Injection Unit

Magnetic emission filter construction is as follows:-

It consists of a cylindrical filter (meshed from inside for transfer of exhaust gases), urea injection unit, Neodymium magnets (placed on the periphery of the cylindrical filter)

Working principle:-

The harmful exhaust gases from engine pass from the inlet of the filter device which contains nitrogen oxides (NO<sub>x</sub>),

carbon monoxide (CO), Hydrocarbons (HC), particulate matter (PM).

Following chemical reactions were takes place inside the filter:

**Table -1:** Chemical Reactions of Emission Gases

<b>NOx</b> $N_2 + O_2 = NO + NO_2$	<b>reactions:</b>	<b>CO</b> $CO + \frac{1}{2} O_2 = CO_2 + \text{Heat}$	<b>reaction:</b>
<b>HC</b> $HC + O_2 = H_2O + CO_2$	<b>reaction:</b>	<b>PM</b> $PM + O_2 = CO_2 + H_2O$	<b>reaction:</b>
<b>Urea</b> $6NO_2 + 8NH_3 = 7N_2 + 12H_2O$ $6NO + 4NH_3 = 5N_2 + 6H_2O$ $NO + NO_2 + 2NH_3 = 2N_2 + 3H_2O$	<b>reactions</b>	<b>with</b>	<b>NOx</b> :

**2.1 Reduction of NOx**

NOx is produced by the reaction of nitrogen and oxygen gases during combustion, especially at higher temperatures. In regions of dense vehicle transportation, significant air pollution caused due to nitrogen oxides emission. Most of this will be nitrogen oxide (NO), with a small amount of nitrogen dioxide (NO<sub>2</sub>) and remaining of other nitrogen-oxygen combinations. NOx is considered as an undesirable emission and regulations for restriction of this compound are getting stringent. Photochemical smog formation is mainly occurring when NOx reacts with ozone, which is quite harmful for health. NOx is generally created from nitrogen in the air. Atmospheric nitrogen exists as a stable diatomic molecule at low temperatures, however, at the very high temperatures like that in combustion chamber of an engine, few of the diatomic nitrogen (N<sub>2</sub>) breaks down to monatomic nitrogen (N) which is reactive. A significant amount of monoatomic nitrogen can be formed as the temperature in combustion chamber is around 2500°C in an engine. Other gases that are relatively stable at low temperatures like oxygen and water vapor become reactive at high temperature which contributes in the formation of NOx. For the purpose of NOx reduction, we have used the urea injection unit. In urea injection a fine atomized spray of urea blend which consist of 40% Urea and 60% water is sprayed into the setup resulting in mixing of the flue gases with the atomized spray. For the purpose of atomizing, the fine spray of urea injection is required and for that carburetor is used. The flue gas is let in instead of the fresh air and urea blend is let in instead of fuel. This carburetor has efficiently worked, and a perfect atomization of the urea blend is obtained continuously. The urea blend is stored in a tank through which continuous passage of the liquid flow takes place. The liquid can be refilled easily once it gets over.

**2.2 Reduction of Particulate Matter**

A magnetic field generated by permanent earth magnets is used for reducing pollutants, mainly HC from exhaust gases.

A housing having an inlet for receiving exhaust gases with pollutants, and an outlet for the exit to the exhaust gases which is free from pollutants. A magnetic filter element defines a plurality of flow paths for exhaust gases between inlet and the outlet; during this inlet through flow paths to outlet pollutants in exhaust gases are substantially reduced. To apply magnetic field applied in the pathways of exhaust gases is created by pass strong permanent magnets, due to that magnetic field hydrocarbon changes their orientation and convert from para state to ortho state. In ortho state inter molecular force is reduced to a considerable and increase space between hydrogen. This hydrogen of fuel reacts with oxygen producing a complete burn in the combustion chamber



**Fig -2:** Magnetic Field Effect on Outlet Emission Gases

For the filter permanent magnets are used as their magnetic properties are stronger than other normal magnets, So, Neodymium magnets are used based on their low cost and easy availability.



**Fig -3:** Magnetic Field Effect on Outlet Emission Gases

Actual Magnetic Pollution filter set-up:



**Fig -3:** Actual magnetic emission filter setup

**3. RESULTS AND DISCUSSION**

The results were taken by the following method:

Firstly, we measured the emission levels without the setup and then with the setup on same engine

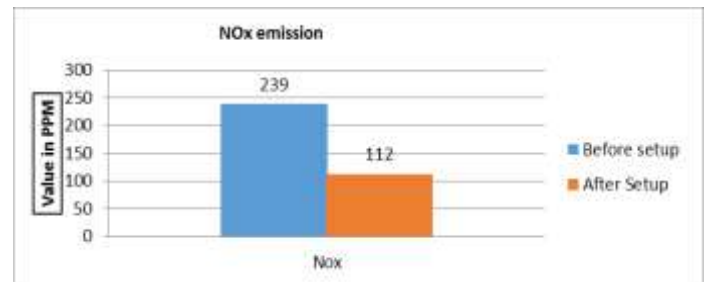
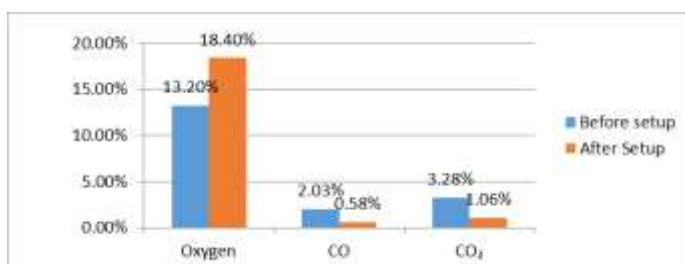
**Table -2:** Engine specifications

Type	Single Cylinder, Naturally Aspirated Air Cooled, Diesel engine
Displacement (CC)	436 CC
Max. Power	5.52 kW @ 3600 rpm+ 50rpm
Max. Torque	18 Nm @ 2400 – 2200 rpm

**Table -3:** Comparison of Measured Emission with and Without Magnetic Pollution Filter Setup

Sr No.	Parameter	Emissions measured without setup	Emissions measured with setup
1.	Oxygen	13.2%	18.4%
2.	Fuel temp	95 °C	33 °C
3.	CO	2.034%	0.58%
4.	Nitric oxide	239 ppm	112 ppm
5.	Methane	2.35%	1.25%
6.	CO2	3.28%	1.06%
7.	Excess air ratio	84.54	560.30
8.	Heat loss in dry flue gas	3.28%	0.48%
9.	Total heat loss	27.33%	5.89%
10.	Overall efficiency	72.67%	94.09 %

**Chart -1:** Comparison of before and after setup emission parameters



It is evident from the above data that NOx is reduced to about 53% and CO is reduced from 2.034 to 0.58% and the oxygen content has increased from 13.2 to 18.4% which gives quite a clear picture of emission reduction with the help of the setup.

#### 4. CONCLUSION

The harmful emissive gases tend to pollute the environment so there is need to reduce them if not eliminate them from the surrounding. Above research work conclude that the use of magnetic filter as catalytic converter is effective in reducing the harmful content from emission when used with a diesel engine. Use of magnetic filter with urea injection unit can be used as a substitute to other after treatment devices as it is more cost effective. With neodymium magnets along with urea dosing unit best results of reduced pollutants can be achieved

#### ACKNOWLEDGEMENT

The authors sincerely thank Jawaharlal Nehru Engineering College, for the resources and support provided for the study.

#### REFERENCES

- [1] Engr. Okoronkwo C. A ,Engr. Dr. Nwachukwu, C.C,Engr. Dr. Ngozi –Olehi L.C and Engr. Igbokwe, J.O, The effect of electromagnetic flux density on the ionization and the combustion of fuel (An economy design project)” in AMERICAN JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
- [2] Piyush M Patel, Prof. Gaurav P Rathod ,Prof. Tushar M Patel, “Effect of magnetic field on performance and emission of single cylinder four stroke diesel engine” in IOSR Journal of Engineering (IOSRJEN)Vol. 04, Issue 05 (May. 2014)