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A REVIEW ON STUDY AND USAGE OF COMBINING AFTER TREATMENT DEVICES INTO EXISTING DIESEL ENGINE

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Abstract -In this study, were the diesel engines produces lot of harmful pollutants to the atmosphere, the emission control method is used to prevent and reduce the emission of harmful gases. In order efficiently reduce the polluting emissions of engines by exhaust after treatment systems, We tried to control the reduction of emission implementation of post combustion techniques like Diesel particulate filter (DPF), Diesel oxidation catalyst (DOC), Selective catalytic reduction (SCR) are adopted for existing diesel engine to reduce the emissions and induce significant gain in emission reduction were tried. The paper summarizes developments in diesel emissions regarding regulations, engines, Particulate matter (PM) reduction, and hydrocarbon (HC), and CO oxidation.

Keywords- DOC, DPF, SCR, Diesel engine, New Catalytic converter.

I. INTRODUCTION

The usage of diesel engines are useful for the transportation services and other useful works, it produces lot of harmful pollutants which effects living organisms. Urban air pollution is mainly caused by automobiles which significantly contribute toward pollutants like hydrocarbons (HCs), carbon monoxide (CO), and oxides of nitrogen (NOx) in urban shed. These air pollutants have high impacts on human beings, other living creatures and environment. Exposing to HCs, beyond certain limits can damage our respiratory system and CO is harmful for human vascular system. Emissions of NOx are responsible for the acid rain, greenhouse effect, and visible impairment. NO and CO are identified as precursors of photochemical smog and other secondary pollutants. These consequences of the pollutants have historically lead toward implementation of more and more stringent vehicular emission control regulations. To overcome with these regulations, one of the most widely used options by vehicle manufacturers today is catalytic converter. Diesel engine, like other internal combustion engines, converts chemical energy contained in the fuel into mechanical power. Diesel fuel is a mixture of hydrocarbons which during an ideal combustion process would produce only carbon dioxide (CO2) and water vapour (H2O). Indeed diesel exhaust gases are primarily composed of CO2, H2O and the unused portion of engines charge air. Most of the pollutants originate from variant non-ideal processes during combustions, such as incomplete combustion of fuel, reactions between mixture components under high temperature and pressure, combustion of engine lubricating oil and oil additives as well as combustion of non-hydrocarbons components of diesel fuel. There are other sources that can contribute to pollutant emissions from internal combustion engines-usually in small concentrations, but in some cases containing material of high toxicity. These additional emissions can include metals and other components from engine wear or components emitted from emission control catalysts.

DIESEL PARTICULATE FILTER (DPF)

It is an exhaust after treatment device that traps particulate matter such as soot and ash. A DPF typically uses a subtracted made of a ceramic material that is formed into a honeycomb structure. When the particulate matter (or) soot which is exhausted through outlet value of the engine it passes to the DPF cylinder, were the soot is collected on the side walls of the honeycomb structure and the exhaust sir is released to atmosphere which leads to less emission of particulate matter (PM). In this cylinder oxidation of particles doesn't takes place, so the carbon monoxide (CO) doesn't react with the ceramic materials and they release (CO), But the hydro carbon (HC) and other particles are captured and controlled in cylinder.

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Particulate emission control technologies				
		Removal efficiency	Example uses	Considerations
Cyclones	Centrifugal force	>90%	Fluid catalytic crackers (refineries)	Collection efficiency falls off for smaller particle sizes
Filters	Impaction	>99.9%	Coal-fired boilers	High back pressures, making this technique impractical for many operations
Electrostatic precipitators	Electrostatic force	>99.9%	Power generation, petroleum refinery, waste incinerators	Electricity consumption for operation
Wet gas scrubbers	Nucleation/ impaction	>90%	Petroleum refineries, pulverized coal combustors	Waste solvent is contaminated with wet dust; requires disposal

DIESEL OXIDATION CATALYST (DOC)

It is specifically designed to reduce the emission rate of carbon monoxide (CO) before releasing it to atmosphere. The oxidation takes place in the catalytic converter by the material coated in ceramic honey comb structure. When materials like hydro carbons (HC), particulate matter (PM), Carbon monoxide (CO) and Soluble organic fraction (SOF) gets reacts to the material and converted into carbon dioxide (CO2) and water (H2O). Basically the diesel engines works normally using more air than fuel, so therefore they operates as an oxidation catalyst cutting CO and HC emissions by more than 90%.

1. $CO + ½\ O2 \rightarrow CO2$
2. $[HC] + O2 \rightarrow CO2 + H2O$

The ceramic honey comb structure use material coated with metals such as platinum (or) palladium.

Emission Legislation	PM Limit	DOC Application
Light-Duty Vehicles		
Euro (1996)	PM = 0.08 g/km	DOCs introduced on larger size diesel cars.
Euro 3-4 (2000-2005)	PM = 0.05-0.025 g/km	The main after treatment strategy, used on most diesel passenger cars and light trucks. Many cars could meet Euro 5a using a DOC, but DPFs became adopted in some markets (e.g., Germany) for political reasons.
Euro 5a (2009.09)	PM = 0.005 g/km	Many cars could meet Euro 5a using a DOC, but DPFs became adopted in some markets (e.g., Germany) for political reasons.
Heavy-Duty Engines		

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US 1994	PM = 0.10 g/bhp-hr	DOC introduced on many light and medium heavy-duty engine models, most with mechanical fuel injection systems. DOCs widely used on urban bus engines due to a more stringent PM limit of 0.07-0.05 g/bhp-hr.
US 1998	PM = 0.10 g/bhp-hr	DOC remained common in many light and medium heavy-duty engine models. In some cases, a DOC was no longer required as in-cylinder control was enabled by the replacement of remaining mechanical fuel injection systems with electronically controlled systems required for the lower NOx limits. Urban bus engines continued to rely heavily on DOCs.
US 2004	PM = 0.10 g/bhp-hr	The DOC continued to remain popular for light and medium heavy-duty engine models using EGR to comply with NOx limits. Used for all on-highway engines that did not use external EGR (e.g. Caterpillar ACERT engines). Continued to be used on urban bus engines.
Euro IV/V (2005/2008)	PM = 0.02 g/kWh	DOC technology used on some truck engines with EGR (without urea-SCR).
Nonroad Tier 4i/Stage IIIB (2011-2012)	PM = 0.02 g/kWh	DOC technology introduced on selected nonroad engine models (mostly those using EGR for NOx control).

CATALYTIC CONVERTER

Catalyst is simply a chemical that makes a chemical reaction go faster without itself changing in the process. Normally catalyst consists of two-way pipes of opposite direction, one is input pipe where they allow the emission gas from engine outlet to ceramic structure. Other pipe leads the gas from catalytic cylinder to the atmosphere with less harmful gas emission. Ceramic structure inside the cylinder normally uses palladium, platinum and rhodium by varying the usage ratio of these metals the emission of gas is controlled. By through various researches the catalytic converter uses various ratios of metals inside. Normally when carbon monoxide released to atmosphere it gets into carbon dioxide, so using the catalytic converter to reduce the carbon monoxide (CO) make the process easier for atmosphere and makes less harmful than compare to No catalytic converter.

II. PROPOSED WORK

Combination of after treatment devices makes the emission control very effective having the value of emission lesser than compare to every catalytic converter like DPF, DOC and SCR. When the emission of exhaust gas passes through every catalyst the gas passing from one catalytic to another makes the chemical reaction between the gas and ceramic honey comb structure easier, emission level is decreased. The catalysts are connected in the order Diesel particulate filter (DPF) next Diesel oxidation catalyst (DOC) and finally new catalytic converter so that the emission of exhaust gas is decreased at maximum level and released to the atmosphere.

III. CONCLUSION

This paper shows that the emission can be reduced by the implementation of combination of after treatment devices into existing diesel engine. Considering a catalytic converter as the study point and investigation on combination of DPF,

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DOC and catalytic converter to the diesel engine. By using the filter method in DPF catalyst we can reduce the emission up to 99%. According to the research the emission level in DOC get reduced in euro from 0.08 to 0.005 g/km and in US reduced from 0.10 to 0.02 g/kWh, so we took the advanced researches and made a cost and eco-friendly catalyst to reduce the emission level

REFERENCES

[1]. M. L. Mathur& R. P. Sharma, "Internal combustion engines", DhanpathRai publications, eight editions -21th Reprint: 2010.

[2]. S. S. Tipse, "Alternate fuels", First edition: 2010.

[3]. B. P. Pundir, "IC engines combustion and emissions", Narosa publishing house, edition 2010.

[4]. David F, Merrion, "Heavy duty diesel emission regulations-Past, Present and future", SAE Paper 2003-01-0040.

[5]. James P Warren et.al [4] First international conference on health effects from vehicle emissions, SAE Journals.

[6]. Hartmut Luders, peter stommer and Sam & Sam grackle et.al [5] SAE Journals No 1999-01-0108.

[7]. Thompson N, Ntziachristos l, Samaros Z Aako PWass U, Hausberger S AND SAMS et al [3] SAE journals no 2004-01-1986.

[8]. Dhole Dattatray, M, Doekar Akshay, Shelar Amit M, Kargal Maruti D, PROF Ankush RD volume: 04 issue: 10oct-2017,international journal of engineering and technology(IRJET) journals.

[9]. Prof Dipak P Kharat Rahul N Bhagavat T adhao arjun r pawal manoj a gorale [2] vol7/issue/02/2019/438. International journal for scientific research and development (IJSRD0.

[10]. Ambs, J.L., B.T. McClure, 1993. "The Influence of Oxidation Catalysts on NO2 in Diesel Exhaust", SAE Technical Paper 932494, doi: 10.4271/932494

[11]. Russell, A., Epling, W.S., 2011. "Diesel Oxidation Catalysts", Cat. Rev. - Sci. Eng., 53(4), 337-423, doi:10.1080/01614940.2011.596429

[12]. Wade, J., & Farrauto, R. J. (2012). Controlling emissions of pollutants in urban areas. Metropolitan Sustainability, 260–291. doi:10.1533/9780857096463.3.260