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EXPERIMENTAL INVESTIGATION ON EMISSION CONTROL USING COPPEROXIDE COATING ON CATALYTIC CONVERTER

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ABSTRACT : Diesel power invitably finds a very important role in the development of the plant's economy and technical growth. Inspite of their high thermal efficiency, one cannot ignore the fact about the effect of their exhaust, in the atmosphere. Objective of this project is to design & fabricate a simple system, where the toxic levels are controlled through chemical reaction to more agreeable level. This system acts itself as a silencer; there is no need to separate the silencer. The whole assembly is fitted in the exhaust pipe, it does not give rise to any complications in assembling it. This system is very cash effective and more economical.

Key words–Copper Oxide, Coating, Emission

INDRODUCTION

Diesel engine known for its vide range of application in various fields like sea transport, Agriculture, mining and many other industries. Inspite, we cannot ignore the harmful effects of the large mass of the burnt gases, which erodes the purity of our environment everyday. It is especially so, in most developed countries like USA and EUOPE. 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. For achieving this toxic gases are to be reduced to acceptable limits before they are emitted out of this atmosphere, which otherwise will be hazardous and prone to accidents. In this project we are dealing with reduction of toxic gases from an diesel engine by a copper oxide coating to a catalytic converter of an diesel engine exhaust. Conducting emission analysis and comparing the values obtained from the setup with before values to find out the reduction in emissions. This system is very cash effective and more economical.

II-LITERATURE REVIEW

Lundsager et al (1975): A highly versatile and efficient catalytic converter for internal combustion engine exhaust which includes a porous ceramic monolithic support provided with through 'holes substantially uniformly throughout a ?first portion for passing the exhaust in contact with catalyst metal values deposited on walls defining the holes. The support is provided with a second portion wherein similar holes are free of deposited catalyst and adapted to prevent passage of the exhaust. Also disclosed are an installation assembly including the converter and a process for preparing the converter.

T.Velmurugan et al (2015),This journal presents effect of ceramics material on a new catalytic converter to be used for diesel fueled engine with 20% of neem oil blend. The catalytic converter was developed based on catalyst materials consisting of metal oxide such as zinc oxide(Zno) and manganese oxide(Mno) with ceramic substrates .Both of the catalyst materials are inexpensive in comparison with conventional catalysts such as palladium or platinum. In addition, the noble metals such as platinum group metals are now identified as human health risk due to their rapid emissions in the environment from various resources like conventional catalytic converter, jewelers and other medical usages. The Original Engine Manufacturer (OEM) catalytic converter was based on noble metal catalyst with honey comb ceramic substrate. Such that here also using ceramic substrate and coated with oxides of metals are Zno/Mno based catalytic converter reduce smoke emissions. The objective of this paper is to develop a low-cost three way catalytic converter to be used with the newly developed catalytic converter. Detailed review on ceramic coated catalytic converter and emissions test results have been presented with discussion.

Saeed Dehestani Attar et al (2012), Diatomite coated by nanoparticles of copper and zinc mixed oxides were used to investigate catalytic oxidation of carbon monoxide. Objectives: Aim of this paper was to investigate diatomite performance as a supporting host to confine the Cuo and Zno nanoparticles and its catalytic activity for carbon monoxide oxidation. Materials and Methods: The prepared catalysts were characterized BURNER-EMMETT-TELLER (BET) surface area, SCANNING ELECTRON MICROSCOPY (SEM) and X-RAY DIFFRACTION (XRD). Catalytic behavior for CO oxidation was studied at different conditions in a tubular reactor packed with catalyst. Results: The results illustrated that diatomite is the promising candidate for catalyst support due to its unique characteristics. The variation of catalytic activity of the prepared composite catalysts with different molar fractions of Cuo and No for CO oxidation in different reaction temperatures was investigated. Conclusions: It was found that a CO conversion of 100% can be achieved at 300 ºCover catalyst with 80 mol% CuO and 20 mol% ZnO content.

III- EXPERIMENTAL PROCEDURE

In this experimental procedure to design and fabricate the new honeycomb structure using coperoxide (cuo) with diesel in already existing catalytic converter under follow the mythology with manually

PROBLEM IDENTIFICTAION

DATA COLLECTION

IDENTIFICATION AND SELECTION OF MATERIALS

EXPERIMENTAL WORK BY COATING ON SPECIMEN

TESTING

TEST REVOLUTION

COMPARISION OF RESULT

FIG:EXPERIMENT ANALYSIS

PART	SPECIFICATION
Product	Single cylinder , 4 stroke, multi-fuel VCR (computerised)
Product code	240PE, Make: apex innovation pvt. Ltd.
Engine	Single cylinder, 4 stroke, water cooled, bore 87.5mm, capacity 661cc. Diesel mode: power 3.5 kw, speed 1500 rpm, Injection variation: 0 – 25 degree bTDC power 3.5 kW @1500 rpm, speed range 1200-1800 rpm,
Dynamometer	Eddy current i.e water cooled, with loading unit Model iag10 of Sai test plant pvt. Ltd.
Fuel tank	Capacity 15 lit. Type: dual compartment, with fuel metering pipe of glass
Piezosensor	Combustion: range 5000 psi, Diesel line: range 5000 psi
Crank angle sensor	Resolution 1degree, speed 5500 rpm with TDC pulse
Data acquisition device	Ni usb-6210, 16 bit, 250 ks/s
Engine control hardware	Fuel injector, fuel pump, ignition coil, idle air
Temperature sensor	Type rtd, pt100 and thermocouple, type k
Load indicator	Digital, range 0-50 kg, supply 230 v ac
Load sensor	Load cell, type strain gauge, range 0-50 kg
Software	"Enginesoft" engine performance analysis software

TABLE: ENGINE SPECIFICATION

ITEM	DETAIL
Measurement principle	Measurement of filter paper blackening
Measured value output	FSN (filter smoke number) or mg/m3 (soot concentration)
Measurement range	0 – 10 fsn
Detection limit	0.002 fsn or 0.02 mg/m3

TABLE: SPECIFICATION OF AVL SMOKE METER

Resolution	0.001 fsn or 0.01 mg/m3
Exhaust pressure ranges	(-300*) – 100 to 400mbars (-500*) – 200 to 750 mbars 0 – 3000 mbars with the high pressure option (*) with activate altitude simulation
Maximum exhaust temperature	600° C with standard 340 mm sample probe
Interfaces	2 serial rs 232 interfaces with a k protocol Digital via instrument 6approx.6per 4210 1 ether net interface with in port option install
Power supply Power consumption	100 – 115V ac or 230V ac, 50/60 hz 700 va
Compressed air	150i/min during purge Grades 1.1.1 to 1.4.1 according to ISO 8573.1:2001I Recommended connection pressure on the AVL smoke meter: 5 to 8 bars at the measurement device input
Weight	<40 kg
Dimensions(w x h x d)	560 x 620 x 300 mm
Sample flow	10 i/min
Ambient condition	5 to 55° C /max. 95 rh; without condensation Sea level -500 to +5000m
Repeatability	Standard deviation is=+- (0.005 fsn+3% of the measured value@ 10 sec intake time)

IV-RESULT ANALYSIS

We have selected the ANIL 6HP diesel engine to test an emission control process. In the previous chapter, the full details of operation and working principles of the ORSAT apparatus. At first, impure and non-treated exhaust from the engine was tested in the ORSAT apparatus. Then, the treated exhaust gas coming through the scrubber tank was tested in the ORSAT apparatus. The orsat apparatus observations of before and after treatment of exhaust gases are shown in the following two separate observation tables 8.5 &8.6 respectively.

The results obtained from the observations are given in percentage reduction of gases. The variation in the percentage gives amount of pollutants control by this project.

ANALYSIS:

1. Reduction of carbon-di-oxide (CO_2 in %) = 9.50 – 6.75 = 2.75
2. Reduction oxygen (O_2 in %) = 7.25 – 7.00 = 0.25
3. Reduction of carbon monoxide (CO in %)= 1.00 – 0.50 = 0.50

4.The significant reduction in CO_2 in due to the formation of salts likes carbon- bi carbonate. (Chemical reactions 3 & 5).

5. Even though there ought to be a significant reduction in oxygen because nitrogen –di –oxide is converted to calcium nitrate and calcium nitrite. In the observe there is no significant reduction. This might due to the presence of steam in the diesel emission after scrubbing.

6. There is 0.5 % in carbon monoxide which is equal to 50% reduction of the original value. Eventhough the theoretical value of CO in diesel emission is only 2%, the accuracy which could be obtained from orsat apparatus (+0.5%) does not permit this level of accurate measurement.

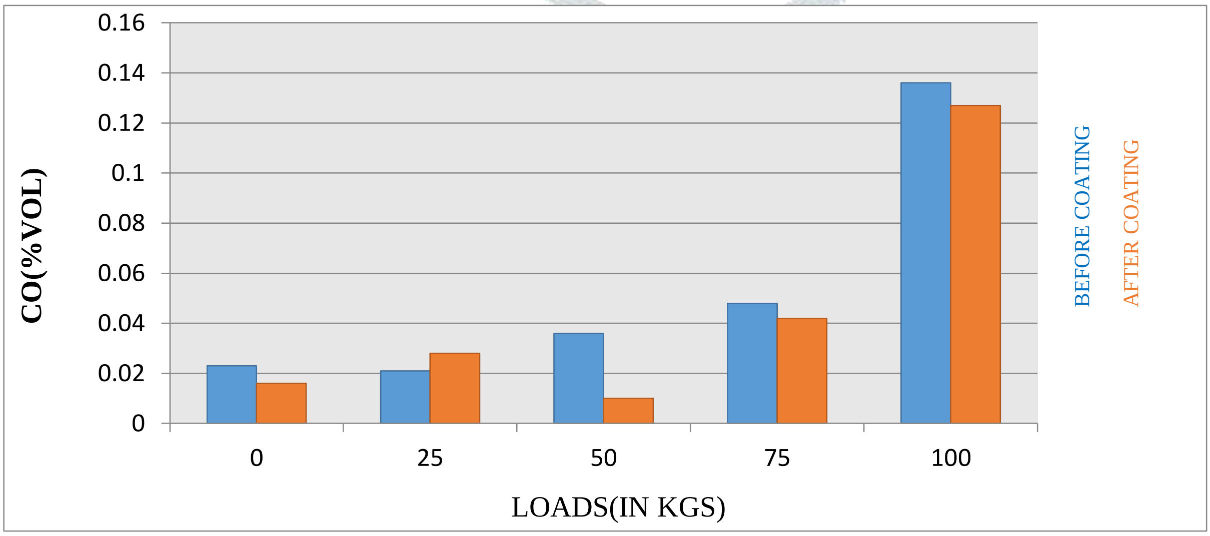
7. The nitrogen content is also reduced due to the formation of calcium nitrate & calcium nitrite salts. But it cannot be noted, because these are measuring nitrogen only by difference.

8. After scrubbing the presence of hydrogen in the emission is inevitable, because of the presence of steam.

RESULTS(BEFORE&AFTER COATING)

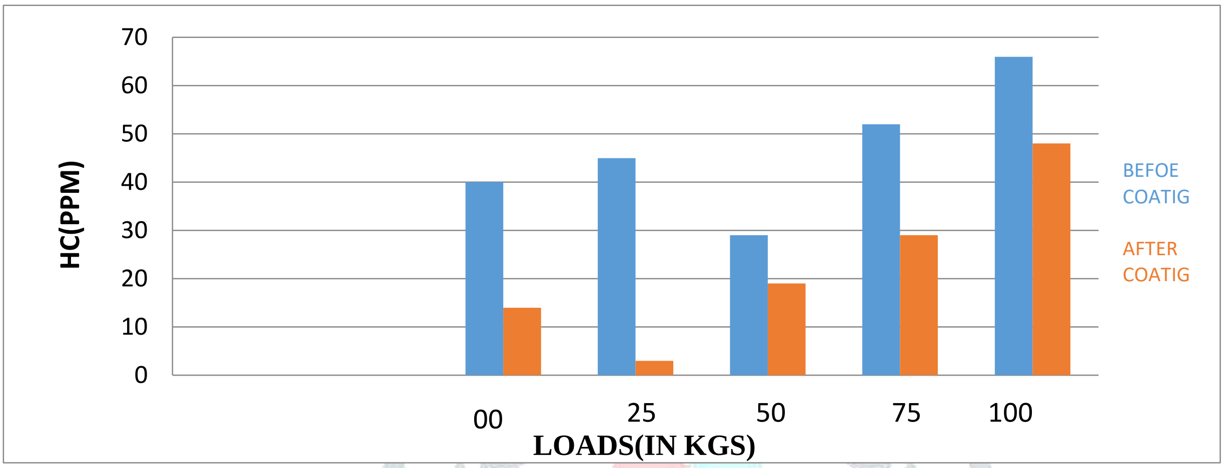
1.CO VALUES:

S.NO	FUEL	LOADS (Kgs)	BEFORECOATING	AFTERCOATING
			CO(%VOL)	CO(%VOL)
1	DIESEL	0	0.023	0.016
2	DIESEL	25	0.021	0.028
3	DIESEL	50	0.036	0.01
4	DIESEL	75	0.048	0.042
5	DIESEL	100	0.136	0.127



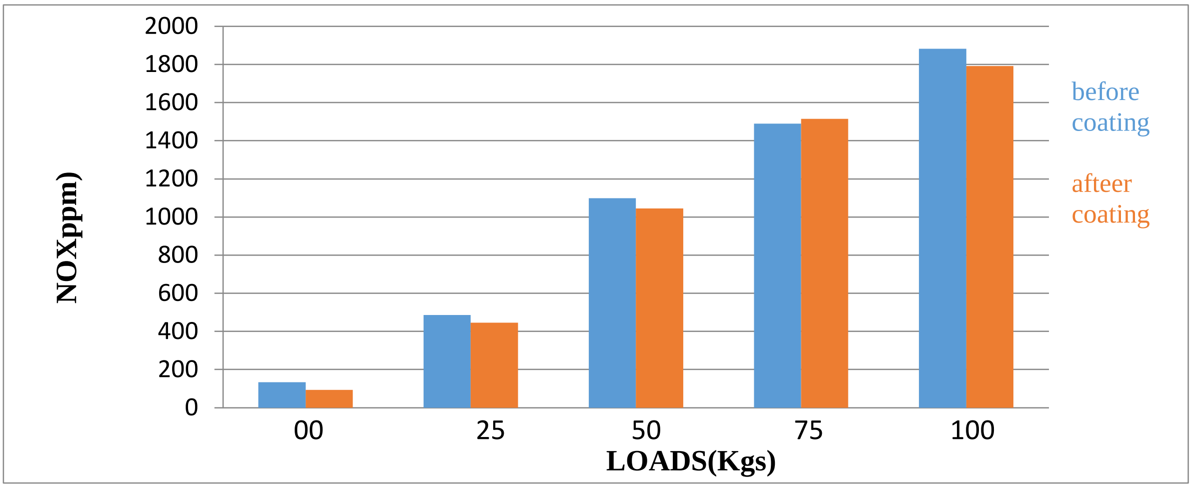
2.HC VALUES:

S.NO	FUEL	LOADS(kgs)	BEFORE COATING	AFTER COATING
			HC (IN PPM)	HC (IN PPM)
1	DIESEL	0	40	14
2	DIESEL	25	45	3
3	DIESEL	50	29	19
4	DIESEL	75	52	29
5	DIESEL	100	66	48

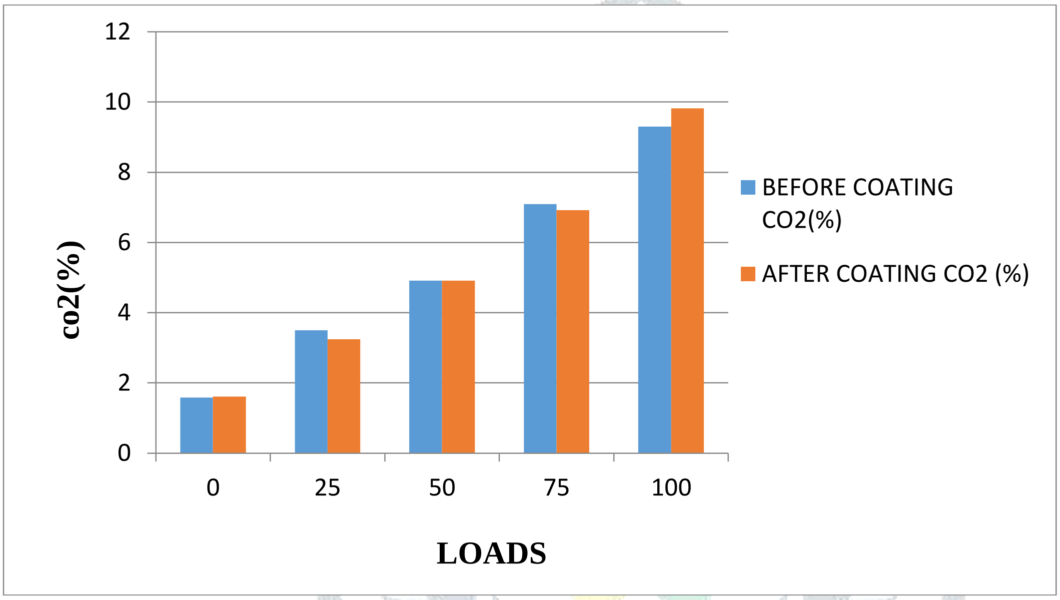


3.NOX VALUES:

S.NO	FUEL	LOADS(kgs)	BEFORE COATING	AFTER COATING
			NOX (IN ppm)	NOX (IN ppm)
1	DIESEL	0	134	93
2	DIESEL	25	486	446
3	DIESEL	50	1098	1045
4	DIESEL	75	1489	1514
5	DIESEL	100	1882	1792



4. **CO2 VALUES:**



S.NO	FUEL	LOADS(kgs)	BEFORE COATING	AFTER COATING
			CO2(%)	CO2 (%)
1	DIESEL	0	1.58	1.61
2	DIESEL	25	3.5	3.24
3	DIESEL	50	4.91	4.91
4	DIESEL	75	7.09	6.92
5	DIESEL	100	9.3	9.82

V- CONCLUSION

The exhaust manifold of a four cylinder engine was investigated for thermal and flow analysis using Ansys workbench. The thermal analysis concludes that model with zirconium coating exhibits the better results than other coating powders in terms of temperature distribution and total heat flux variables. So Zirconium dioxide coating is recommending for the future work. And also from the CFD simulation it is concluded that the model with double outlet (model 1) possess excellent flow characteristics in terms of back pressure, exhaust velocity, turbulence kinetic energy than the existing model. So the double outlet model is considered for future work.

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