iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VII **Month of publication:** July 2017

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, July 2017- Available at www.ijraset.com

Emission Controller of a Four Stroke Engine by Using Catalytic Converter

T.Pushpaganeshan[1] , A.Mohammed Abdul Ajeez[2]
[1,2] *Mechanical Engineering, Dhanalakshmi Srinivasan College of Engineering and technology*

Abstract: Air and noise pollution are the biggest cause of environmental degradation in the world . these pollutants also cause health decoration . the major source for these pollutions are industries, automobiles ,etc. these pollutants can be reduced by using a catalytic converter the main aim of our project is fabricate the low cost catalytic converter for two wheeler. In this project the filter is thermal coated by mixing the ammonium hydroxide with copper oxide and nickel oxide. And the small size solid charcoals are placed between the two filters. By this setup the emission contents namely Nox and Hc are 90% reduced . finally implement the catalytic converter in two wheeler

Air pollution is most important from the public health point of view, because every individual person breathes approximately 22000 times a day, inhaling about 15 to 22 Kg of air daily. Polluted air causes physical ill effects and undesirable aesthetic and physiological effects. The main pollutants are contributed by automobiles which include carbon monoxide (CO), unburned hydrocarbon (UBHC), oxides of nitrogen (Nox) and Lead. So it is imperative that serious attempts should be made to conserve earth's environment from degradation

Keywords: Four Stroke Engine ,copper oxide ,nickel oxide ,Silencer,Filter

I. INTRODUCTION

Catalytic Converter is a vehicle emissions control device that converts toxic pollutants in exhaust gas to less toxic pollutants by catalyzing a redox reaction (oxidation or reduction). Catalytic converters are used in internal combustion engines fuelled by either petrol (gasoline) or diesel—including lean burn engines. The catalytic converter was invented by Eugene Houdry, a French mechanical engineer and expert in catalytic oil refining who lived in the U.S. around 1950. When the results of early studies of smog in Los Angeles were published, Houdry became concerned about the role of smoke stack exhaust and automobile exhaust in air pollution and founded a company, Oxy-Catalyst. Houdry first developed catalytic converters for smoke stacks called cats for short. Then he developed catalytic converters for warehouse fork lifts that used low grade non-leaded gasoline.

catalytic converter is a simple device that uses basic redox reactions to reduce the pollutants released by an engine. It converts around 98% of the harmful fumes produced by a car engine into less harmful gases. It is composed of a metal housing with a ceramic honeycomb-like interior with insulating layers. This honeycomb interior has thin wall channels that are coated with a wash coat of aluminum oxide. This coating is porous and increases the surface area, allowing more reactions to take place and containing precious metals such as platinum, rhodium, and palladium. No more than 4-9 grams of these precious metals are used in a single converter The converter uses simple oxidation and reduction reactions to convert the unwanted fumes. Recall that oxidation is the loss of electrons and that reduction is the gaining of electrons.

A. Two-way

A two-way catalytic converter has two simultaneous tasks:

1) Oxidation of carbon monoxide to carbon dioxide: $2CO + O2 \rightarrow 2CO2$
2) Oxidation of unburnt hydrocarbons (unburnt and partially-burnt fuel) to carbon dioxide and water: $CxH2x+2 + 2xO2 \rightarrow xCO2 + 2xH2O$ (a combustion reaction)

This type of catalytic converter is widely used on diesel engines to reduce hydrocarbon and carbon monoxide emissions

B. Three-way

Since 1981, three-way catalytic converters have been used in vehicle emission control systems in North America and many other countries on road going vehicles. A three-way catalytic converter has three simultaneous tasks:

Reduction of nitrogen oxides to nitrogen and oxygen:

$2NOx \rightarrow xO2 + N2$

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, July 2017- Available at www.ijraset.com

Oxidation of carbon monoxide to carbon dioxide:

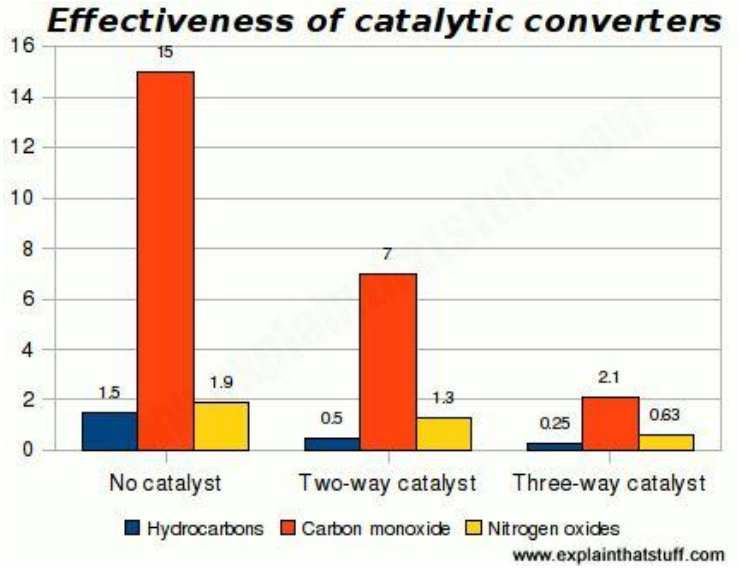
$2CO + O2 \rightarrow 2CO2$

Oxidation of Un burnt hydrocarbons (HC) to carbon dioxide and water:

$CxH2x+2 + 2xO2 \rightarrow xCO2 + 2xH2O$

These three reactions occur most efficiently when the catalytic converter receives

Exhaust from an engine running slightly above the stoichometric point. This is between 14.6 and 14.8parts air to 1 part fuel, by weight, for gasoline. The ratio for LPG, natural gas and ethanol fuels is slightly different, requiring modified fuel system settings when using those fuels. Generally, engines fitted with 3-way catalytic converters are equipped with a computerized closed-loop feedback fuel injection system employing one or more oxygen sensors, though early in the deployment of 3-way converters, carburetors equipped for feedback mixture control were used. While a 3-way catalyst can be used in an open-loop system, NOx reduction efficiency is low. Within a narrow fuel/air ratio band surrounding stoichometry, conversion of all three pollutants is nearly complete. However, outside of that band, conversion efficiency falls off very rapidly. When there is more oxygen than required, then the system is said to be running lean, and the system is in oxidizing condition. In that case, the converter's two oxidizing reactions (oxidation of CO and hydrocarbons) are favoured, at the expense of the reducing reaction. When there is excessive fuel, then the engine is running rich. The reduction of NOx is favoured, at the expense of CO and HC oxidation.



C. Problem Identification

In the present IC engine catalytic converter is high cost. Because the material used in the catalytic converter is platinum, rhodium and

Palladium.

II. LITERATURE SURVEY

A. *V.Veeraragavan*

In his paper discussed about an attempt has been made to study the performance of various metal oxide catalyst a combustion of carbon monoxide and tri metal oxide catalyst in reducing the pollutant from four stroke C.I engine it has been found that a stable catalyst have been found through experimental that can act as a promising technology in future.

B. SojiAdeyinka

In his paper designed a reactor for the conversion of exhaust pollutants from an internal combustion engine using gasoline as fuel. A bed height of 420 mm was used with an internal diameter of 40mm; a space-time of 23.6s and a frac-tional conversion of 0.99 at a space velocity of 0.042 m/s was achieved. And also it was shown performance evaluation of the pollutant conversion at 375 degree C showed 98% conversion of CO, 99% of HC and NO, 98% with 100% nitrogen utilisation.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, July 2017- Available at www.ijraset.com

C. Rajesh B Biniwale

In his study showed that National Environmental Engineering Research Institute (NEERI) has developed a non-noble metal based catalytic con-verter considering the present and future emission standards. These non-metal based converters can also be fitted to old, on-road vehicles, which shares major part of total vehicular emissions, and thus a large mar-ket is readily available. Financial analysis reveals that the technology is cost- effective and has wide commer-cial application.

D. R. Makwana

In his work developed a cost effective Nickel based oxidation catalytic converter to be used with four stroke diesel engine. Inexpensive CAT development, performance evolution and engine test results have been presented with discussion

III. EXPERIMENT SETUP

A. Materials Used

1) Mild Steel:

Mild steel (steel containing a small percentage of carbon, strong and tough but not readily tempered), also known as **plain-carbon** steel and Low carbon steel. It is now the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications. Mild steel contains approximately 0.05–0.25% carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing.

It is often used when large quantities of steel are needed, for example as structural steel. The density of mild steel is approximately 7.85 g/cm^3 (7850 kg/m^3 or 0.284 lb/in^3) and the Young's modulus is 200 GPa (29,000,000 psi).

Low-carbon steels suffer from *yield-point runout* where the material has two yield points. The first yield point (or upper yield point) is higher than the second and the yield drops dramatically after the upper yield point. If a low-carbon steel is only stressed to some point between the upper and lower yield point then the surface develop Lüder bands. Low-carbon steels contain less carbon than other steels and are easier to cold-form, making them easier to handle

2) Stainless Steel:

stain-proof in low-oxygen, high-salinity, or poor air-circulation environments. There are various grades and surface finishes of stainless steel to suit the environment the alloy must endure. Stainless steel is used where both the properties of steel and corrosion resistance. Stainless steel does not readily corrode, rust or stain with water as ordinary steel does. However, it is not fully are required.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, July 2017- Available at www.ijraset.com

Stainless steel differs from carbon steel by the amount of chromium present. Unprotected carbon steel rusts readily when exposed to air and moisture. This iron oxide film (the rust) is active and accelerates corrosion by making it easier for more iron oxide to form. Since iron oxide has lower density than steel, the film expands and tends to flake and fall away. In comparison, stainless steels contain sufficient chromium to undergo passivation, forming an inert film of chromium oxide on the surface. This layer prevents further corrosion by blocking oxygen diffusion to the steel surface and stops corrosion from spreading into the bulk of the metal. Passivation occurs only if the proportion of chromium is high enough and oxygen is present

3) Charcoal

Charcoal is a lightweight, black residue, consisting of carbon and any remaining ash, obtained by removing water and other volatile constituents from animal and vegetation substances. Charcoal is usually produced by slow pyrolysis- the heating of wood or other substances in the absence of oxygen)

The question of the temperature of the carbonization is important; according to J. Percy, wood becomes brown at 220 °C (428 °F), a deep brown-black after some time at 280 °C (536 °F), and an easily powdered mass at 310 °C (590 °F). Charcoal made at 300 °C (572 °F) is brown, soft and friable, and readily inflames at 380 °C (716 °F); made at higher temperatures it is hard and brittle, and does not fire until heated to about 700 °C (1,292 °F).

IV. CHEMICALS USED

A. Copper Oxide

1) *Copper (II) Oxide or Cupric Oxide:* is the inorganic compound with the formula CuO. A black solid, it is one of the two stable oxides of copper, the other being Cu_2O or cuprous oxide. As a mineral, it is known as tenorite and paramelaconite. It is a product of copper mining and the precursor to many other copper-containing products and chemical compound
2) *Reactions:* It can be reduced to copper metal using hydrogen, carbon monoxide, or carbon:

$$CuO + H_2 \rightarrow Cu + H_2O$$
$$CuO + CO \rightarrow Cu + CO_2$$
$$2CuO + C \rightarrow 2Cu + CO_2$$

3) *Use in Disposal:* Cupric oxide can be used to safely dispose of hazardous materials such as cyanide, hydrocarbons, halogenated hydrocarbons and dioxins, through oxidation.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, July 2017- Available at www.ijraset.com

B. Nickel Oxide

Nickel (II) oxide is the chemical compound with the formula NiO. It is notable as being the only well-characterized oxide of nickel (although nickel (III) oxide, Ni2O3 and NiO2 have been claimed. The mineralogical form of NiO, bunsenite, is very rare. It is classified as a basic metal oxide. Several million kilograms are produced in varying quality annually, mainly as an intermediate in the production of nickel alloys.

NiO can be prepared by multiple methods. Upon heating above 400 °C, nickel powder reacts with oxygen to give NiO. In some commercial processes, green nickel oxide is made by heating a mixture of nickel powder and water at 1000 °C, the rate for this reaction can be increased by the addition of NiO.[4]

NiO was also a component in the nickel-iron battery, also known as the Edison Battery, and is a component in fuel cells. It is the precursor to many nickel salts, for use as specialty chemicals and catalysts

C. Engine Specification

A spark-ignition engine is an internal combustion engine, generally a petrol engine, where the combustion process of the air-fuel mixture is ignited by a spark from a spark plug. This is in contrast to compression-ignition engines, typically diesel engines, where the heat generated from compression together with the injection of fuel is enough to initiate the combustion process, without needing any external spark.

Spark-ignition engines are commonly referred to as "gasoline engines" in North America, and "petrol engines" in Britain and the rest of the world. However, these terms are not preferred, since spark-ignition engines can (and increasingly are) run on fuels other than petrol/gasoline, such as autogas (LPG), methanol, ethanol, bioethanol, compressed natural gas (CNG), hydrogen, and (in drag racing) nitromethane

The working cycle of both spark-ignition and compression-ignition engines may be either two-stroke or four-stroke.

A four-stroke spark-ignition engine is an Otto cycle engine. It consists of following four strokes: suction or intake stroke, compression stroke, expansion or power stroke, exhaust stroke. Each stroke consists of 180 degree rotation of crankshaft rotation and hence a four-stroke cycle is completed through 720 degree of crank rotation. Thus for one complete cycle there is only one power stroke while the crankshaft turns by two revolutions.

Type	Air cooled, 4 - stroke single cylinder OHC
Displacement	97.2 cc
Max. Power	6.15kW (8.36 Ps) @8000 rpm
Max. Torque	0.82kg - m (8.05 N-m) @5000 rpm
Max. Speed	87 Kmph
Bore x Stroke	50.0 mm x 49.5 mm
Carburettor	Side Draft , Variable Venturi Type with TCIS

Compression Ratio	9.9 : 1
Starting	Kick / Self Start
Ignition	DC - Digital CDI
Oil Grade	SAE 10 W 30 SJ Grade , JASO MA Grade
Air Filtration	Dry , Pleated Paper Filter
Fuel System	Carburetor
Fuel Metering	Carburetion

V. WORKING

When the engine starts working it emits the harmful exhaust gases such as NOx ,HC and CO which causes severe health problem . It is controlled by fixing the catalytic converter with the engine and then the harmful gases get reduced when it react with catalytic converter coated with some chemicals such as copper oxide and nickel oxide are mixed with ammonium hydroxide and in between the filters the small amount of charcoal is placed .The reactions are generally

A. Reduction of nitrogen oxides to nitrogen and oxygen

$$2NO_x \rightarrow xO_2 + N_2$$

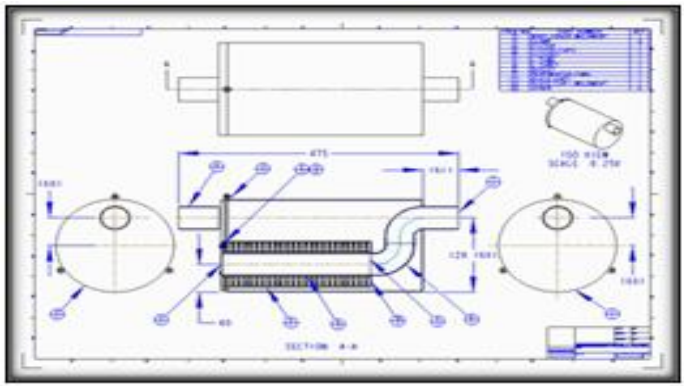
B. Oxidation of carbon monoxide to carbon dioxide

$$2CO + O_2 \rightarrow 2CO_2$$

C. Oxidation of unburnt hydrocarbons (HC) to carbon dioxide and water:

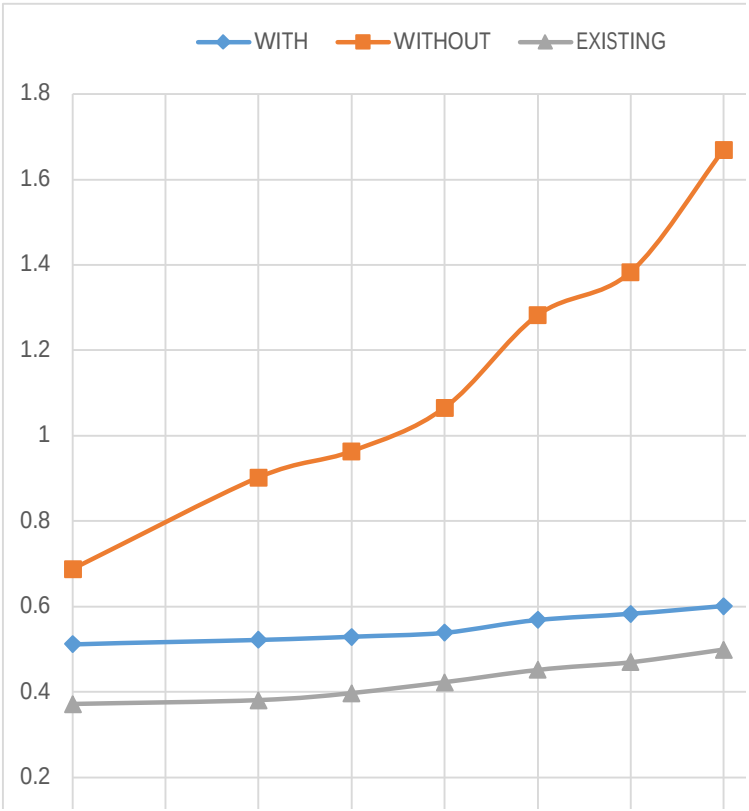
$$C_xH_{2x+2} + [(3x1)/2]O_2 \rightarrow xCO_2 + (x+1)H_2O$$

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, July 2017- Available at www.ijraset.com

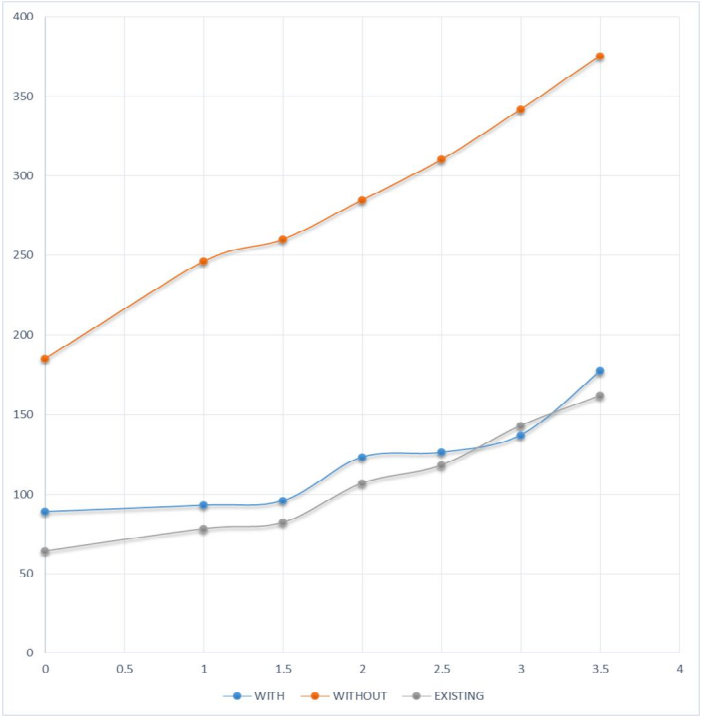


VI. GRAPH

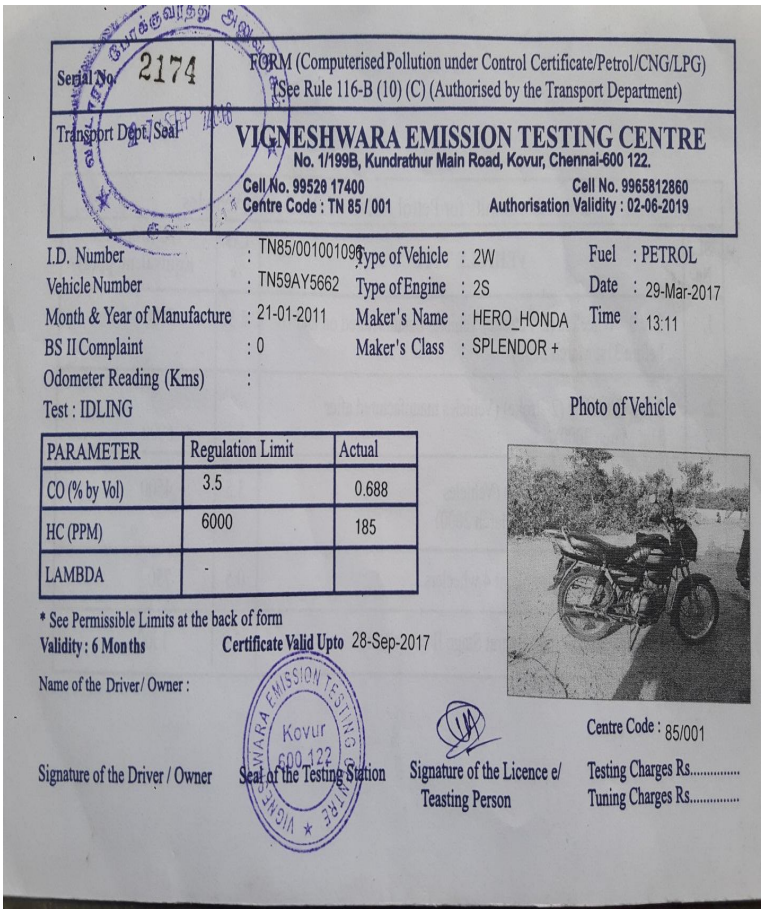
A. Comparison of Co Between With, Without and Existing Catalytic Converter



B. Comparison of Hc Between With, Without and Existing Catalytic Converter



C. Result



Serial No. 2174

FORM (Computerised Pollution under Control Certificate/Petrol/CNG/LPG)
(See Rule 116-B (10) (C) (Authorised by the Transport Department)

Transport Dept. Seal

VIGNESHWARA EMISSION TESTING CENTRE
No. 1/199B, Kundrathur Main Road, Kovur, Chennai-600 122.
Cell No. 99528 17400 Cell No. 9965812860
Centre Code : TN 85 / 001 Authorisation Validity : 02-06-2019

I.D. Number	: TN85/001001096	Type of Vehicle	: 2W	Fuel	: PETROL
Vehicle Number	: TN59AY5662	Type of Engine	: 2S	Date	: 29-Mar-2017
Month & Year of Manufacture	: 21-01-2011	Maker's Name	: HERO_HONDA	Time	: 13:11
BS II Complaint	: 0	Maker's Class	: SPLENDOR +		
Odometer Reading (Kms)	:				

Test : IDLING

Photo of Vehicle

PARAMETER	Regulation Limit	Actual
CO (% by Vol)	3.5	0.688
HC (PPM)	6000	185
LAMBDA	-	

* See Permissible Limits at the back of form
Validity : 6 Months Certificate Valid Upto 28-Sep-2017

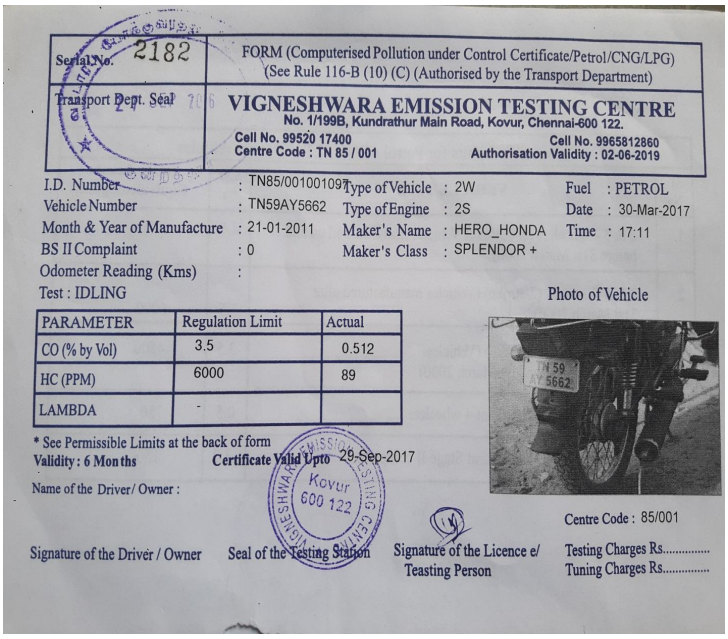
Name of the Driver/ Owner :

Signature of the Driver / Owner

Seal of the Testing Station

Signature of the Licence e/ Teasting Person

Centre Code : 85/001
Testing Charges Rs.....
Tuning Charges Rs.....



Serial No. 2182

FORM (Computerised Pollution under Control Certificate/Petrol/CNG/LPG)
(See Rule 116-B (10) (C) (Authorised by the Transport Department)

Transport Dept. Seal

VIGNESHWARA EMISSION TESTING CENTRE
No. 1/199B, Kundrathur Main Road, Kovur, Chennai-600 122.
Cell No. 99520 17400 Cell No. 9965812860
Centre Code : TN 85 / 001 Authorisation Validity : 02-06-2019

I.D. Number	: TN85/001001097	Type of Vehicle	: 2W	Fuel	: PETROL
Vehicle Number	: TN59AY5662	Type of Engine	: 2S	Date	: 30-Mar-2017
Month & Year of Manufacture	: 21-01-2011	Maker's Name	: HERO_HONDA	Time	: 17:11
BS II Complaint	: 0	Maker's Class	: SPLENDOR +		
Odometer Reading (Kms)	:				

Test : IDLING

Photo of Vehicle

PARAMETER	Regulation Limit	Actual
CO (% by Vol)	3.5	0.512
HC (PPM)	6000	89
LAMBDA	-	

* See Permissible Limits at the back of form
Validity : 6 Months **Certificate Valid Upto** 29-Sep-2017

Name of the Driver/ Owner :

Centre Code : 85/001

Signature of the Driver / Owner | Seal of the Testing Station | Signature of the Licence e/ Teasting Person | Testing Charges Rs..... Tuning Charges Rs.....

C. Cost Estimation

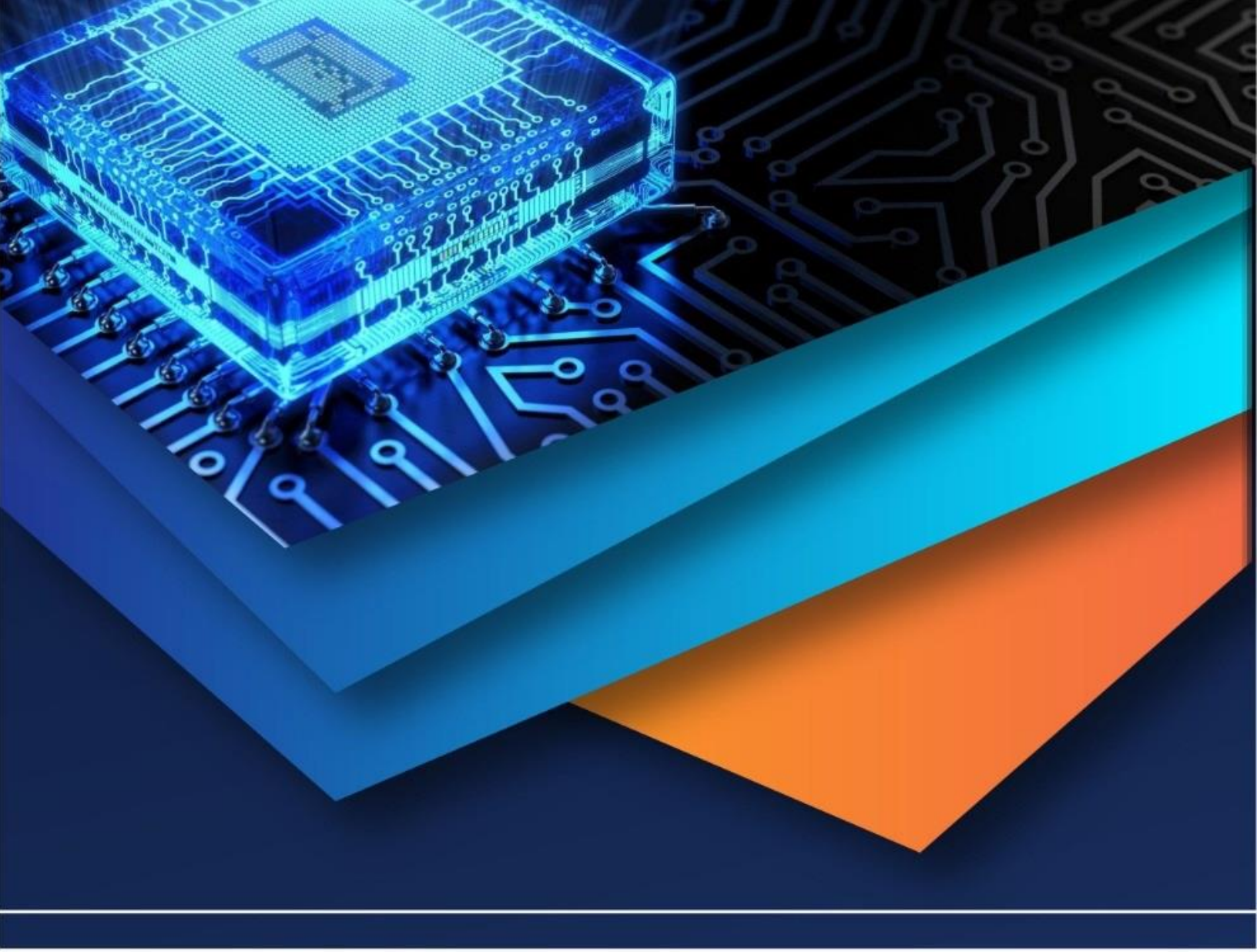
S.NO	MATERIAL	QUANTITY	COST
1	CYLINDER ROD (MILD STEEL)	1	400
2	FLANGE	1	350
3	WELDING	1	500
4	CUO(250g)	1	850
5	NIO(100g)	2	3924
6	AMMONIUM HYDROXIDE 200ml	1	200
7	FILTER	2	300
8	CHARCOAL		50
9	EMISSION TEST		4500
	TOTALCOST 11074		

VII.CONCLUSION

Thus the catalytic converter used in our project is coated with some chemicals such as copper oxide, nickel oxide and the two oxides is mixed with ammonium hydroxide to get a proper dilution of that chemicals which is applied on the filter and insert the filter inside the cylindrical rod and fix some charcoal over the filter and weld with flange to connected to the engine and read the emission comes out from the exhaust. The emission reduced in the vehicle by using our catalytic converter are CO (74%),HC (68%) and our catalytic converter is low cost when compared to existing catalytic converter because palladium, rhodium and platinum are the materials they are used to coated in that catalytic converter for car engines but we are used chemicals to coated in our catalytic converter for two wheeler spark ignition engine

REFERENCES

[1] V.Veeraragavan, “Fabrication and Testing of a Catalytic Convertor”, International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 2, Issue 11, November 2013 ISSN 2319 – 4847.
[2] J SojiAdeyinka, J U Okoli, YousuoDigineni, “Design and Fabrication of a catalytic reactor for treating automobile exhaust”, Indian Journal of Chemical Technology, Vol. 11, July 2004, pp. 560-564.
[3] Rajesh B Biniwale, Moqtik A Bawase, M MDeshmukh, “Production of Automotive Catalytic Converter based on Non-noble Metal Catalyst technology: A feasible Option”, Journal of Scientific & Industrial Research, Vol. 60, September 2001, pp 728-734.
[4] Narendrasinh R. Makwana, Prof. Chirag M. Amin, Prof. Shyam K. Dabhi, “Development and Performance Analysis of Nickel Based Catalytic Converter”, International Journal of Advanced Engineering Technology E-ISSN 0976-3945.
[5] Prof. Bharat S Patel, MrKuldeep D Patel, “A Review paper on Catalytic Converter for Automotive Exhaust Emission”, International Journal of Applied Engineering Research, ISSN 0973-4562 Vol.7 No.11 (2012).



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY