Scientific Journal of Impact Factor(SJIF): 3.134

e-ISSN(O): 2348-4470
p-ISSN(P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2,Issue 4, April -2015

Fabrication, Advancement And Emission Analysis of Pre-Filter and its Effect on Catalytic Converter

P.M.Sangadiya[1], M.V.Mohite[2]

[1]P.G. Student, Mechanical Engineering Dept, M.I.T., Mehsana, India
[2]Asst. Professor, Mechanical Engineering Dept, M.I.T.S, Mehsana, India

Abstract- *Nowadays, one of the greatest challenges faced by the mankind is the increasing pollution at an alarming rate. It is causing an environmental imbalance, increase the green house effect & impact on health of human being. Environmental imbalance created by automobile due to tailpipe exhaust emission which mainly depends on changes in driving conditions engine performance, composition of fuel & air fuel ratio. As there are large number of two wheeler automobile hence they contribute more in automobile environment pollution. There are two methods for controlling pollution which are pre-pollution control & post pollution control methods. This study is based on the pre-pollution control method in four stroke two-wheeler. In Present work, modified OEM design attaching carbon absorbing device because some leaded fuel decreases the efficiency of catalytic converter & thus increases rate of pollution. To increase the retention period of exhaust gas in catalytic converter providing more time for its oxidation and also to reduce harmful effect of lead fuel on catalytic converter. To provide a pre-filter device to increases good effect of catalytic converter. The proposed method is very effective in the prevention of environmental pollution contributed from two wheeler automobiles and open a gate way to study the change in concentration of exhaust emission due to carbon absorbing device with three-way catalytic converter.*

Keyword- *Pollution; Two wheeler automobile; Pre-pollution; Catalytic converter; Carbon absorbing device*

I. INTRODUCTION

During the last ten years, the use of motor vehicles has tremendously increased due to population growth and increased industrialization. The motorized two-wheeler market has been rapidly increased particularly in the urbanized area of Asia about 80 percent of the 300 millon two-wheeler worldwide are in Asia as are 90 percent of world two-wheeler sales. Fig.1 shows growth of vehicle & Fig .2 shows the population of two wheeler in India. And table-1 show the total emission from Indian Transport.[6]

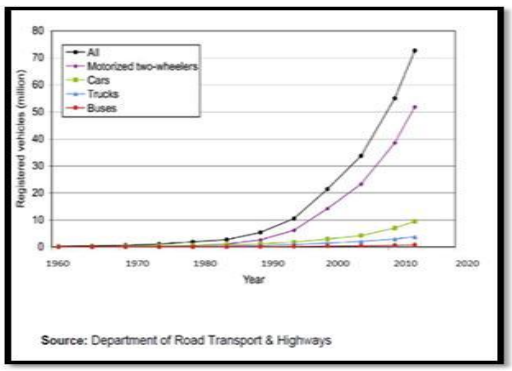


Figure 1. Growth of vehicle road transport & highway

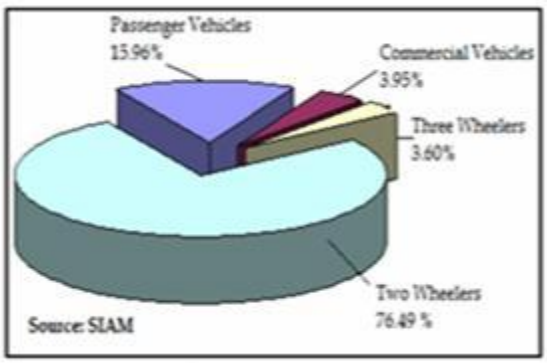


Figure 2. Population of two wheeler in India

	CO_2	CO	NO_x	CH_4	SO_2	PM	HC	N_2O
Shipping								
High speed diesel	782.28	10.66	8.5273	0.533	-	-	-	0.0064
Light diesel oil	162.18	2.21	1.7679	0.011	-	-	-	0.0013
Fuel oil	510.19	6.55	5.24	0.033	-	-	-	0.0039
Railways								
Coal	5.280	0.0155	0.0121		0.0421	-	-	
Electricity	Not considered				-	-	-	
High Speed diesel	5186.58	70.6712	56.54	0.353	-	-	-	0.0424
Light diesel oil	6.360	0.0867	0.0693	0.004	-	-	-	0.0001
Fuel Oil	25.04	0.3215	0.2572	0.0016	-	-	-	0.002
Aviation-								
High speed diesel	85.860	1.17	0.9359	0.0058	-	-	-	0.0007
Light diesel oil	6.360	0.0867	0.693	0.004	-	-	-	0.0001
Fuel oil	222.23	2.835	2.2828	0.0143	-	-	-	0.0017
Aviation turbine fuel	7294.14	2565.35	8.7331	6.549	-	-	-	-
Road transport	243816.6	3032.104	2213.85	126.78	709.09	153.127	723.409	-
Total	258103.14	5692.16	2298.29	133.8038	709.135	153.127	723.409	0.0568

Table 1. Total emissiom from India transport for 2011-2012 (Gg).

Vehicular emissions consist of the carbon dioxide, carbon monoxide, nitrogen oxide, hydrocarbons including lead, particulate matter etc. Inhaling of carbon monoxide and other pollutants hinders oxygen supply from blood into the tissues, as it combines with the iron in hemoglobin, leading to variety of ailments, viz. Cancer. Carbon dioxide causes the environmental problems related to global warming. The past decade has shown a sudden increase in the atmospheric concentration of heat-trapping gasses, due to human activity.

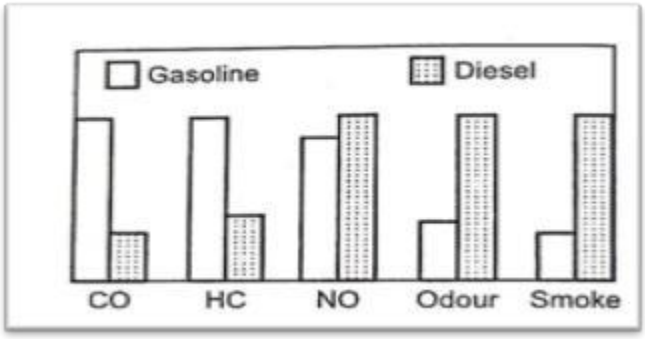


Figure 3. Comparison of emission from petrol and diesel engines

As Fig.3 shows the comparison of emission from petrol and diesel engines. It is clearly to be seen that there is a marked difference between the products of combustion of petrol and diesel engines. Where as petrol engines have somewhat similar emission pattern all diesel engines have different emission characteristics. One of these important heat-trapping gasses is carbon dioxide (CO_2). Carbon monoxide (CO) is considered as toxic pollutant, whose effective reduction can be achieved by using three-way catalytic converter[2] .This device is most effective to convert harmful gases due to engine exhaust into comparatively less harmful gases. Government of India has already made legislation for the use of Catalytic Converters in new passenger cars with effect from April 1995. But the day has come, where the number of two wheelers has overcome the four wheelers especially in Gujarat and thus it is required to reduce the amount of emission from these vehicles.[4]

II. LITERATURE REVIEW

A number of studies during the 60s reported evidence that seventy-five percent of carbon monoxide come from automobile. In all studies different techniques are used to control harmful pollution from vehicles. As per the all previous research and review papers, majority of them focused use of nano particle as catalyst, improved & latest design of nanosized catalytic converter, studies on ROL profile in catalytic converter and also modification and optimization of catalytic converter . In present studies, with the use of different pre-filter (poisoning control device) for catalytic converter in four stroke two wheeler. Some leaded fuel reduce the oxidation process by catalytic converter and so decreased the efficiency of it. Also to increase the retention period of exhaust gas in catalytic converter providing more time for its oxidation and to reduce poisoning effect of lead fuel on catalytic converter. The proposed method is very effective in the prevention of environmental pollution contributed from two wheelers.

III. DEMAND OF CATALYTIC CONVERTER

A catalytic converter is a vehicle emissions control device that converts toxic pollutants in exhaust gas to less toxic pollutants by catalyzing a reaction (oxidation or reduction).

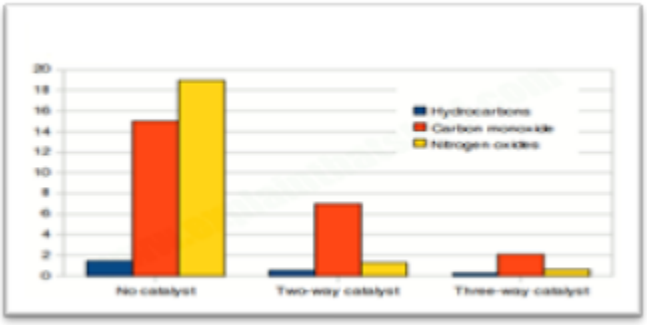


Figure 4. The effectiveness of catalytic converters

As Fig.4. show the effectiveness of catalytic converters. Catalytic converter is used in internal combustion engines fueled by petrol and diesel engines. This system to reduce HC and CO by oxidizing catalyst and NO by reducing catalyst. Although catalytic converters are most commonly applied to exhaust systems in automobiles, they are also used on electrical generators, mining equipment, and airplanes. This is usually in response to government regulation, either through direct environmental regulation or through safety regulations.

IV PRE-FILTER DEVISED

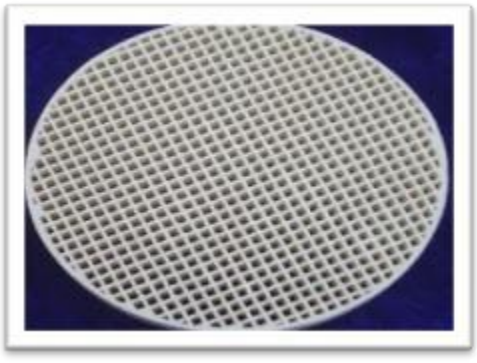
A pre-filter device to increases good effect of catalytic converter. In particular new and better technique for pollution control are emerging different pre-filter with three-way catalytic converter applied to a two wheeler. It provides more time for oxidation of exhaust gases & decrease the rate of carbon deposit on catalytic converter & is important for reducing harmful effect of leaded fuel with increase efficiency and life of catalytic converter in four stroke-two wheeler. Different types of pre-filter such as,

- Thin wall non glaze porous ceramic filter.
- Copper porous mesh filter.
- Aluminium porous mesh filter.
- Zirconia ceramic foam filter.

In the presented work, with the use of as carbon absorbing devices are studies as under.

4.1 Thin wall non glaze porous ceramic filter.

The use of porous ceramic as filter elements in industrial gas and liquid filtration. At the beginning, porous ceramic was applied in the shape of filter disks or stones, later on in the shape of filter candles, a true innovation at that time. Today, ceramic honeycomb or foam elements as well as ceramic hollow fiber and multi-channel structures are also being applied as filter elements.

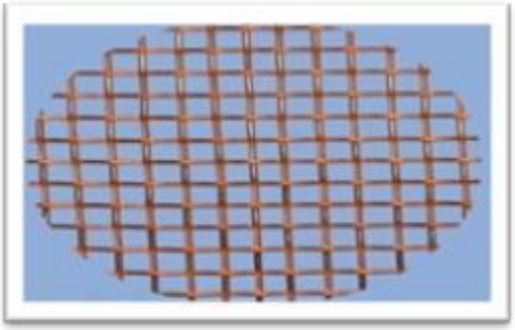


Figurer 5. Honeycomb ceramic filter

Clay was one of the earliest materials used to produce ceramics, but many different ceramic materials are now used in domestic, industrial and building products. As Fig.5 show the honeycomb ceramic filter. The filter materials mainly used consist of aluminum oxide, silicon carbide silicate, cordierite, and technically pure carbon.

4.2 Copper porous mesh filter.

.

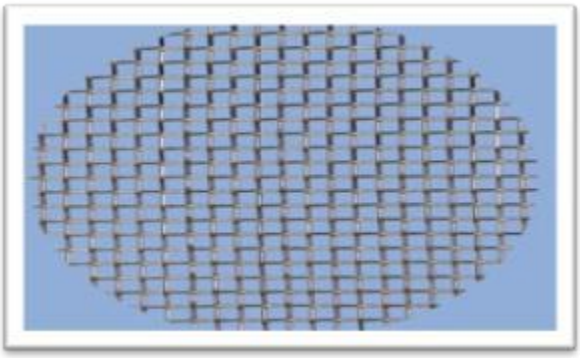


Figurer 6. Copper porous mesh filter

Copper wire mesh or copper screen, is a plain square weave mesh woven by copper wire. Copper is a soft and malleable material, and its chemical composition is 99.9% Cu, which has excellent thermal and electrical conductivity, and on-magnetic. So, copper mesh can be widely used as electromagnets interference and radio frequency interference shielding. Fig.6 show the copper porous mesh filter. It is also used as separation and filtration in many industries.

4.3 Aluminium porous mesh filter.

This highly efficient aluminium mesh has been proven to perform in a diverse range of applications. The material is available as coils, cut to size sheets .



Figurer 7. Aluminium porous mesh filter

Amongst its uses, aluminium foil is layered into filter panels to capture dust and grease for both internal and external air filtration. Fig.7 show the aluminium porous mesh filter The product offers a range of versatile features which have been adapted to suit a range of functional applications including heat spacers in the automotive industry, anti-explosive products and components for air and oil filtration.

V METHODOLOGY

5.1 Experimental method:

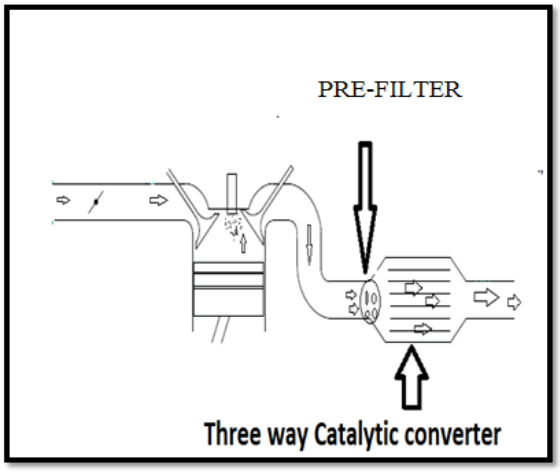


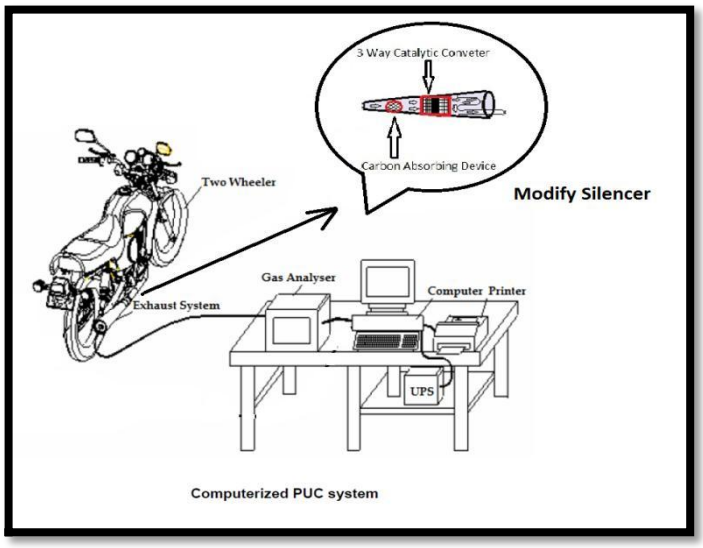
Figure 8. Experimental method.

- In this Experiment OEM Design is modified by attaching the catalytic converter with carbon absorbing device for decreasing the pollution from two wheeler.
- Pre pollution control method is used to control the poisoning of catalytic converter by passing the exhaust gases through different pre-filter.
- The before of catalytic converter is porous ceramic filter through which exhaust gas flows.
- A pre-filter device to increases good effect of catalytic converter and it provides more time for oxidation of exhaust gases & decrease the rate of carbon deposit on catalytic converter in four stroke-two wheeler
- A catalytic converter is a vehicle emissions control device which converts toxic by products of combustion in the exhaust of an internal combustion engine to less toxic substances by way of catalyzed chemical reactions.
- In order to evaluate the effectiveness of the setup, exhaust gas analyzer is used to measure contents of CO , HC,CO_2,O_2.
- Measure the pollutant at different time and RPM of Hero Honda splendor plus's engine.

5.2 Experimental flow chart:

- Step: 1 Fuel
- Step: 2 Combustion of Fuel
- Step: 3 Produced Exhaust Gas
- Step: 4 Exhaust Gases Passing Through Pre-Filter
- Step: 5 Exhaust Gases Passing Through Catalytic Converter
- Step: 6 Reading of Exhaust Gases Contain
- Step: 7 Analysis of Exhaust Gases
- Step: 8 Conclusion

5.3 Experimental setup view:



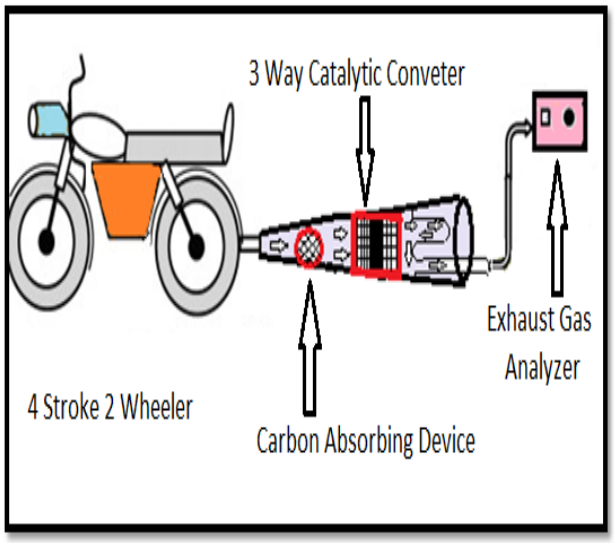


Figure 9. Experimental setup view.

5.4 Experimental equipment:

- Engine & Silencer of Hero Honda splendour plus.
- Three way catalytic converter.
- 70 to 72 mm diameter of Non glaze porous ceramic filter, Copper porous mesh filter, Aluminium porous mesh filter.
- 680 Series Exhaust Gas Analyzer.
- Contactless Tachometer.

5.5 Real diagram of equipment :

Figure 10. Real diagram of equipment

VI EXPERIMENTAL RESULTS

6.1 Indian emission standards for two wheelers gasoline vehicle, g/km:

Year	CO	HC	HC+No_x
1991 norms	12–30	8–12	–
1996 norms	5.50	–	3.60
Indian stage 2000 norms	2.00	–	2.00

Table 2. Indian emission standards for two wheelers gasoline vehicle, g/km.

6.2 HC & CO level in Hero Honda splendour plus:

Prescribed Standard CO	Prescribed Standard HC
3.5%	4500 ppm

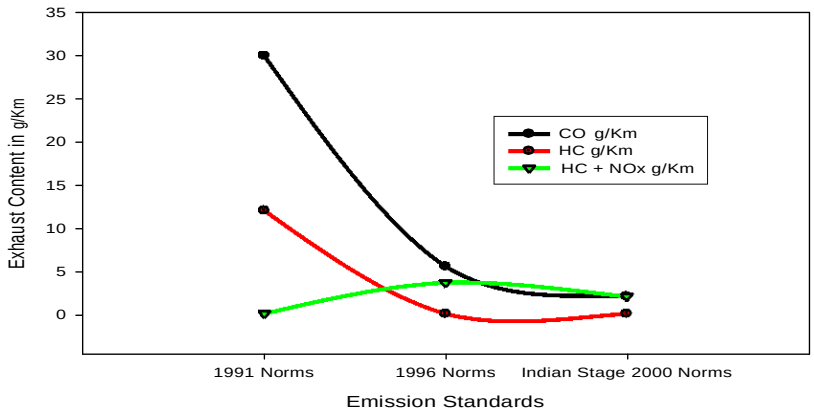


Figure 11. Graph for Indian emission standards for two wheelers gasoline vehicle

6.3 Graph for value of CO At different TIME,RPM for different Pre-filter:

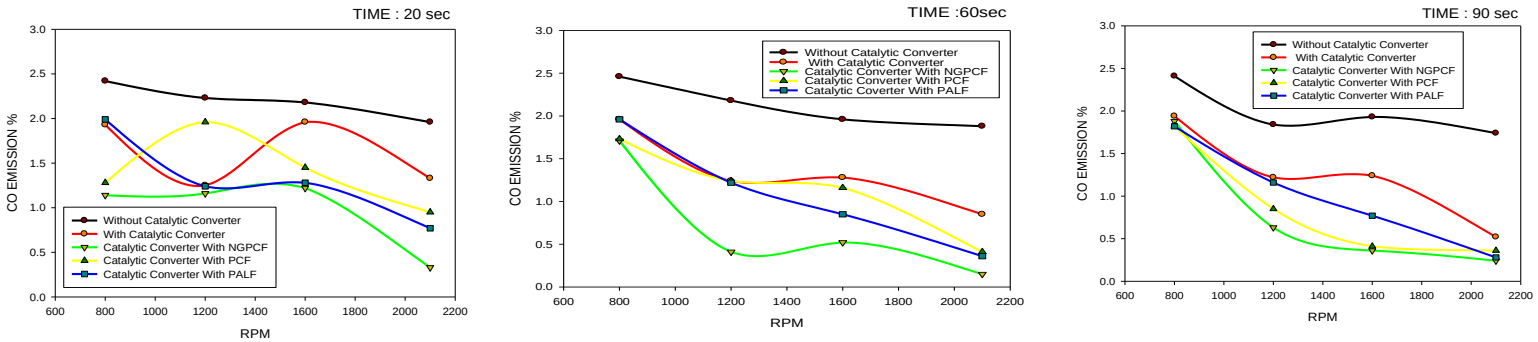


Figure 12. Graph for value of CO At different TIME, RPM for different Pre-filter.

6.4 Graph for value of HC At different TIME,RPM for different Pre-filter:

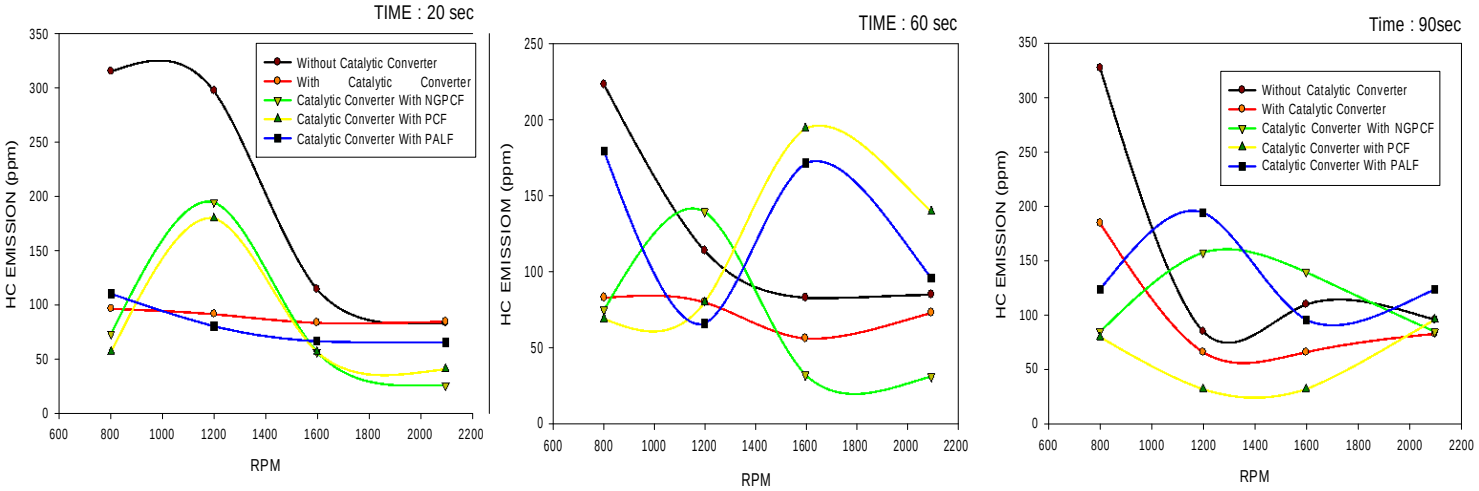


Figure 13. Graph for value of HC At different TIME, RPM for different Pre-filter.

6.5 Comparison Values Of CO & HC with PUC Standards For Different Pre-filter :

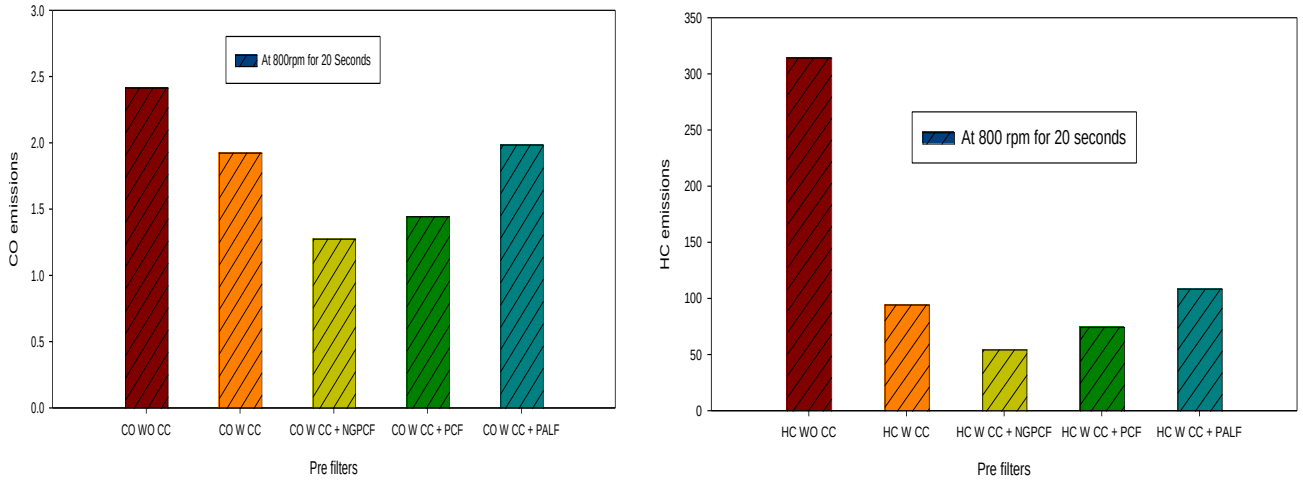


Figure 14. Comparison Values Of CO & HC with PUC Standards For Different Pre-filter .

VII CONCLUSION

The idea behind the work is to increase oxidation period of exhaust stream and also minimizing the amount of catalyst required. Pre-filter material is selected for the present work as it is cheaper than other material. The exhaust gases pass through a pre-filter and catalytic action takes place at surface of pre-filter material which are porous and the higher catalytic activity towards the oxidation of CO and HC. A pre-filter device to increases good effect of catalytic converter and it provides more time for oxidation of exhaust gases & decrease the rate of carbon deposit on catalytic converter in four stroke-two wheeler. Comparison Values of CO & HC with PUC Standards for different Pre-filter show the good efficiency and capacity of reduce CO & HC level by using different Pre-filter. Back pressure of exhaust gases is reduced of attaching the angular fan in silencer. The proposed method is very effective in the prevention of environmental pollution contributed from two-wheeler automobiles. This paper opens a gateway to study the changes in the concentration of exhaust emission due to the nano-material as pre-filter devised.

REFERENCES

[1] Mukesh Thakur and N.K. Saikhedkar , "Improved and Latest Design of a Nanosized Catalytic Converter for Pollution Prevention Implemented to Four Stroke Engine with Experimental Validation by Modeling",International Journal of Environmental Science: Development and Monitoring (IJESDM)ISSN No. 2231-1289, Volume 4 No. 2 (2013)

[2] Thakur Mukeshand Saikhedkar N.K. , " Reduction of Pollutant Emission from Two -wheeler Automobiles using Nano-particle as a Catalyst" ,Research Journal of Engineering Sciences : ISSN 2278 – 9472, Vol. 1(3), 32-37, Sept. (2012).

[3] Qingyun Su, ShijinShuai, Jianxin Wang, Jinou Song, Zhijun Li,"Optimization of automotive catalytic converter by numerical modeling and simulation with detailed mechanism",Volume 216, 1 November 2013, Pages 292–298.

[4] Avinash Kumar Agarwal, PrakharBothra,Tarun Gupta, "An evaluation of the emission profile for two-wheelers at a traffic junction", DOI10.1016/j.partic.2014.01.007 Available online 27 May 2014.

[5] Rajeish B Biniwale, moqik A Bawase, M MDeshmukh, N K Lahsetwar, "Production of Automotive Catalytic Converter based on Non-noble Metal Catalyst Technology A Fesible Option", Journal of Scienific& Industrial Research Vol.60,September 2001.

[6] R Kumar,M Z Hasan , "A Non noble metal based catalytic converter for two-stroke, two wheeler applications." Journal of Scienific& Industrial Research Vol.69,September 2005.

[7] Pascal Kiwitz, Christopher Onder, LinoGuzzella , " Control- otiented modeling of a three-way catalytic converter with observation of the relative oxygen level profile" .Journal of Process ControlVolume 22, Issue 6, July 2012, Pages 984–994.

[8] Akira luiz jose Ricardo, "Evalution of catalytic converter aging for vehicle operation with ethanol", ." Journal of Scienific& Industrial Research Vol.36,oct. 2004.

[9] M VS Murali, " Comparative studies on performance evalution of a two stroke copper coted spark ignition engine with alcohols with catalytic converter. DOI: 10.1016/j.ces.2012.01.061.

[10] R.E. Hayes, "Hierarchical multi-scale model reduction in the simulation of catalytic converters" DOI: 10.1016/j.ces.2013.01.059.

[11] M.S. Hegde ,Giridhar Madras "Catalysis for NO*x* abatement" DOI: 10.1016/j.apenergy.2009.03.022 .

[12] Ankankumar, "Toward simulation of full-scale monolithic catalytic converters with complex heterogeneous chemistry" DOI: 10.1016/j.compchemeng. 2009.05.018.

[13] Zissis samaras, "Emission control options for power two wheelers in Europe" DOI: 10.1016/j.atmosenv.2006.04.003

[14] Ingenuin Gasser, "Modelling and simulation of gas dynamics in an exhaust pipe" DOI: 10.1016/j.apm.2012.06.010.

[15] HE ling, YU Xiu-Min, "Dynamic Response of a Three-Way Catalytic Converter 2012 International Conference on Future Electrical Power and Energy System", DOI: 10.1016/j.egypro.2012.02.134.

