Manufacturing of Carbon Collector from Engine Exhaust

A.S. Bhosale[1] N.G. Jadhav[2] P.R. Patange[3] V.M. Panchal[4] S.P. Dhamone[5]
[1,2,3,4,5]Bharati Vidyapeeth Collage of Engineering Pune, Lavale India

Abstract— Vehicle that runs fossil fuels such as gas , coal or oils, carbon dioxide is released into atmosphere ,Vehicular is a major source of air pollution in a long time the oxides of carbon and Nitrogen are emitted significant amount from vehicle exhaust which increased the air pollution .In natural carbon cycle CO2 is absorbed by plants and trees. In this review design of carbon collector has proposed to reduce air pollution from engine exhaust by using of filter element. The carbon collector would be placed in exhaust of engine, which trap carbon particles thereby reduced air pollution.
Keywords: GGBS, Geopolymer Concrete, CO2

I. INTRODUCTION

Vehicular exhaust has been a major source for air pollution for a long time. Across the world, the personal vehicle is actually the greatest pollution contributor. It is the same effect of this one vehicle which when scaled up across the entire world gets multiplied many folds resulting in a million vehicles causing a pollution disaster. The negative effect of automotive emissions does not affect only the person driving but also the others around them. Various greenhouse gases such as carbon dioxide, methane, nitrous oxide, Carbon (Soot) Particles and other gases like chlorofluorocarbon are emitted.

There are many methods are invented for reducing effect of pollutants but there are few methods to reduce effect of carbon (soot) particles. Therefore, we focus on the manufacturing of the carbon collector. The carbon collector is designed in such a way that it only collects carbon particles and releases other gases directly to the atmosphere. The exhaust gases generated by the vehicle which contains carbon (soot) particles is captured with the help of device which we are used. At the end of silencer, we will fit the device which collect the carbon and this carbon will be filtered because it is hazard for human body.

As we all know that air pollution is most important factor from the public health point of view because every person breathes nearly about 2200 times a day and inhaling about 15 to 20 kg of air in day. Polluted air effects living by the causes such as ill effect and physiological effects. The main pollutants which are develop their automobiles are carbon-monoxide (Co), unburned hydrocarbon and oxides of nitrogen (NOx). Air pollution is not only cause due to the automobiles but the other sources which are producing air pollution are electric power generating station.

Industrial and domestic fuel consumptions. In order to prevent the problem up to some extent by aqua silencer, according to the principle of aqua silencer sound produces under water is less hirable than that of in case atmosphere. But aqua silencer has many disadvantages in design as well as material use, thereby we introduce new developed design by using different material like charcoal and oil instead of water by using some working principle of that aqua silencer. Its construction and working are caused latter in the task.

II. VARIOUS WAYS TO REDUCE THE POLLUTION

A. Catalytic Converter

It is the device, which convert harmful gases from exhaust into harmless gases. Catalytic converter is the part of automobile exhaust system. Catalytic converter has been standard on U.S Automobile since the mid- 1970s. The catalytic converter helps to drive the push towards engine carefully controls the amount oil fuel they burnt. They try to keep calculated ideal ration of air to fuel. Theoretically, at this ratio is about 14:7:1 which means that for each pound of gasoline 14:7 ratio quite in bit during driving sometimes. The mixture can be lean (an air to fuel ratio higher than that of 14:7) and other time mixture can be rich (lower than that of 14.7)

1) Reduction catalyst

The reduction catalyst is the fire stage of catalytic converter, H induced platinum and rhodium help to reduce the NOx emission. When No or No2 molecules contacts with the catalyst ribs the nitrogen atom of the molecules and hold on it. Free the oxygen in the farm of O2 and nitrogen atom bond with other nitrogen atoms that are also stuck to the catalyst forming N2

e.g. 2NO-> N2+ O2
2NO-> N2+ 2O2

2) Oxidation catalyst

The oxidation catalyst in the second stage of catalytic converter. It reduces the unburned hydrocarbon and carbon monoxide by oxidizing them over platinum and palladium catalyst. This catalyst aids the reaction of co and Hydrocarbon with the remaining oxygen in the exhaust gas.

e.g. 2CO + O2-> 2CO2

B. Zeolite membrane

Zeolite are crystalline, porous material. Zeolite is also available in powder and metal forms. This material can used for reduce emission of Carbon Dioxide. The membrane of zeolite can be placed in the exhaust system of engine, which trap the harmful gases for reducing the air pollution.

C. Aqua silencer

Aqua silencer is a device used for control the emission and noise. Aqua silencer is an advanced device used for reduce for emission. Aqua silencer uses the activated charcoal, lime water, perforated tube and non-return valve for its operation.

D. Magnetic pollution filter

Prof. Bhokre N.M., Mohit A. Bagul, Nilesh S. Boddawar, Yogesh S. Tuptewar studied the Magnetic pollution filter for reducing exhaust emissions. In this filter the Neodium magnets are used. This magnet is placed around the periphery of the silencer, they generate the magnetic field for reducing pollution by ionization process. The function of neodium magnets is to absorb the carbon dioxide from the exhaust gases.in this the silencer is manufactured by the ionization process. By the ionization process it is easy to

capture the carbon dioxide. It also changes the content of hydrocarbons.

E. Selective catalytic reduction

Selective catalytic reduction is developed for reduce effect of Nitrogen Oxide (NOX). SCR is also used with the particulate filter. With the use of SCR, it also helps to reduce fuel consumption. Now a days all heavy-duty vehicles are equipped with the SCR

F. Diesel particulate filter

Particulate filter is a device used to trap soot particles from exhaust gases. This is a device which captures 90% of soot particles from the exhaust gases. Porous cordierite ceramic is used for diesel particulate filter. DPF has low coefficient of thermal expansion and having melting temperature of 1460ºC. In this filter without use of catalytic the soot burns at a temperature of 500ºC to 600ºC.

III. DESIGN OF DEVICE

A. Simple Design

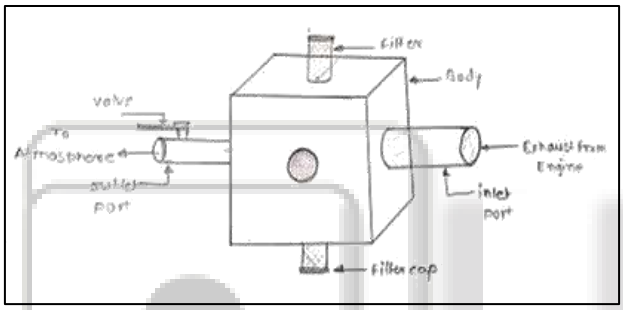

Fig. 1: Simple Design

B. Model making in Inventor

1) Inlet port

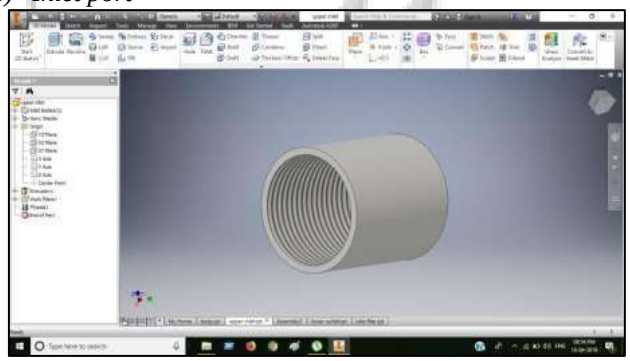

Fig. 2: Inlet Port

2) Outlet port

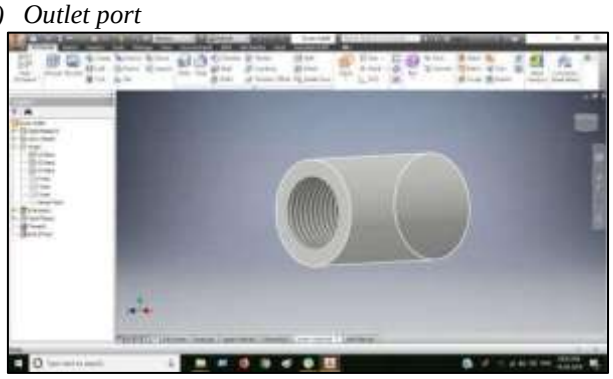

Fig. 3: Outlet Port

3) Filter element

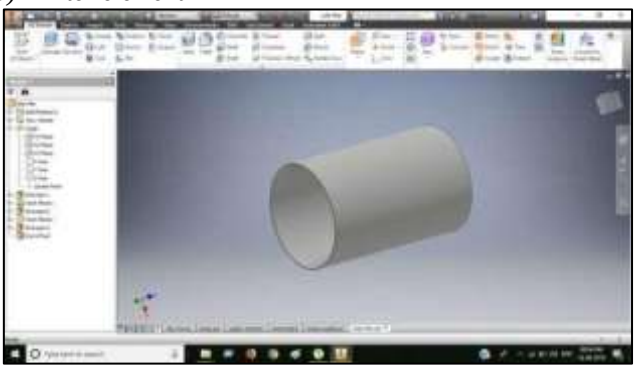

Fig. 4. Filter Element

4) Collector Body

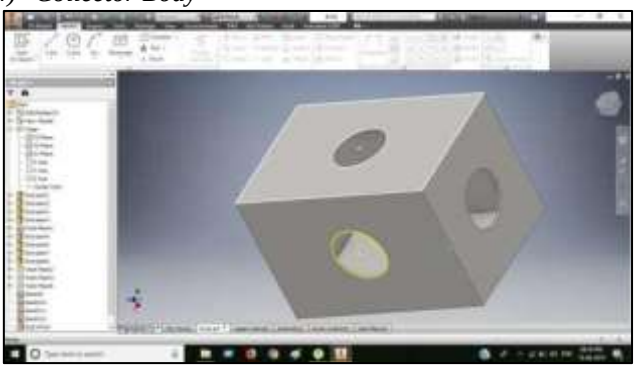

Fig. 5: Collector Body

5) Assembly

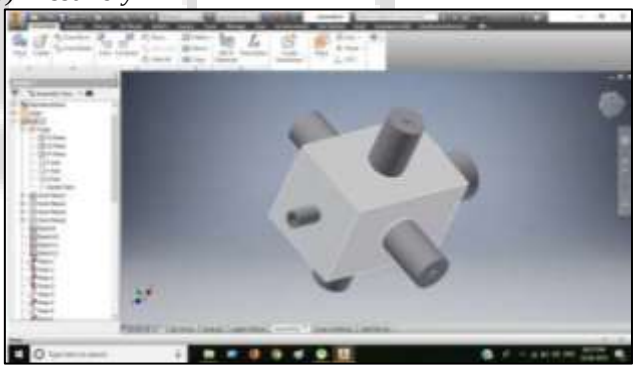

Fig. 6: Final Assembly

IV. CONSTRUCTION & WORKING

A. Component

1) Filter Element (Bronze synthetic, size - 25µ)
2) Filter Cap.
3) Flow Control Valve.
4) Inlet & outlet for Exhaust Gases.
5) Collector Body.
6) Fasteners.

B. Working

Initially we set the engine in proper way. Then we connected our device to engine exhaust when engine started, exhaust gases comes out from engine outlet port, it acts as input for our device. In which soot particles or solid carbon particles are comes in device collector body through inlet port of device. Then gases are passed through filter (filter is mounted on collector body) due to minimum size of pores of filter element than the solid carbon particles or soot particles

then are trapped in filter pores and other remaining gases are out to the atmosphere

Fig. 7: Device Setup

Hence, we reduce some amount of carbon percentage. The trapped carbon gets collected into collector body and then it easily removal and it can be used to other purposes like manufacturing of ink etc.

V. EXPERIMENTAL ANALYSIS

A. Experimental setup Details and Specifications

Fig. 8: VCR Engine Test Setup

1) Engine

Number of Cylinders -1
No. of strokes -4
Fuel- Diesel
Rated Power - 3.5KW at 1500 RPM Cylinder diameter - 87.5 mm
Stroke length - 110 mm
Connecting rod Length - 240mm
Compression Ratio – 12 to 18:1
Orifice meter - 20 mm

2) Dynamometer

Type - Eddy Current
Water Cooled with Loading Unit
Arm Length - 185 mm

3) Fuel Tank

Capacity – 10 liter with graduated glass fuel metering column
Fuel Density – 830 kg/m3
Fuel Calorific value – 42000 KJ/KG

B. Observation Table with Device

Sr. No.	Load (kg)	Speed (RPM)	Temperature (^{O}C)						Fuel Consumption (ml)
			T1	T2	T3	T4	T5	T6	
1	2	1490	27.5	31.5	27.5	29.5	165	138	8

Table 1: Observation Table

VI. RESULT

A. Heat Balance Sheet with Device on Various Load

Heat Supplied	KW	%	Heat Utilized		KW	%
Q= mf × CV = 1.2726 ×$_{10}$-4	5.34	100	1	Brake power	0.5633	10.54
			2	Heat loss due to cooling water	1.889	35.37
			3	Heat loss due to exhaust gases	2.0586	38.55
			4	Unaccounted heat loss	0.8343	15.62
Total		100	Heat Utilized		5.34	100

Table 2: Heat balance sheet for 2 KG load

Heat Supplied	KW	%	Heat Utilized		KW	%
Q= mf × CV = 6.391	6.391	100	1	Brake power	1.121	17.54
			2	Heat loss due to cooling water	2.075	32.42
			3	Heat loss due to exhaust gases	2.6895	42.08
			4	Unaccounted heat loss	0.508	7.94
Total	6.391	100	Heat Utilized		6.91	100

Table 3: Heat balance sheet for 4 KG load

B. Result Table

Sr. No	Load (kg)	Brake Power (KW)	*Torque (N.M)*	*Mass Flow Rate (Kg/s)*	*BSFC (Kg/Kwh)*
1	*2*	*0.563*	*3.6297*	1.2726×10^{-4}	*0.8133*
2	*4*	*1.121*	*7.2594*	1.521×10^{-4}	*0.4886*

Table 4: Result Table

C. Heat Balance Sheet without Device on 2 kg Load

Heat Supplied	KW	%		Heat Utilized	KW	%
Q= mf × CV = 6.391	6.391	100	1	Brake power	1.121	17.54
			2	Heat loss due to cooling water	2.075	32.42
			3	Heat loss due to exhaust gases	2.6895	42.08
			4	Unaccounted heat loss	0.508	7.94
Total	6.391	100		Heat Utilized	6.91	100

Table 5: Heat Balance sheet

D. Result Table without Device

Sr. No	Load (kg)	Brake Power (KW)	*Torque (N.M)*	*Mass Flow Rate (Kg/s)*	*BSFC (Kg/Kwh)*
1	*2*	*0.57*	*3.63*	1.10×10^{-4}	*0.69*

Table 6: Result table

VII. Discussion

From above heat balance sheet and result table for with and without carbon collector we can conclude that, when we use carbon collector then it negligible affect on brake power, torque, mass flow rate of fuel and BSFC.

Sr. N	Load (kg)	Result with Device			Result without Device		
		BP	T (Nm)	BSFC (Kg/s)	BP (KW)	T (Nm)	BSFC (Kg/s)
1	2	0.563	3.629	0.8133	0.57	3.63	0.69

Table.7. Comparison of results

VIII. Sample Calculation for 2 kg Load in Heat Balance Sheet:(with Device)

Heat balance sheet for 2kg load
Given data,
N=1482 rpm

Vf= 9.2 ml
t1=29℃ t2=34 ℃ t3=29℃

t4=32℃ t5=153℃ t6=123℃

1) Mass flow rate of fuel (mf): -
mf = vf $\times10^{-6}$ /60×830
=9.2$\times10^{-6}$/60×830
mf = 1.2726$\times10^{-4}$ kg/s

2) Heat supplied (Q): -
T = (load× g) × Dynamometer arm length
(2×9.81) ×0.185
=3.6297 N-m

Heat utilized

3) Brake Power (BP): -
BP= 2πNT/ 60000
=2π1482×3.6297/60000
=0.5633kw

4) Mass flow rate of water(mw):
=mw× cpg (t2-t1)
=0.090×4.187(34-29)
=1.889kw

5) Heat loss from exhaust gas: -
= mg × cpg (t5-t6)
=mcw ×cpw(t4-t3) mg × cpg
= mcw × cpw (t4-t3)/(t5-t6)
=150/3600×4.187(32-29)/(153-123)
mg× cpg =0.01744

6) Heat loss due to exhaust gas: -
= mg × cpg (t5-tA) … (tA=35℃
=mg ×cpg (153-35)
=2.0586kw

7) Unaccountable Heat: -
=2-(4+6+8)
=5.34 -(0.5633+1.889+2.0586)
=0.8343kw

IX. Conclusion

The use of Carbon collector, we effectively collect carbon particles (soot) from exhaust gases. Also reduces the noise in carbon collector. It does not affect on fuel consumption. It is smokeless and pollution free emission to the environment. And it is economically feasible as it does not require external source of energy. These are more effective to decrease the emission of carbon from engine exhaust. It is collets 4.2 gm per 30 min.

References

[1] R.Sanjay, K. Siragiri Velavan, Vijaya Kiran Kumar, Raveen,"A review on controlling automobile exhaust emission".

[2] S. Jenoris Mutiya, V.Amarnath,P. Senthil kumar, S.Mohan kumar. "Carbon capture and storage from automobile exhaust to reduce CO2 emission".
[3] Shweta B. Said, Sonali P. Wagh, Prachi D. Gaikwad, Swapnil Kondo, "AQUA SILENCER".
[4] Prof.Bhokre N.M., Mohit A.Bagul, Nilesh S.Boddawar, Yogesh S.Tuptewar,"Emission reduction using Magnetic pollution filter".
[5] Kirtan Aryal, Bishal Sapkota, Chiran Adhikari, "Vehicular emission control techniques".
[6] Khasim Sharif. SK, D.Jagadish, K., Phaneendra Kumar, K. Rakesh, "Diesel
[7] Particulate Filter Modeling For Compression Ignition Engine.
[8] Dr. P.K.Sharma, Swapnil V. Kasar, Suryabhan A. Patil , Naresh A.Jadhav, Manish Deore, "Desin and manufacturing of aqua silencer for two stroke petrol I.C engine".
[9] Oana ZBARCEA, Dan SCARPETE, Vlad VRABIE, "Environmental pollution by diesel engines. Part 2: A literature review regarding HC, CO, CO2 and soot emissions".

