Citation: 10.2348/ijset09151157
ISSN (O): 2348-4098
ISSN (P): 2395-4752

FABRICATION OF EMISSION CONTROL SILENCER FOR 2-STROKE PETROL ENGINE USING REFRACTORY AND ACTIVATED CARBON LAYER

[1]PAVAN KUMAR, [2]DR. RAJAGOPAL, [3]DR. HIREGOUDAR YERRANA GOWDA, [4]RAGHURAM G

[1]Asst Professor, Mechanical Engineering Department, RYMEC Bellary, Karnataka, India

[2]Professor (R&D), JNTU, Hyderabad, Telangana, India

[3]Professor PG Coordinator (Thermal Power Engineering), RYMEC Bellary, Karnataka, India

[4]M.Tech (Thermal Power Engineering), Mechanical Engineering Department, RYMEC Bellary, Karnataka, India

ABSTRACT

Air pollution is one of the important aspects from the public health of view, because an average rate of respiration in a human is 22000 times a day, inhaling about 15 to 22 Kg of air per day. Air pollution is the introduction of particulates, biological molecules, or other harmful materials into Earth's atmosphere, causing disease, death to humans, damage to other living organisms such as food crops, or the natural or built environment. The main pollutants contribute by automobile are carbon monoxide (CO), unburned hydrocarbon (UBHC), oxides of nitrogen (NOx) and Lead. Automobiles are not the only sources of air pollution, other sources such as electric power generating units, industrial and domestic fuel consumption, industrial processing etc. also contribute heavily to contamination of our environment so it is imperative that serious attempts should be made to conserve of our environment from degradation. The pollution level is very high in 2-stroke engine which emits significant amount of particulate matter (PM), unburned hydrocarbons (UBHC), Carbon Monoxide (CO) and Oxides of nitrogen (NOx) which affects the eco system.

Our newly fabricated Silencer is an attempt, in this direction, it is mainly dealing with control of emission in 2 stroke engine. The inner surface of the Silencer is coated with Refractory(Aluminium Silicate), and Activated carbon filter(ACF) in a particular ratio which absorbs the unburned hydrocarbon(UBHC) and reduces the Carbon monoxide(CO) emission. This fabricated silencer is fitted to the exhaust pipe of engine. Refractory and Activated carbon filter acts as an adsorbent at low temperature. Because of this property both are used in a silencer in order to control the emission from the 2-stroke engine. The smoke level is considerable less than the conventional silencer, it is cheaper, no need of catalytic converter and easy to install

Key Words: *Carbon monoxide(CO), Unburned Hydrocarbon(UBHC), Oxides of Nitrogen(NOx), Activated carbon filter(ACF)*

1. INTRODUCTION

Air pollution is one of the important topics in current society as it affects the human life and the ecosystem. Any substance that is introduced into the atmosphere that has damaging or adverse effects on the environment and living species is considered as air pollution. The sources of air pollution include, but are not limited to, transportation, power plants, burning of tires and human activities that involve the burning of fossil fuels; an example of a human activity that causes air pollution is heating and cooling a home or workplace

The emissions created by an individual vehicle are generally low, compared to many other sources of pollutant. However, emissions from millions of vehicles add up every day. The personal vehicle is the single greatest contributor to air pollution, by mass, in this World.

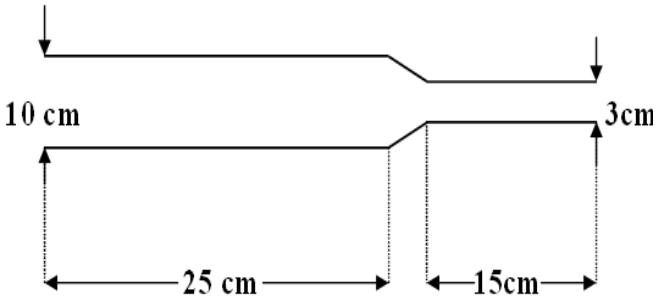
Conventional natural gas engines are facing problem with in-cylinder combustion as they produce higher quantity of unburned hydrocarbons (HC) and carbon monoxide (CO) emissions. The NO emission either increases or decreases, as it strongly associated with in cylinder fuel combustion temperature characteristics that depend on air–fuel ratio and fuel injection system. However, the gaseous pollutants from engine exhaust can be reduced either by using Refractory (Aluminium Silicate), Activated carbon filter (ACF) or catalytic system

Hence modification must be planned carefully by replacing the conventional silencer with newly fabricated Refractory and Activated carbon coated silencer. It was found that emission level was reduced after modification of the silencer without disturbing the operating parameters

Refractory (Aluminum silicate) Activated Carbon filter (ACF)

2. EXPERIMENTAL DETAILS

Citation: 10.2348/ijset09151157
ISSN (O): 2348-4098
ISSN (P): 2395-4752



Outer Horizontal view Inner vertical view

3. METHODOLOGY OF FABRICATION OF SILENCER

Pure aluminium powder and sodium silicate is collected separately and The aluminium silicate and sodium silicate is mixed in 10:2 ratio to prepare slurry. Moisture can be added upto 2% for mixing. The slurry should be free from any impurities. The slurry prepared is taken and neatly pasted inside walls of the casing manually with hands. Other method for pasting slurry to the walls is by placing the slurry in the open end and air is passed from air compressor. The slurry pasted to the walls is heated to remove the moisture content. Heating also makes the slurry to get attached to the mild steel surface which reduces the risk of material detaching from the metal surface

Different composition of slurry

1. 100% Refractory and 0% Activated carbon
2. 90% Refractory and 10% Activated carbon
3. 80% Refractory and 20% Activated carbon
4. 70% Refractory and 30% Activated carbon

Refractory is pasted uniformly all over the inner surface of silencer upto 0.5 cm. Activated carbon is advisable to paste only in the central pipe (middle section) of silencer because at the outlet port of an engine the temperature will be more than the ignition temperature of ACF. Also when the area of cross section increases the velocity decreases, This makes the gas to stand in the middle region for sometime compared to front pipe. This makes the ACF particle to adsorb unburnt hydrocarbon effectively within its ignition temperature. Through the welding process the silencer is attached to the engine

SPECIFICATION OF ENGINE

Stroke - Two stroke petrol engine

Type - Air cooled

No. of cylinder - Single cylinder

Bore x Stroke - 42.6 mm x 42 mm

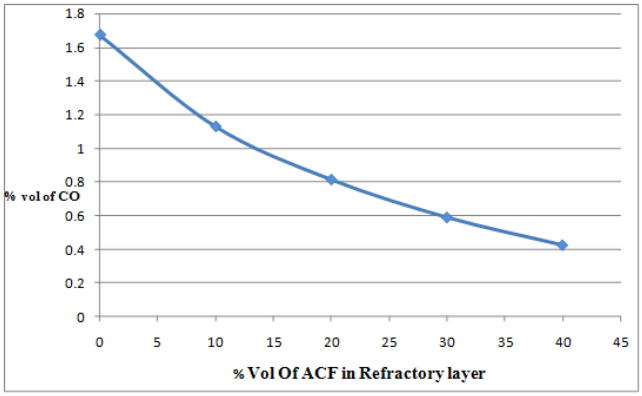
Displacement - 59.9 cc

Maximum Power - 3.5 hp at 5500 rpm

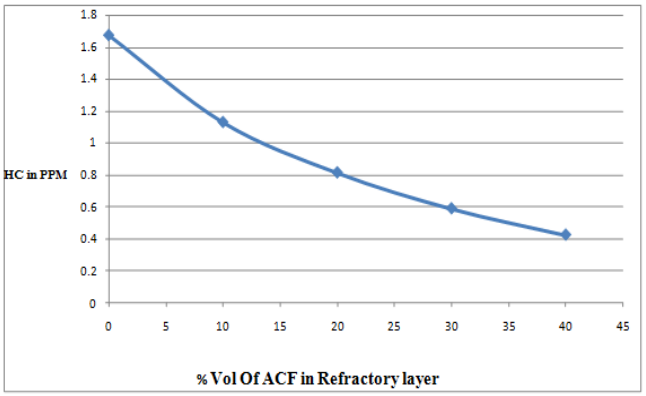
Max. Torque - 4.5 Nm at 5000 rpm

Temperature of Exhaust gas – 152.52 degree C

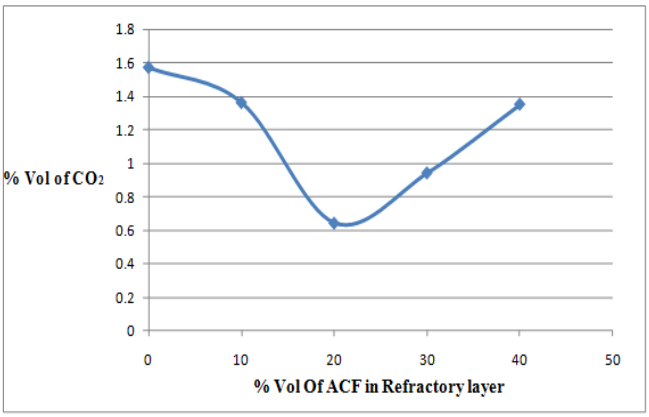
EFFECT OF REFRACTORY AND ACTIVATED CARBON ON EXHAUST GAS



EFFECT OF REFRACTORY AND ACTIVATED CARBON ON HC EMISSION

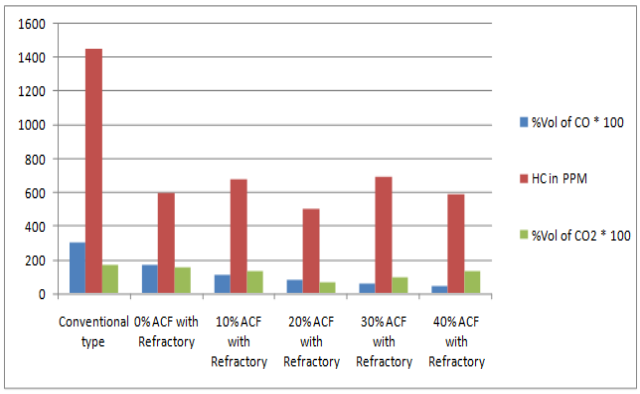


EFFECT OF REFRACTORY AND ACTIVATED CARBON ON CO2 EMISSION



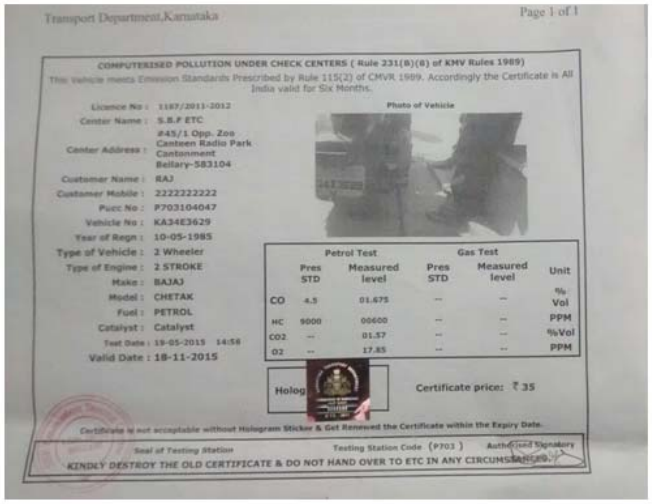
Citation: 10.2348/ijset09151157
ISSN (O): 2348-4098
ISSN (P): 2395-4752

COMBINED EFFECT OF REFRACTORY AND ACTIVATED CARBON ON CO AND HC EMISSION AT CONSTANT 50 NM LOAD AND 2000 RPM.



From the above bar chart it is clear that using 20% ACF with 80% Refractory will give low emission result compared to other compositions .

FABRICATED SILENCER EMISSION REPORT WITH 100% REFRACTORY LAYER


Transport Department,Karnataka

COMPUTERISED POLLUTION UNDER CHECK CENTERS (Rule 231(8)(8) of KMV Rules 1989)

Licence No : 1187/2011-2012
Center Name : S.B.F ETC
Center Address : #45/1 Opp. Zoo Canteen Radio Park Cantonment Bellary-583104
Customer Name : RAJ
Customer Mobile : 2222222222
Pucc No : P703104047
Vehicle No : KA34E3629
Year of Regn : 10-05-1985
Type of Vehicle : 2 Wheeler
Type of Engine : 2 STROKE
Make : BAJAJ
Model : CHETAK
Fuel : PETROL
Catalyst : Catalyst
Test Date : 19-05-2015 14:58
Valid Date : 18-11-2015

Photo of Vehicle

	Petrol Test Pres STD	Petrol Test Measured level	Gas Test Pres STD	Gas Test Measured level	Unit
CO	4.5	01.675	--	--	% Vol
HC	9000	00600	--	--	PPM
CO2	--	01.57	--	--	%Vol
O2	--	17.85	--	--	PPM

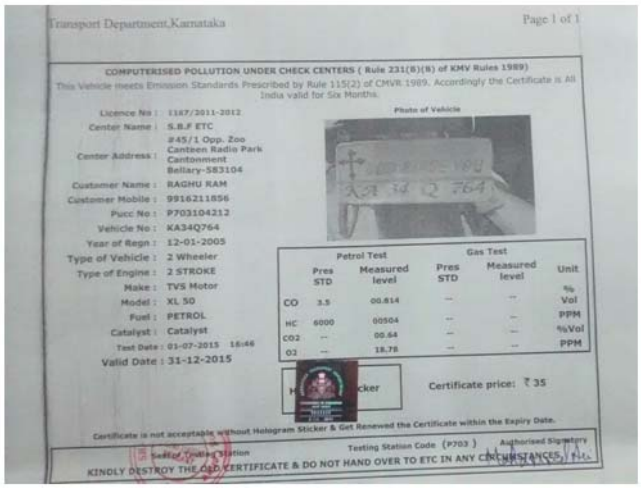
Certificate price: ₹ 35

Certificate is not acceptable without Hologram Sticker & Get Renewed the Certificate within the Expiry Date.

Seal of Testing Station | Testing Station Code (P703) | Authorised Signatory

KINDLY DESTROY THE OLD CERTIFICATE & DO NOT HAND OVER TO ETC IN ANY CIRCUMSTANCES

FABRICATED SILENCER EMISSION REPORT WITH 20% ACF AND 80% REFRACTORY LAYER


Transport Department,Karnataka

COMPUTERISED POLLUTION UNDER CHECK CENTERS (Rule 231(8)(8) of KMV Rules 1989)

Licence No : 1187/2011-2012
Center Name : S.B.F ETC
Center Address : #45/1 Opp. Zoo Canteen Radio Park Cantonment Bellary-583104
Customer Name : RAGHU RAM
Customer Mobile : 9916211656
Pucc No : P703104212
Vehicle No : KA34Q764
Year of Regn : 12-01-2005
Type of Vehicle : 2 Wheeler
Type of Engine : 2 STROKE
Make : TVS Motor
Model : XL 50
Fuel : PETROL
Catalyst : Catalyst
Test Date : 01-07-2015 16:46
Valid Date : 31-12-2015

Photo of Vehicle

	Petrol Test Pres STD	Petrol Test Measured level	Gas Test Pres STD	Gas Test Measured level	Unit
CO	3.5	00.814	--	--	% Vol
HC	6000	00504	--	--	PPM
CO2	--	00.64	--	--	%Vol
O2	--	18.78	--	--	PPM

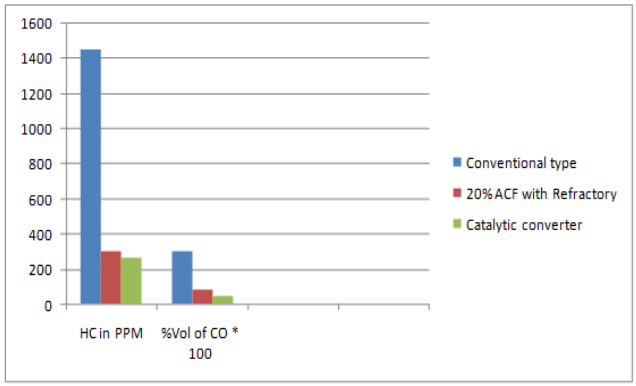
Certificate price: ₹ 35

Certificate is not acceptable without Hologram Sticker & Get Renewed the Certificate within the Expiry Date.

Testing Station Code (P703) | Authorised Signatory

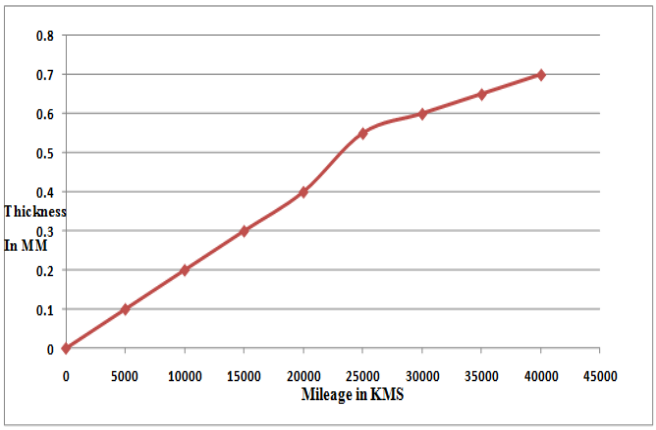
KINDLY DESTROY THE OLD CERTIFICATE & DO NOT HAND OVER TO ETC IN ANY CIRCUMSTANCES

COMPARISON OF EMISSION RESULTS OF 2 STROKE ENGINE WITH 2- WAY CATALYTIC CONVERTER AND REFRACTORY COATED SILENCER



Catalytic converter is ahead of 5 to 10% better results compared to our newly fabricated Refractory coated silencer

LIFE OF AN EQUIPMENT



Increasing trend of carbon layer thickness on refractory surface will reduce the life of the silencer .When the carbon layer thickness exceeds 0.70mm, the adsorbtion capacity will decrease. After 38000kms of engine service this 0.70mm thickness of carbon layer achieved. So the life of this Refractory coated silencer is 38000Kms.

4. RESULTS

	Prescribed level CO	Measured standard CO	Prescribed level HC	Measured standard HC
Conventional silencer	3.5	2.996	6000	1455
Only Refractory coated silencer	3.5	1.675	6000	600
Refractory coated with 10% ACF	3.5	1.130	6000	675
Refractory coated with 20% ACF	3.5	0.814	6000	504
Refractory coated with 30% ACF	3.5	0.589	6000	691
Refractory coated with 40% ACF	3.5	0.424	6000	592
2 way Catalytic converter	3.5	0.408	6000	262

CO & HC Level at idling (% volume) (ppm)

4.1 ADVANTAGE

- Mixture of Refractory and Activated carbon filter will reduce CO to 60 to 70% compared to conventional silencer

Citation: 10.2348/ijset09151157
ISSN (O): 2348-4098
ISSN (P): 2395-4752

- Low cost
- Controls air pollution
- It gives better result than Catalytic converter
- Doesn't create back pressure as in case

4.2 DISADVANTAGE

- Surface temperature of Silencer will increase due to the presence of refractory compared to ordinary silencer
- Activated carbon filter will reach its ignition temperature at 240 degree C
- Only part of Exhaust gas will hit the refractory film

4.3 COST ANALYSIS

Material cost	Rs 100
Fabrication work	Rs 1000
Refractory cost	Rs 40/Kg
Additive cost	Rs 500/lt
Installation cost	Rs 1000
Total	Rs 2640
2 way catalytic converter cost	Rs 8000

5. CONCLUSION

By above result we can see that the quantity of CO and HC can be reduced by using a silencer which is coated with 20% Activated carbon filter and 80% refractory layer at inner surface. Smoke emission is less and controls air pollution.