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DESIGN AND MANUFACTURING OF AQUA SILENCER FOR TWO STROKE PETROL I.C. ENGINE

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Abstract — *The reduction of air pollution is most important from the public health of view, because every individual person breaths approximately 23000 times a day, inhaling about 15 to 22 kg of air daily. Polluted air causes physically unkind effect decides unwanted aesthetic and physiological effects. Air pollution can be defined as addition to our atmosphere of any material, which will have a harmful effect on life upon our planet. The main pollutants contribute by vehicles are carbon monoxide, partially & unburned hydrocarbon, oxides of nitrogen and Lead. For air pollution only Automobiles are not responsible but also other sources such as electric power generating stations, industrial and domestic fuel intake, refuse burning, industrial process also contribute severely to contamination of our environment so it is mandatory that serious attempts should be made to preserve of our environment from degradation. An Aqua Silencer is mainly commerce with control of emission and noise. An Aqua Silencer is fixed to the exhaust pipe of engine. Sound created under water is less hearable than it produced in environment. This mainly because of small cogs in water molecules, which reduce its range of amplitude thus, decreases its sound level. Hence water is used in this silencer and hence its name AQUA SILENCER. The noise and smoke level is less than the conventional silencer, it is cheaper, no need of catalytic converter and easy to install.*

Keywords*-Aqua Silencer, Activated Carbon, Perforated tube, IC Engine ,Air pollution,*

I. INTRODUCTION

This System is designed to replace conventional single unit engine silencers on board structures. With its lighter in weight and slender design, it offers a minimal 'footprint' while optimizing the entire exhaust system for low noise and decreases backpressure. It is used to control the noise and emission in IC engines. The reason why we go for aqua silencer is, now a days air pollution causes physical unkind effects to the human beings and also the environment. The main contribution of the air pollution is vehicle releasing the gases like carbon dioxide and unburnt Hydrocarbon. In order to avoid this type of gases by introduced aqua silencer. It is fitted to the exhaust pipe of the engine, the emission can be controlled by using activated charcoal layer and it is highly porous and Posses free valences so it has high absorption capacity. So absorb the gases from engine and release ample less position to the environment. The noise and smoke level is considerable less than the ordinary silencers which are used now a days, also catalytic converter is not essential and easy to install. In this silencer, the Charcoal and Water so it is known as hybrid aqua silencer, and it is useful in vehicles, industry, DG sets & DG machines, Marin and Boats also, so it is known as hybrid universal aqua silencer.

II. LITERATURE REVIEW

Keval I. Patel & Swastik R. Gajjar worked on an aqua silencer. An Aqua Silencer is an attempt, in the direction of air pollution, it is mainly dealing with control of emission and noise. An Aqua Silencer is fixed to the exhaust pipe of engine. Sound produced under water is less hearable than it produced in atmosphere. This mainly because of small sprockets in water molecules, which drops its amplitude thus, lowers the sound level. Because of this property water is used in this silencer and hence its name AQUA SILENCER. The noise and smoke level is considerable less than the conventional silencer, it is inexpensive, no need of catalytic converter and easy to install.

Air pollution can be defined as addition to our environment of any material, which will have a dexterous effect on life upon our planet. The main pollutants contribute by automobile are carbon monoxide (CO), unburned hydrocarbon, oxides of nitrogen (NOx) and Lead. Automobiles are not the only sources of air pollution, other sources such as electric power generating stations, industrial and domestic fuel consumption, refuse burning, 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.

Alen.M.A et.el they worked on An Aqua Silencer is mainly dealing with control of emission and noise in vehicle exhaust. By using activated charcoal, perforated tube and outer shell it is constructed. An aqua silencer is fitted to the exhaust pipe of engine. The activated charcoal filters the injurious sulphur and nitrous content produced from the engine. Sound produced under water is less hearable than it produced in atmosphere. This mainly because of small sprockets in water molecules, which lowers its amplitude thus, drops the sound level. Because of this property water is

used in this silencer and hence its name AQUA SILENCER. It is tested in single cylinder 4- stroke IC diesel engine the noise and smoke level is considerable less than the conventional silencer. The main pollutants contribute by automobiles are CO, UBHC, Nox and Lead etc., other resources such as electric power generating stations, industrial and domestic fuel consumption, refuse burning, industrial processing. So it is imperative that serious attempts should be made to conserve earth's atmosphere from degradation. An aqua silencer is an attempt in this direction; it is mainly dealing with control of emission and noise.

Elsevier The outflow velocity circulation and inner pressure distribution could be improved by improving the structure of silencer. Therefore modifying inner area Section or reducing the area of shell & end cover. The new exhaust muffler s obviously effective in controlling the low-frequency exhaust Noise. This experiment reduce noise of the Engine.

A research was carried out to test three cases about the installation position of the thermoelectric generator.

III. CONSTRUCTIONAL DETAILS

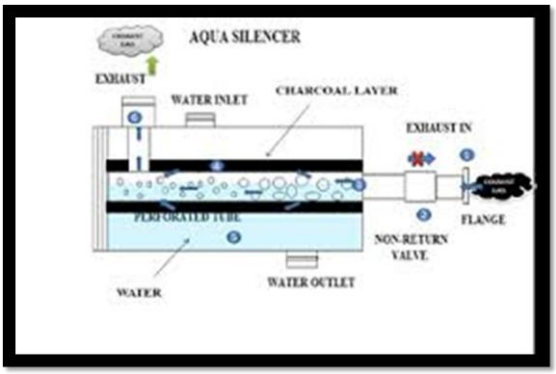


Fig.1 AQUA SILENCER

3.1 CONSTRUCTION

Basically an aqua silencer involves of a perforated tube which is installed at the end of the exhaust pipe. The perforated tube may have holes of dissimilar diameters. The very purpose of providing dissimilar diameter hole is to break up gas mass to form smaller gas bubbles the perforated tube of different diameter .Generally 4 sets of holes are drilled on the perforated tube. The other end of the perforated tube is closed by plug. Around the perimeter of the perforated tube a layer of activated charcoal is provided and further a metallic mesh covers it. The whole unit is then placed in a water vessel. A small opening is provided at the Top of the container to remove the exhaust gases and a drain plug is provided at the bottom of the container for periodically cleaning of the container. Also a filler plug is attached at the top of the container. At the inlet of the exhaust pipe a non-return valve is provided which prevents the back flow of gases and water as well.

3.1.2. COMPONENT

1) Perforated tube
2) Layer of activated charcoal
3) Cover of metallic mesh
4) Non return valve at inlet of silencer
5) Casing

1) Perforated tube :-The perforated tube consists of number of holes of dissimilar diameters. It is used to convert high mass bubbles to low mass bubbles. The charcoal layer is pasted over the perforated tube.
FUNCTION ;-The function of perforated tube is to brake up the mass of gas to form bubbles and to react with activated charcoal and water, to reduce the pollutants and noise of exhaust gases.

2) Layer of activated charcoal:- The charcoal layer has more absorbing capacity because it has more surface area. This charcoal is called as ACTIVATED CHARCOAL. It is produced by heating the charcoal above 1550 'c for several hours in a burner. Its surface area gets increased. The activated charcoal in granular form is used in this system. Between two meshes wrapped on perforated the layer of activated charcoal is filled (thickness up to 5 – 8 mm).
FUNCTION :- The activated charcoal plays very important role in reducing the pollutants also it absorb the ash and impurities from the exhaust system.

3) Cover of Metallic Mesh :- Cover of metallic mesh is used over the layer of activated carbon.
FUNCTION "- Cover of metallic mesh keep the charcoal layer over the tube through its length

4) Non return valve:- Non return valve is fitted at the inlet of silencer to prevent the flow of gases return to the exhaust manifold.
FUNCTION :- Its main function is to allow the one side flow of gases and prevent it to come back. Here it is used to restrict the water to go outside the casing through inlet side of exhaust system.

5) **Casing:-** The whole setup was kept inside the outer shell. It is made up of iron or steel. The water inlet, outlet and exhaust tube was provided in the shell itself.
FUNCTION:- It plays very important role as it is used as a water tank of the aqua silencer. Also the perforated tube with charcoal layer is inserted in it. The whole reaction over gases takes place in the casing.

3.1.3. WORKING OF AQUA SILENCER

As the exhaust gases arrive in to the aqua silencer, the perforated tube converts high mass bubbles in lo low mass bubbles after that they passes through charcoal layer which again purify the gases. It is extremely porous and Posses extra free valences so it has high absorption capacity. After passing over the charcoal layer some of the gases may dissolved into the water and finally the Exhaust gases escape through the opening in to the air. Hence aqua silencer reduces noise and pollution.

Small sprockets in water molecules, which lowers its amplitude thus, lowers the sound level hence aqua silencer reduces noise and pollution.

IV. EFFECT OF DISSOLVED GASES ON WATER

The water is a nice absorbing medium. In aqua silencer the gases are made to be dissolved in water. When these gases dissolved in water they form acids, carbonates, bicarbonates etc.

(1) Action of dissolved SO2 :- When SOx is mixed in water, it form SO3, SO4, H2SO4, H2SO, i.e. sulfur Acid (H2SO3,), it forms Hydrogen Sulphide which causes egg smell, acidify and corrosion of metals.

(2) Action of dissolved CO2 :- The dissolved CO2 forms bicarbonate at lower PH and Carbonates at higher PH. This levels 40-400 mg/liter. The form a scale in pipes and boilers. The carbon dioxide mixed with water to form Carbonic acid. It is corrosive to metals and causes greenhouse effect.

(3) Effect of dissolved Nitrogen oxide:- The Nitrogen in water under goes Oxidation to form ammonia, Nitrate, Nitrite, Nitric acid. This synthesis of protein and amino acids is affected by Nitrogen. Nitrate usually occurs in trace quantities in surface water.

(4) Absorption Process:- Activated charcoal is available in granular or powdered form. As it is highly porous and Possess free valences. So it keeps high absorption capacity. Activated carbon is more widely used for the removal of taste and odorous from the public water supplies because it has excellent properties of attracting gases, finely divided solid particles and phenol type contaminations, The activated carbon, usually in the powdered form is added to the water either before or after the coagulation with sedimentation. But it is every time added before filtration. Feeding devices are similar to those used in feeding the coagulants.

V. MATERIAL SELECTION

6.1. STAINLESS STEEL

The materials used for this project is corrosion resistant and machinable. The same material of stainless steel is used in the project for all project component. The project were subjected to drilling, grinding and welding so the material is selected by considering following aspects.

Corrosion Resistance: stainless steel is alloy having chromium content in it which is corrosion resistive in nature. Hence the stainless steel is used for aqua silencer.

Electrical And Thermal Conductivity: Stainless steel is an excellent heat and electricity conductor and in relation to its weight is almost twice as good as copper. This has made Stainless steel the most commonly used material to made utensils.

Reflectivity: Stainless steel is a good reflector of noticeable light as well as heat, and that together with its low weight makes it an ideal material for reflectors in, for example, light fittings or rescue blankets.

Ductility: Stainless steel is ductile and has a low melting point and density. In a liquid condition it can be processed in a number of ways. Its ductility allows products of Stainless steel to be basically formed close to the end of the product's design.

Odorless: Stainless steel is the metal itself is non-toxic and releases no aroma or taste substances which make it ideal for packing sensitive product's design.

Recyclability: Stainless steel is 100 % recyclable with no downgrading of its qualities. The re-melting of Stainless steel requires little energy only about 4 percent of the energy required to produce the primary metal initially is needed in the reprocessing process.

Weldability: Stainless steel has high degree of weld ability. Hence it is used in many industrial application.

6.2. ACTIVATED CARBON

Activated carbon, also called activated charcoal, or activated coal, is a form of carbon processed to have small, low-volume pores that increase the surface area presented for adsorption or chemical reactions, Activated is sometimes substituted with active.

Due to its high degree of micro porosity, just one gram of activated carbon has a surface area in excess of 450 m^2 , as determined by gas adsorption. An activation level sufficient for useful application may be attained solely from high surface area; however, further chemical action often enhances adsorption properties.
Activated carbon is usually derived from charcoal and is sometimes utilized as bio char.

GAS PURIFICATION
Filters with activated carbon are usually used in compressed air and gas purification to eliminate oil vapors, odor, and other hydrocarbons from the air. The most common designs use a 1-stage or 2 stage filtration principle in which activated carbon is embedded inside the filter media.
Activated carbon filters are used to retain radioactive gases within the air vacuumed from a nuclear boiling water reactor turbine condenser. The big charcoal beds absorb these gases and retain them while they quickly decay to non-radioactive solid species. The solids are trapped in the charcoal particles, while the filtered air passes through.
SIZE – 0.35 to 0.80 mm
SHAPE – Granular

6.3. WATER
The AQUA SILENCER is fully based on use of water in it here the exhaust gases get dissolved in water and the remained gases get accumulate in Activated carbon and at last we got processed gasses.
THERMAL PROPERTIES OF WATER:
Maximum density - 1000 kg/m3
Specific weight - 9.80 KN/m3
Freezing point - 0 ^{o} C
Boiling point - 100 ^{o} C
Latent heat of melting - 334 KJ/Kg
Latent heat of evaporation – 2.270 X 10^3 KJ/Kg
Specific heat - 4.187 KJ/Kg °K
Thermal expansion – 4 °C to 100 °C

VI. SELECTION OF STANDARD PARTS

6.4.1 NON RETURN VALVE

Fig. 2. Non return valve

The system is subjected to exhaust of silencer hence the Non return valve is fitted at entrance of AQUA silencer and exhaust out of petrol test rig. to avoid flow of exhaust gases in one direction only towards silencer. It also retracts the flow of gases to flow back to the test rig.
Here as per diameter of exhaust pipe of test rig and perforated tube the Non return valve is selected with diameter of 1.25 inch.
SIZE – 1.25 inch Diameter
LENGTH- 3 inch
MATERIAL – Stainless steel

6.4.2. BARREL NIPPLE

Fig. 3. Barrel nipple.

Here we used barrel nipple for joining the perforated tube with Non return valve with threaded joint. We cut the barrel nipple in two symmetric pieces and one of it we welded directly with welded joint.
SIZE- Diameter 1.25 inch
Length- 3 inch
Material- Stainless steel.

6.4.3. COUPLING

Fig. 4. Coupling

Here we used couplings in casing for inlet and outlet of water the coupling is welded over drilled holes and the bolt is tighten over it. There by it is helpful in refilling of water after a period of time.
DIAMETER - 20 mm
MATERIAL – Stainless steel
LENGTH – 1.5 inch.

8.1. CASING

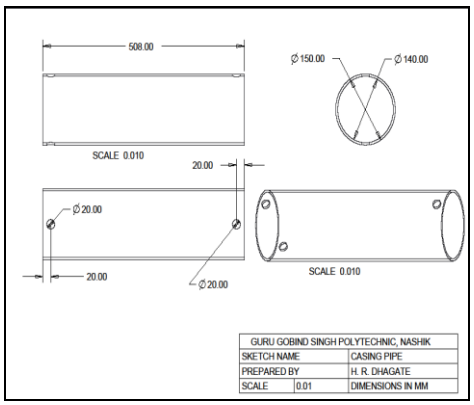


Fig. 5. CASING

VII. EXPERIMINTATION

1.1. EXPERIMENTATION OF AQUA SILENCER

First we determine the amount of exhaust gas like hydrocarbons, nitrogen etc. which is present in the single cylinder two stroke petrol engine without connecting AQUA silencer. And then AQUA silencer is connected on the exhaust and determine the amount of exhaust gas by smoke analyzer. At last the silencer which is connected to exhaust pipe and readings are taken. The results which are obtained from the project analysis is given below in the tables. Smoke analyzer tests were carried out for analyzing the performance of the silencer.

7.1.1. TWO STROKE SINGLE CYLINDER PETROL ENGINE TEST RIG.

- SPECIFICATION OF ENGINE
- Stroke - Two stroke petrol engine.
- Type - Air cooled
- Number 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

Fig. 6 Two stroke single cylinder petrol engine.

7.2 EXAMINATION USING SILENCER WITH ACTIVATED CHARCOAL

Activated charcoal is used in the silencer because of its high absorption capability. It can absorb some portions of the toxic gases present in the exhaust. During this test, it is observed that the amount of hydrocarbons and nitrogen dioxide are reduced as compared to the previous test. This is because of the reason that the charcoal embedded inside the silence has absorbed some amount of the gas. The changes in the amount of other gases are negligible

1.2. RESULTS

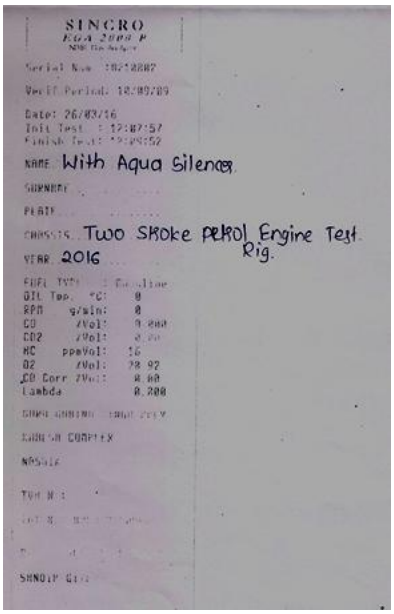
Table. 1. Results Of Exhaust Gas Analyzer

Sr. No.	Particular	Open To Atmosphere	Without Silencer	With Aqua Silencer
1	CO (% volume)	0.001	1.413	0
2	CO2 (% volume)	0	2.57	0
3	HC (ppm Volume)	11	1309	16
4	O2 (% Volume)	20.91	20.92	20.92
5	CO corr.	0	5.19	0
6	Lambda	1.683	0	0

1. **Without Silencer**

2. **Opern to Atmosphere**

3. WITH AQUA SILENCED



1.3. Equipment Used For Testing:

1.3.1. Exhaust Gas Analyzer

Fig7. Exhaust gas analyzer.

EGA 2000 P:- It is an analyzer for the control of exhaust gases from gasoline or LPG engines; it integrates non dispersive infrared (NDIR) detectors for the measure of CO, CO2, HC and electrochemical sensors (ECD) for O2 and NO.

GENERAL FEATURES

- At the same time measure and display of CO, CO2, NO, HC, O2, Oil temperature and engine rotation speed (RPM)
- Calculation and display of air/fuel ratio
- Automatic zero calibration with ambient air.

- Water/dust filter on the rear plate of the analyzer (Lambda)
- Automatic leak test of the sampling line
- Selection of fuel: petrol, LPG, Natural Gas, PET, user specific fuel.
- Interface for connecting an external oil temperature gauging probe
- Automatic calibration of the oil temperature measuring probe
- Interface for connecting a tachometer (engine speed); measure based on the analysis of vibration and noise.
- 6-button keypad for configuration and calibration of the analyzer.
- Integrated printer Data logger by RS232
- Ambient temperature: 0-40 ° C
- Ambient Pressure: 86-108 k Pa
- Relative Humidity: 5-85% RH
- Power supply: 220 VAC ± 20% - 50 Hz± 2%

2. ADVANTAGES, DISADVANTAGES & APPLICATION

8.1. ADVANTAGES

1. It increases the coagulation power of the process.
2. Its use reduces the chlorine demand.
3. The excessive dose of activated carbon is not harmful.
4. The treatment process is very simple and it requires nearly no skill.
5. The efficiency of removing color, odor and taste is quite high.
6. It can be easily regenerated.
7. It has excellent properties of attracting gases.
8. Cheaper in cost
9. No need of catalytic converter.

8.2 DISADVANTAGES

1. Aqua silencer is big in size
2. More space required
3. Water filling and flushing is required periodically

8.3. APPLICATION

1. In automobiles for control of exhaust gas emission.
2. In electrical power generation stations.
3. In industrial process, domestic fuel consumption & refuge burning.

3. CONCLUSION

The aqua silencer is more effective in the decrease of emission gases from the engine exhaust using perforated tube and charcoal. By using water as a medium the sound can be lowered and also by using activated charcoal in water we can regulate the exhaust emission to a greater level. The water contamination is found to be negligible in aqua silencer. It is smokeless and pollution free emission and also it is very inexpensive. It can be also used both for two wheelers and four wheelers and also can be used in industries. The aqua silencer is more effective in the decrease of emission gases from the engine exhaust using perforated tube and charcoal. By using perforated tube the backpressure will remain constant and the sound level is reduced. By using perforated tube the fuel consumption remains same as available system. By using water as a medium the sound can be lowered and also by using activated charcoal in water we can control the exhaust emission to a better level. The water contamination is found to be negligible in aqua silencer. It is smokeless and pollution free emission and also it is very cheap. This aqua silencer's performance is almost equal to the conventional silencer. It can be also used both for two wheelers and four wheelers and also can be used in industries.

4. ACKNOWLEDGEMENTS

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5. REFERENCES

[1] Mankhiar Ajay B,Sindhu L S,G Sasikala, (March 2014) "An Advancement to Reduce Pollution Effectively by Using TI Nano tubes in Aqua Silencer",International Journel of Engineering Sciences and Research Technology

[2] Rawale Sudrshan S & Patil S Nehal S, (September 2013) "Use of aqueous Ammonia in Silencer for removal of CO2,SO2 and NOx from exhaust gases of IC Engines",International Journal of Engineering Science and Innovative Technology,Vol.2, Issue 5.

[3] Swastik R, Gajjar, (June 2014) "Design and Development of Aqua Silencer for Two Stroke Petrol Engine",International Journal for Innovative Research in Science and Technology, Vol.1, Issue 1.

[4] Balashanmugam P,Balasubramanian,(January 2015)

[5] "Developments of Emission and Noise Control Device",International Journal of Modern Trends in Engineering and Research,Vol.02,Issue 01

[6] Amruthraj M, Nataraj J.R. & Sushmit Poojary, (October 2012) "Emission Control in IC Engines",International Journel of Engineering Research abd Devolopment,Vol .4, Issue 4.

[7] K. Kannan & M. Udayakumar, (October 2009) "NOx and HC Emission Control Using Water Emulsified Diesel in Single Cylinder Diesel Engine",ARPN Journal of Engineering and Applied Sciences,Vol.4, No 8 .

[8] Guromoorthy S. Hebbar & Anantha Krishna Bhat, (July-Aug. 2012) "Diesel Emission Control by Hot EGR and Ethanol Fumigation; an Experimental Investigation", International Journal of Modern Engineering Research, Vol.2, Issue.4, pp-1486-1491.

[9] Prabavathi Nagarajan & Priscilla Prabavathi,(November 1999) " A Study of removal of Pb (II) by adsorption technique using carbonized tamarind seed",Indian Environment. Prot. 25(5): 433 □ 435..

