

Aqua Silencer

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ABSTRACT: This research paper is about Aqua Silencer which mainly deals with control of emission and noise in automobile 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 harmful 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, lowers 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 petrol engine and 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 sources such as electric power generating stations, industrial and domestic fuel consumption, refuse burning, industrial processing. So, it is important that serious attempts should be made to conserve earth's environment from degradation. An aqua silencer is an attempt in this direction; it is mainly dealing with control of emission and noise.

KEYWORDS: Activated carbon, Perforated tubes, Lime powder, Outer shell, Non return valve.

I. INTRODUCTION

Silencer is also termed as muffler. It is used for reducing the noise emitted by exhaust of an internal combustion engine, which is a major source of noise pollution. It becomes a more vital concern when used in residential areas or areas where noise creates hazard. Generally, noise level of more than 80-90 dB is injurious for human being. The main source of noise in an engine are divided in two parts, first is the exhaust noise and second is the noise produced due to friction of various parts of the engine. The engine exhaust noise is the most dominant. To reduce this noise,

the most effective way of using a muffler in engines. The level of noise reduction depends upon the design, construction and the working procedure of mufflers. If a car running without a muffler then the noise level is unbearable. The most of the advances in the acoustic filters and exhaust mufflers came out in last four decades. Hence good design of the muffler should give the best noise reduction and offer optimum backpressure for the engine. Backpressure is the extra static pressure exerted by muffler on the engine through the restriction in the flow of exhaust gases. The insertion loss is defined as the difference in the acoustic power radiated without and with the muffler fitted.

Problem Statement:

In this study it is dealt with emission reduction mechanisms due to the environmental pollution what is observed around our living area by introducing the machine component called hybrid aqua silencer. Here targeting this study deeply about air emission rather than sound emission. The reason why we go for hybrid aqua silencers is, in today's life the air pollution causes physical ill effects to human beings and also to our environment. The main contributors to air pollution are exhaust gases from automobiles like carbon dioxide, unburnt Hydrocarbon, oxide of nitrogen etc. In order to avoid these types of gases, introducing this aqua silencer is very essential at this moment. This hybrid aqua silencer system is designed to replace conventional single unit engine silencers on board structures. It is used to control the noise and emission in IC engines. It is fitted to the exhaust pipe of the engine. Sound produced under water is less hear able than produced in atmosphere. This is mainly because of small sprockets in water molecules, which lowers its amplitude thus, lowers the sound level. The emission can be controlled by using the activated charcoal layer and it is highly porous and possesses

an extra free vacancy which renders it high absorption capacity. So, in this study it's tried to minimize the size of the silencer as much as possible without affecting the weight of the vehicle using some experimental chemicals (Ca(OH)₂) inside the components.

Objectives:

General objective of the study:

The general objective of this thesis is to design and analyze the effectiveness of Hybrid Aqua silencer for emission reduction in vehicles.

The specific objectives are:

- To study the existing emission reduction mechanism.
- To design and model the new emission reduction mechanism.
- To prepare the part and assembly drawing of the system using AutoCAD.
- To prepare the prototype of the system.
- To test the functionality of the designed system and
- Compare the effectiveness with the Conventional system.

1. Scope Of Study:

The scope of the thesis work is as mentioned below:

- It helps in reducing the air emission as much as possible.
- Expected to be economical compared with the conventional silencer.
- Can be easily manufactured and maintained from local material.

II. CLASSIFICATION OF CONVENTIONAL SILENCER

1. Baffle Silencer

It is generally cylindrical in shape with a number of baffles spot welded inside. There are many designs of baffles, but the principle in all cases is the same that is, closing in any direct passage for the gas. Major drawback of this type muffler is their low efficiency. Because of the restrictions provided to the flow by the baffles, the back pressure is increased, thus causing loss in engine power (Sarath Raj, 2016)

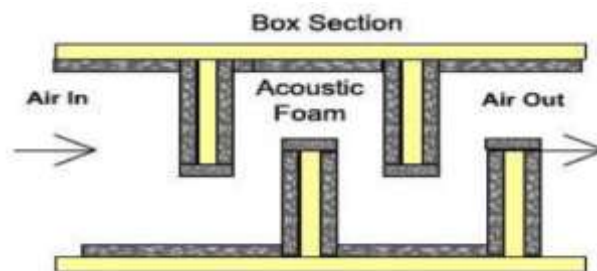


Fig. Baffle silencer

2. Wave Cancellation Silencer

In this type, exhaust gases are divided into two parts. The lengths of these paths are so adjusted that after they come out of the muffler, the crests of one wave coincide with the troughs of the second wave, thus the cancelling each other and reducing

the noise to zero theoretically. In practice this type of muffler does not eliminate noise completely, because this is possible only at one frequency for which muffler is designed, whereas the noise is a combination of different frequencies. However, appreciable noise reduction is achieved

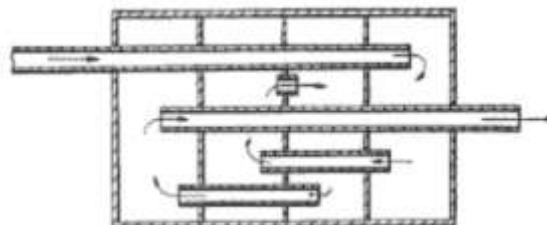


Fig. Wave Cancellation type silencer

3. Resonance Silencer

These are also called Helmholtz type, after the person who originated the idea. It consists of a

number of Helmholtz resonators in series, through which a pipe containing access ports passes. The exhaust gases flow through this type and thus

experience no resistance. Series of resonators eliminate the fundamental and higher harmonics of

the engine noise.



Fig. Resonance type silencer

4. Absorber Silencer

The sound absorbing material, usually fiber glasses, is placed in this case around perforated tube through which the exhaust gases pass. The sound is reduced by conversion into heat by the sound

absorbing material. Such mufflers are commonly known as glass packs and are quite common in performance and raising cars due to their little resistance to flow.



Fig. Absorber type silencer

5. Combined Resonance and Absorber type

It is seen that the absorber type muffler, has a drawback in that it is not efficient in reducing noise of low frequency. To obviate this defect, this is combined with a resonant chamber. It has been found that this type is more efficient than either the simple resonance or the absorber types.

As the exhaust gases enter into aqua silencer, the perforated tube converts high mass bubbles into low mass bubbles after that they passes through charcoal layer which again purify the gases. It is highly porous and posses extra free valences so it has high absorption capacity. After passing over the charcoal layer some of the gases may dissolve into water and finally the exhaust gases escape through the opening into the atmosphere. Hence aqua silencer reduces noise and pollution.

III. PRINCIPLE AND BLOCK DIAGRAM

Working Principle:

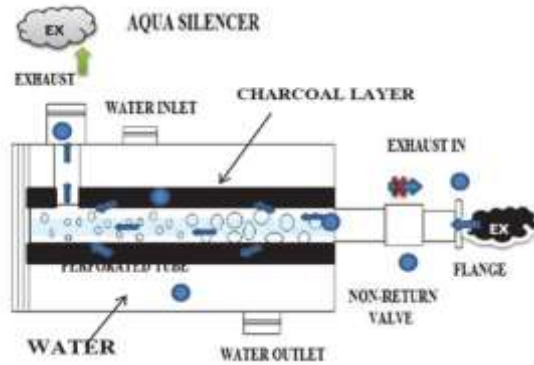


Fig. Structure of the aqua silencer

Components of Aqua Silencer:

Activated Carbon (Charcoal):

Activated carbon, also called activated charcoal, 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. In the form of granular it doesn't take that much area coverage because of bigger in size even if it is solid like a powder form of activated charcoal.



Fig. Activated Carbon

Water:

Water is the chemical substance with chemical formula H₂O, it is tasteless, odourless liquid water has weak absorption bonds. Unlike

other analogous hydrides of the oxygen family, water is primarily a liquid under standard conditions due to hydrogen bonding. Water also has high adhesion properties because of its polar nature.



Fig. Water for Aqua silencer

Perforated tube:

The perforated tube consists of number of holes of different diameters. It is used to convert high mass bubbles to low mass bubbles. The charcoal layer is pasted over the perforated tube. Perforated tube is tube generally made up of stainless steel and have holes punched or drilled

around its periphery. These tubes are provided to guide the flow and hence their main function is to reduce the backpressure of the engine. However, with the appropriate design of perforated tube it is possible to increase the transmission loss of the muffler.

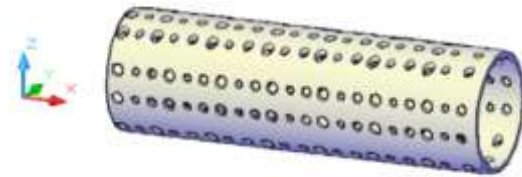


Fig. Perforated Tube

Lime powder:

Saturated solution of calcium hydroxide is known as Lime water. Some amount of Calcium hydroxide $\text{Ca}(\text{OH})_2$ is soluble in water. Pure limewater is crystalline, odourless and colourless. Limewater is prepared by stirring allowable calcium

hydroxide in pure water, and filtering off the allowable insoluble $\text{Ca}(\text{OH})_2$. When calcium hydroxide particles dissolve in pure water then it looks like milky, hence its name known as milk of lime. It is an alkaline solution.



Fig. Lime powder

Outer Shell:

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. Material selection of the outer shell is the crucial parameter because of the consideration of heat conductivity, corrosiveness and cost.

Requirement of good shell material selection:

1. Its thermal conductivity.
2. The thermal conductivity of material must not be high enough so that it will liberate all of its heat and will cause less effective temperature for necessary reactions.

3. The material should have good resistance to corrosiveness and erosion.

Non return valve:

The non-return valve is a mechanical device a valve, which normally allows fluid (liquid or gas) to flow through it in only one direction. They have two ports, one as an inlet for the media and one as the output for the media. Since they only allow media flow in one direction, they are commonly referred to as one way valves or non-return valves. The main purpose of a check valve is to prevent backflow in the system.

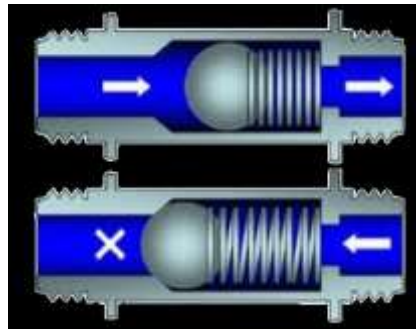


Fig. Non return valve

IV. LITERATURE REVIEW:

The literature review has been referred from journals, reports, conferences and books. Some research papers were also referred to have information on the previous art of research. Thus, this chapter tries to discover previous studies and expedite it for the current study in this thesis.

1. Sarah Raj et al. (2016) discussed about silencer types in that the combined resonance and absorber type is the more effective type. In that project they made model and carried out the analysis. The outcome of this experimental analysis was that twin filter silencer is more effective and the water contamination was found to be negligible in aqua silencer.
2. Rahul.s.padval et al (2016) had proved in their experiment of an aqua silencer that water in a silencer reduces the sound. The system is very cheap and is use for four and two 7 wheelers. The performance of twin silencer is almost equivalent to the conventional silencer.
3. Dr.P.K.Sharma et al (2017) the investigator of An Aqua Silencer said that it is fixed to the exhaust pipe of engine. 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 (UHC), oxides of nitrogen (NOx) and Lead.

4. Vijayabalan P et al (2016) conducted the experiment; they have successfully controlled emission of carbon dioxide from the diesel operated engines, which is about 9.266% of the overall emission from a vehicle. AVG gas analyzer is used to measure the content of gases and their percentage. Through this other gases has also been controlled like hydro carbon, nitrogen, carbon monoxide and particulate matter.

So this study looks the gaps and survey to react with size reduction using absorptive chemicals. Before saying more about the study, this study say something about the existing sound eliminating machine component called silencer and air emission reduction components like that of catalytic converter respectively.

V. SUMMARY:

- No Vibration when engine is running.
- Start the Engine very easily.
- Sound is reduced
- Low Cost compared to normal silencer
- Control Emission and noise in greater level
- Carbon is precipitated
- CO is reduced 60 % to 70 % compared to normal silencer.

VI. CONCLUSION:

- The aqua silencer is more effective in the reduction 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 remains same as conventional 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 greater level.
- It is smokeless and pollution free emission and also it is very cheap. This aqua silencer's performance is almost equivalent to the conventional silencer. It can be also used both for two wheelers and four wheelers and also can be used in industries.

REFERENCES:

- [1]. International Journal of Mechanical Engineering Research. ISSN 2249-0019 Volume 5, Number 2 (December, 2015), pp. 211-221 © Research India Publications.
- [2]. International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 10 | Oct -2016 www.irjet.net p-ISSN: 2395-0072.
- [3]. AQUA SILENCER by Nitin.V.Patil ISSN:- 2394-1537 Vol. no 5. Issue no 3 march 2016.
- [4]. Mankhiar Ajay B, Sindhu LS , G. Sasikala ,“An Advancement To Reduce Pollution Effectively By Using Ti Nanotubes in Aqua silencer” International Journal Of Engineering Sciences & Research Technology.
- [5]. Design and Fabrication of Aqua Silencer for I.C Engines by Ajay Kumar Dhiman , Prakash Joshi Journal from International Journal of Recent Innovation in Engineering and Reasearch.