
Emission & Noise Control Device Aqua Silencer: A Review

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ABSTRACT

Global warming is increasing on our earth because of major explosion within the pollutants. Air pollution is very critical trouble on our earth. Air pollution is most essential from the public health point of view. Polluted air causes physical ill effect decides undesirable aesthetic and physiological effects. The primary element due to which the air pollutants is increasing are (Co), (No_x) and lead that are get exposed from cars. The alternative resources including huge factories, electric strength, generation flora, and massive industries .So its miles required to resolve these issues with the aid of taking various extreme attempts. Aqua Silencer is a custom designed version of a usual silencer designed for the reduction of poisonous emission from the exhaust of an IC engine into the environment and additionally to reduce the sound that is produced by damping strategies which entails water and as a result the name aqua silencer. It contains the use of least expensive chemicals like lime water, activated charcoal and water with the help of simple but powerful alternate in the layout and fabrication of the silencer to reduce the noise and toxic emission degrees.

Keywords: Aqua Silencer, Emission Control, Noise Reduction, Perforated Tube, Outer shell.

1. INTRODUCTION

The aqua silencer system is design for replace generally used single unit silencers in engine with its narrow shape and much less weight. It plays a crucial position in control the noise and emission of gases from engines. Air pollution causes dangerous physical impact on the human frame, animal and surroundings. The primary reason to use aqua silencer is because now a day's air pollutants is increasing rapidly. This device reduces the harmful exhaust gases from the auto. This emission controlled by the activated charcoal layer round perforated tube and lime water. The charcoal layer having excessive capability to soak up emission gases from engine. This type charcoal layer with lime water reacts chemically with emission gases and modifications the chemical structure of emission gases. The smoke or emission gases and noise degree in aqua silencer may be very less than the usually used silencers. The main reason behind the air pollution is automobile releasing the gases like carbon dioxide and un-burnt Hydrocarbon. Carbon emission is the release of carbon into the atmosphere. The carbon emissions are directly referred to the greenhouse gas emissions. The main contributors to climate change.

Currently, overall exhaust emissions, crankcase blow by & evaporative losses are the main constituents contributing towards exhaust emissions in case of automobiles catalytic converter is used for getting control over carbon monoxide (CO), unburnt hydrocarbons (UBHC) & oxides of nitrogen (NO_x), and many more gasses. Muffler is used for controlling undesirable noise at tail pipe of vehicle exhaust system. It also controls the exhaust gas recirculation (EGR) for controlling crankcase blow by.

2. EMISSION AND NOISE REDUCTION

A lot of effort is being made to lessen the air pollutants from petrol and diesel engines and regulations for emission limits are also imposed. Moreover, trends in petrol and diesel engines, blended with upgrades in the vehicles, will make gasoline intake discount of 40% or greater in the destiny automobiles [1]. One such

improvement is development of the silencer unit of an engine. That is wherein an Aqua Silencer comes into play. An Aqua Silencer particularly offers with manipulate of emission and noise in engine exhaust [2]. It basically consists of a perforated tube that is established on the go out of the exhaust from the engine, which may additionally have holes of variable diameters. This is performed to divide the gas molecules of large proportions to shape gas molecules of smaller diameter. Theoretically, four or extra units of holes are made at the perforated tube using drilling. The alternative quit of the perforated tube is sealed using a plug.

In addition to heat and water vapor, the pollutants formed in engine exhaust are,

- Carbon monoxide (CO)
- Carbon dioxide (CO₂)
- Oxides of Nitrogen (NO_x)
- Sulphur dioxide (SO₂)
- Particulate and Unburned Hydrocarbons (UBHC)
- Respirable combustible Dust (RCD)

The above polluting contents in the engine exhaust are to be controlled by the Aqua Silencer [3].

Causes of Smoke:

The main cause of smoke is incomplete combustion of fuel inside the combustion chamber. Two main reasons for incomplete combustion are incorrect air – fuel ratio and improper mixing. These might result due to engine design factors, such as injection system characteristics, the induction system, governor control, the fuel used, and the engine rating.

We understand that in addition to harmful emission, engines also produce a completely excessive quantity of noise. Industrialization, together with the needs of our modern-day society for numerous machines for Human comfort, rapid travel and appliances for habitual jobs in homes and workplaces, has caused boom in the degrees of noise pollution almost everywhere. The harmful effects of noise are widely known [4].

The simple precept of the use of water in reducing noise is that sound produced below water is less audible than in atmosphere. This is mainly because of small sprockets in water molecules, which lowers its amplitude for that reason, lowers the sound stage.

2.1 SELECTION OF MATERIAL:

Properties:

The material selected must possess the necessary properties for the proposed application. The various requirements to be satisfied can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc. The following types of principle properties of materials can affect material selection

1. Physical - melting point, thermal Conductivity, specific heat, coefficient of thermal expansion, specific gravity.
2. Mechanical - shear, bending, torsion and buckling load, fatigue resistance, impact resistance, elastic limit.
3. Manufacturing point of view- Cast ability, Weld ability, Surface properties, Shrinkage, Drawing properties, etc.
4. Chemical

3. COMPONENTS AND EXPLANATION

1. 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.



Fig 2.1- Perforated Tube [3]

2. Charcoal Layer: 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 1500⁰c for several hours in a burner. Its surface area gets increased.



Fig 2.2- Charcoal Layer [3]

3. 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.



Fig 2.3-Outer Shell [3]

4. U Bend: The U Bend is provided instead of a non return valve which is a mechanical device, which normally allows fluid (liquid or gas) to flow through it in only one direction. The Aqua silencer was filled with water and it is directly connected to the exhaust pipe of the engine. There is a chance for the water to get enter into the engine cylinder. To avoid this, U bend is used.

5. Flange: A flange joint is a connection of pipes, where the connecting pieces have flanges by which the parts are bolted together. Here flange is used to connect the silencer to the engine.

6. Non-Return valve: The Non return valve which is a mechanical device, which normally allows fluid (liquid or gas) to flow through it in only one direction. The Aqua silencer was filled with water and it is directly connected to the exhaust pipe of the engine. There is a chance for the water to get enter into the engine cylinder. To avoid this, Non Return valve is used.



Fig 2.5- Non-Return valve [3]

4. CONSTRUCTION AND WORKING

➤ **Construction:**

An Aqua Silencer essentially includes a perforated tube that is installed on the exit of the exhaust from the engine, which may also have holes of variable diameters (perforated). This is executed to divide the gasoline molecules of large proportions to form gasoline molecules of smaller diameter. Theoretically, 4 or greater units of holes are made on the perforated tube with the aid of drilling. The other end of the tube is sealed with the aid of a plug. Lime water is stored in the perforated tube, which chemically reacts with the exhaust coming from the engine. A small coating of activated charcoal is supplied everywhere in the perforated tube using an internal box which holds the charcoal in vicinity and separates the charcoal and lime water from the water inside the Aqua Silencer. This unit is then positioned in a container in which water is crammed to a certain level. A small commencing is furnished at the lid of the inner container which consists of the exhaust from it to the outside using a small diameter pipe. A U-bend of pipe is built on the end of perforated tube which doubles as a non-go back valve which prevents the again go with the flow of engine exhaust or lime water returned into the engine. [3]

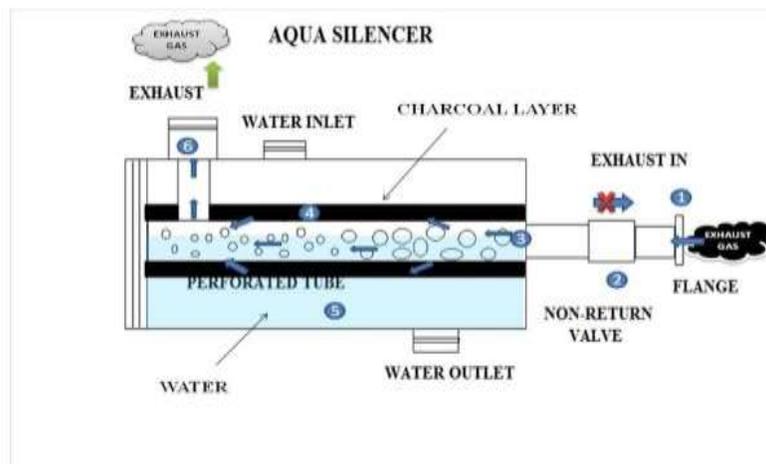


Fig-1: Construction & Working

➤ **Working:**

When the exhaust from engine enters the Aqua Silencer, gasoline molecules of massive proportions are converted into gas molecules of smaller diameter the use of the perforated tube and then they chemically react with the lime water solution and in the end pass via the charcoal layer, which again purifies the exhaust gases. The activated charcoal is exceptionally porous and has a pretty high absorption potential because of possession of more loose valences in it. Since the internal field containing the charcoal layer is immersed in water, noise produced is

damped and decreased to a low degree. Hence, the Aqua Silencer reduces noise and air pollution to an appropriate level.

5. EFFECT OF DISSOLVED GASES ON WATER

In this system water is very good absorbing medium. In aqua silencer gases made to dissolved in water when these gases from engine get dissolved in water they form acid, carbonates and bicarbonates etc.

- **Action of dissolved Sox:-** When Sox is treated with water, it form SO_2 , SO_3 , SO_4 , H_2SO_4 , i.e. sulfur Acid (H_2SO_3), it produces Hydrogen Sulphide which causes egg smell and causes corrosion of metals.
- **Action of dissolved CO_2 :-** The dissolved carbon dioxide forms bicarbonate at less PH and Carbonates at greater level PH. This levels 40 to 400 mg/liter. Form a scale in pipes and boilers. The carbon dioxide mixes with water to form Carbonic acid. It causes green house effect.
- **Action of dissolved NO_x :-** The Nitrogen in water under goes Oxidation to form ammonia, Nitrate, Nitric acid. This synthesis of protein and amino acids is get effect by Nitrogen. Nitrate usually occurs in trace quantities in surface water. A limit of 10 mg per liters Nitrate is affordable.

6. METHODS TO CONTROL WATER POLLUTION [2]

There are two processes in aqua silencer which are used to control water pollution. The water gets polluted by the dissolved gases. When these gases are mixed with water, they form acids like carbonic acid, sulfuric acid, and Nitrous acid etc. The petroleum products contain phenols which gives suffocating smell. The sulfur gas mixes with water to form hydrogen sulfide, which give rotten egg smell. These gasses are needed to be controlled to reduce the water pollution.

6.1 LIME WATER WASH METHOD:

- The water is treated with the calculated quantities of slaked lime. After mixing the heavy precipitates settle down as sludge at the bottom of the tank are removed from time to time.
- Lime can neutralize any acid present in the water. SO_2 .
- The precipitates dissolved carbon dioxide as calcium carbonate and converts bicarbonate ions into carbonates.

6.2 ABSORPTION PROCESS:-

- Activated charcoal is available in powdered or granular form. As it is highly possess free valences and it is highly porous. Hence it posses high absorption capacity.
- Activated carbon is mainly used for the removal of taste and impurities from the public water supplies.
- Because it has high properties of attracting gases, it divided solid particles and phenol type impurities. the activated carbon, usually in the powdered form is added to the water either before or after the coagulation with sedimentation.

7. RESULTS AND DISCUSSION [2]

First we decide the quantity of exhaust gas like hydrocarbons, nitrogen and so on that's present inside the single cylinder diesel engine without connecting zero emission silencers. And then aqua silencer (without lime water) is hooked up at the exhaust and determines the quantity of exhaust gasoline by smoke analyzer. At final the silencer (with lime water) which is related to exhaust pipe and readings are taken. The effects which are obtained from the mission analysis are given in the tables. Smoke analyzer tests were finished for studying the overall performance of the silencer.

➤ **Test using simple silencer**

The smoke from a single cylinder four stroke diesel engine is made to pass via an aqua silencer by connecting it to the exhaust of the engine.

Table 1: Test using simple silencer

Content No.	Constituents	Amount
1	CO	15.00%
2	HC	+22520ppm
3	CO ₂	+20.00%
4	O ₂	+0.00%
5	NO ₂	660ppm

➤ **Test using silencer with activated charcoal**

Activated charcoal is used inside the silencer because of its excessive absorption capability. It is able to soak up some quantities of the toxic gases present in the exhaust. At some point of this check, it's miles located that the amount of hydrocarbons and nitrogen dioxide are decreased as compared to the previous take a look at. That is because of the cause that the charcoal embedded inside the silence has absorbed certain quantity of the gas.

Table 2: Test using silencer with activated charcoal

Content No.	Constituents	Amount
1	CO	15.00%
2	HC	+22654ppm
3	CO ₂	+20.00%
4	O ₂	0.00%
5	NO ₂	559ppm

➤ **Test using lime water**

In this test lime water is filled in the silencer. The quantity of hydrocarbon has multiplied than that of the previous test. Excessive temperature is wanted for the hydrocarbon to burn absolutely and these outcomes within the incomplete combustion of the hydrocarbon. But it is discovered that the there may be a huge reduction in the quantity of nitrogen dioxide. As nitrogen dioxide is more poisonous than hydrocarbons, this test is taken into consideration as greater efficient.

Table 3: Test using lime water

Content No.	Constituents	Amount
1	CO	15.00%
2	HC	+22822ppm
3	CO ₂	+20.00%
4	O ₂	0.00%
5	NO ₂	460ppm

8. COMPARISON:

The comparison of Smoke Density Comparison and Noise Level Comparison for the above three cases are shown in the graphs given below.

Case 1: Test using simple silencer

Case 2: Test using silencer with activated charcoal

Case 3: Test using silencer with activated charcoal and lime water

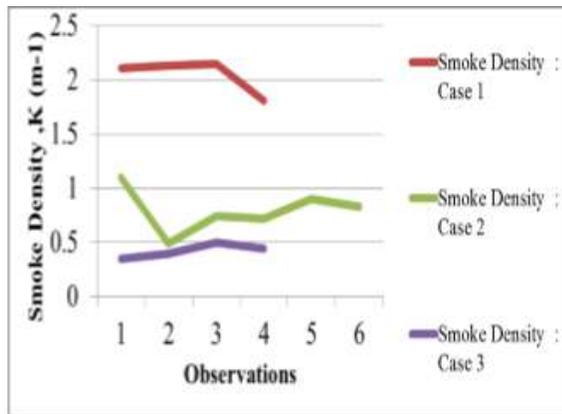


Fig 8.1- Comparison of Smoke Density Levels [4]

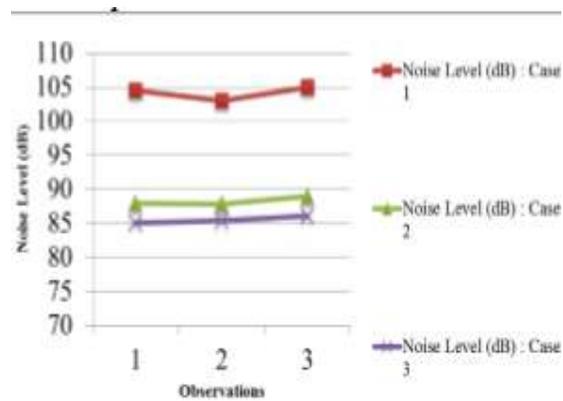


Fig 8.2-Noise Level Comparison [4]

9. SCOPE FOR FUTURE RESEARCH

Modifications and future scope for this project can be done by implementing nano tubes inside the perforated tube. The nano-tubes are polymers which have the manganese in its which will trap the exhaust pollutants inside it and separates the hydrogen molecules. These hydrogen molecules then can be used as regenerative to charge the fuel cells. Nano tubes can be used instead of charcoal in Aqua Silencer [1]. 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.

Presently, the Aqua Silencer is only suitable for use in industrial engines and intense power vehicles. But R&D departments have taken the subject into concern and are going into developing and redesigning the Aqua Silencer to make it possible to be fitted in to automobiles keeping its aerodynamic properties secure and satisfying or increasing its efficiency.

9. CONCLUSION

An Aqua Silencer having more efficiency to reduce emission gases from engine using lime water, charcoal layer and perforated tube with the use of perforated tube back pressure always remains constant and sound level of exhaust reduces. Contamination of water remains very less in aqua silencer. In this system fuel consumption remain same as conventional silencers because the use of perforated tube. Due to use of water as a medium, sound reduces these system having pollution free emission and smokeless. This system is very cheap. This system is used for both four wheelers and two wheelers. It plays important role in industries.

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