

Review on Aqua Silencer

Sameer Mestry¹, Supriya Morye², Akshay Parulekar³, Prajкта Desai⁴, M.T.Sawant⁵

^{1,2,3,4} Dept of Mechanical Engineering

⁵Professor, Dept of Mechanical Engineering

^{1,2,3,4,5} SSPM's College of Engineering, Kankavli, Maharashtra, India

Abstract- *The Exhaust from any vehicle or any industry causes the pollution of air in large scale. There are too many bad effects of air pollution on the biodiversity as well human beings. Air pollution occurs when harmful substances including particulates and biological molecules are introduced into Earth's atmosphere. It may cause diseases, allergies or death of humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. The most widespread pollutants include carbon monoxide, volatile organic compounds, ozone, nitrogen dioxide, sulfur dioxide, and fine and coarse particles. These substances are used as indicators of air quality in cities. Air pollution can cause health problems. To reduce such a problem with technical development and to reduce pollutants from exhaust gases there should be necessity of new exhaust technique called as Aqua Silencer. Aqua Silencer is a modified version of a conventional silencer aimed at the reduction of toxic emission from the exhaust of an IC engine into the atmosphere and also to reduce the noise that is produced by damping methods which involves water and hence the name. It incorporates the usage of cheap chemicals like lime water, activated charcoal and water with the help of simple but effective change in the design and fabrication of the silencer to reduce the noise and toxic emission levels. This exhaust technique also applicable for any industrial exhaust.*

Keywords- Aqua Silencer, Industrial Exhaust, pollutants, chemicals.

I. INTRODUCTION

An aqua silencer System is designed to replace conventional engine silencers on board structures. With its light weight and slender design, it offers a minimum emission contents and entire exhaust system for low noise and reduced backpressure. It is used to control the noise and emission in IC engines. The reason behind for aqua silencer is, in today life the air pollution causes physical ill effects to the human beings and also the environment. The main contribution of the air pollution is automobile releasing the gases like carbon dioxide and unburnt Hydrocarbon. It is mainly dealing with control of emission and noise, 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 with internal combustion engine the noise and smoke level is considerable less than the conventional silencer, no need of catalytic converter and easy to install.

II. LITERATURE REVIEW

There are lots of techniques is being made to reduce the air pollution from petrol and diesel engines and regulations for emission limits are also imposed. Furthermore, developments in petrol and diesel engines, combined with improvements in the vehicles, also for industrial exhaust there are many techniques are available for reduce the air pollution.

The table below shows some of the literature on Aqua Silencer.

[1] **Shweta B. Said (2017)** had analyzed By using Activated charcoal and Perforated tube it effectively eliminates the pollutants in the exhaust gases and reduces the Noise , Also back pressure remains constant, fuel consumption is same that of conventional silencer. It is a smokeless and pollution free emission.

[2] **Sarath Raj (March 2016)** had found The twin filter 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 consumption 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.

[3] **Akhil Anil Kumar (May 2016)** had the aqua silencer is successfully effective in reducing emission of gases from the engine exhaust. By using water as a medium, the sound levels have been reduced and by using activated charcoal in water, it

produces almost pollution-free and smokeless emission and is also cheap considering long term use.

[4] **Mankhiar Ajay B (May 2014)** had worked reduction of the air pollution and water pollution along with eliminating noise. This research portraits on the effective way of managing vehicle parameters to fulfill the emission norms.

[5] **Rawale Sudarshan S. (Sep.2013)** had conclude that the Aqua Ammonia with proper concentration can be very useful for reducing the rate of pollution from I.C engine.

[6] **Akhil Chowdary Bellam. (2016)** had found that Aqua silencer is more effective in the reduction of emission gases, and the engine exhaust using perforated tube, lime water and activated charcoal. The aqua silencer has been fabricated and tested. It shows reduction in emission.

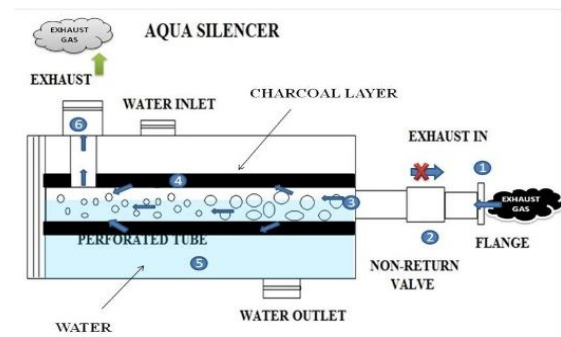
[7] **Rahul.S.Padval (2016)** had observe that An Aqua Silencer having more efficiency to reduce emission gases from engine using lime water, charcoal layer and perforated tube with the use of perforated tube back pressure always remains constant and sound level of exhaust reduces.

[8] **Abhiram Saraf, Tejas Khese, Tarang Shah (2017)** had found that Aqua Silencer is more effective than conventional silencer by reducing the exhaust gasses emissions by using perforated tube and charcoal. The sound level is decreased by using urea based water. By using perforated tube the back pressure will remain constant and vehicle's fuel consumption will remain same. With the help of PUC reports the HSU% is reduced.

[9] **keval Patel (2014)** had conclude that using water as a medium the sound can be lowered and also by using activated charcoal in water it can control 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 cheap.

III. REVIEW ON DESIGN OF AUQA SILENCER.

A. Basic Concept block diagram



B. Review on outer container.

The shape of the outer shell has a cylindrical shape [1].

In some of the concept the of the aqua silencer shows as rectangular box like structure of outer shell [3].

In the some research aqua silencer shows with bigger cylinder.

C. Review on Perforated tubes

The perforated plate converts high mass bubbles into low mass bubbles, when exhaust gases enters the Aqua silencer. After that they pass through activated charcoals which again purify the gases. Some of the research says that, the perforated tube with 4 sets of holes are cut on the tube [1].

The main function of the perforated tube is to suppress the sound and increase the performance [2].

Theoretically, four or more sets of holes are made on the perforated tube by drilling [3].

A tube of 20 mm diameter, 230 mm long is drilled with 500 holes with different Diameters [5].

D. Review on Charcaol layer

It is basically an Activated charcoal . It is made by burning a coal on burner at 1500°C for several hrs. It has high absorbing capacity as its surface area gets increasing and it is very porous and having extra free valance electrons hence gases get purify [1].

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 for several hours in a burner. Its surface area gets increased. Charcoal layer is provided on the surface of the perforated tube. Charcoal is highly porous and possesses extra free valances. So the charcoal is a good absorbing medium. Hence

the gases may purify. Different types of charcoal are available. But activated carbon charcoal is commonly used in twin filter silencer. Charcoal may be activated to increase its effectiveness as a filter. Activated charcoal readily adsorbs a wide range of organic compounds dissolved or suspended in gases and liquids. In certain industrial processes, such as the purification of sucrose from cane sugar, impurities cause an undesirable color which can be removed with activated charcoal. It is also used to absorb odors and toxins in gases, such as air. Charcoal filters are also used in some types of gas mask [2].

A small coating of activated charcoal is provided all around the perforated tube using an inner box which holds the charcoal in place and separates the charcoal and lime water from the water in the Aqua Silencer [3].

These layer having high absorption capacity because it having large surface area. These type of charcoal called activated charcoal. These activated charcoal produce by heating it up to 1500 °C for specified hours in a burner. Thus it is surface is get increasing [5].

Absorption process method i.e. (activated charcoal) in this project to control the water pollution. Activated charcoal is available in granular or powdered form. As it is highly porous and possess free valences. So it possesses 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. The activated carbon is mostly available in the powdered form is added to the water either before or after the coagulation with sedimentation [8].

IV. REVIEW ON METHODOLOGY

The Aqua silencer is modified technique for purify the Engine exhaust form any vehicle and industrial exhaust. As far as the development is occurs in the design and concept, it is seen that there is some advancement is occurs in the concept of Aqua silencer.

A. Combined Resonance and Absorber type [2].

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.[2]

B. Reduce Pollution Effectively by Using TI Nanotubes [4]

In this research, they made an attempt to reduce pollution produced by the power train by using same system of aqua silencer but in a more efficient way by adding the Titanium Nano-tubes in the silencer in the presence of charcoal and water which plays a vital role in controlling pollution.

The Nano-tubes are polymers which have the manganese in its which will trap the gasses and separates the hydrogen molecules. These hydrogen molecules can be used as regenerative to charge the fuel cells. The Nano-tubes are fitted in the water absorption chamber so the purification process is reduced and does not require separate technique.[4]

C. Use of Aqueous Ammonia in Silencer for removal of CO₂, SO₂ and NO_x from exhaust gases [5]

The exhaust gases containing SO₂, NO_x, and CO₂ from the combustion chamber enter the absorber through the spreader. A definite flow rate of aqueous ammonia is capable of absorbing maximum amount of CO₂ and the others. The direction of flow of aqueous ammonia is anti-parallel to that of the flue gases. There is continuous flow of aqueous ammonia as shown in the figure. The function of storage cylinder is to hold aqueous ammonia in case of rise in level due to pressure of the exhaust gases. Further the gases, flowing through the pipe and a pair of filters in the filter cylinder, are ejected to the atmosphere. The gases that are ejected to the atmosphere are found to contain 10% to 25% less carbon dioxide, carbon monoxide and hydrocarbons.[5]

D. Lime water wash method [7]

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. SO₂.

The precipitates dissolved carbon dioxide as calcium carbonate and converts bicarbonate ions into carbonates.[7]

The equations are given below [7]

- 1) $\text{Ca(OH)}_2 + \text{SO}_2 \dots \dots \text{CaSO}_3 + \text{H}_2\text{O}$
- 2) Neutralizes any acid in water
 $2\text{HCl} + \text{Ca(OH)}_2 \dots \dots \text{CaCl}_2 + 2\text{H}_2\text{O}$
 $\text{H}_2\text{SO}_4 + \text{Ca(OH)}_2 \dots \dots \text{CaSO}_4 + 2\text{H}_2\text{O}$
- 3) Precipitate Bicarbonate as calcium carbonate
 $\text{CO}_2 + \text{Ca(OH)}_2 \dots \dots \text{CaCO}_3 + 2\text{H}_2\text{O}$

- 4) Convert bicarbonate ions (like $\text{NaHCO}_3, \text{KHCO}_3$) etc into carbonates
 $\text{NHCO}_3 + \text{Ca}(\text{OH})_2 \dots \text{CaCO}_3 + \text{H}_2\text{O} + \text{Na}_2\text{CO}_3$

keval Patel (2014) [9]

E. Absorption process [7]

Activated charcoal is available in powdered or granular form. As it is highly possess free valences and it is highly porous. Hence it possess 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.

V. REVIEW ON RESULT

Sarath Raj. (March 2016) [2]

TEST 1 (MARUTI 800)		
CONTENTS	BEFORE	AFTER
CO	4.36	1.445
HC	412	196
TEST 2 (stationary)		
CONTENTS	BEFORE	AFTER
CO	9.105	0.06
HC	4328	10

Akhil Chowdary Bellam. (2016) [6]

Silencer	Prescribed CO	Measured CO	Prescribed HC	Measured HC
Ordinary	4.50%	3.80%	7800 PPM	7200 PPM
Aqua silencer	4.50%	2.90%	7800 PPM	6200 PPM

Rahul. S. Padval. (2016) [7]

Silencer	Prescribe d CO	Measured CO	Prescribe d HC	Measured HC
Ordinary	3.5	0.85	4500	837
Aqua silencer	3.5	0.5	4500	429

Abhiram Saraf, Tejas Khese, Tarang Shah (2017) [8]

PARAMETER	Conventional Silencer	Aqua Silencer
CO	0.39%	0.08%
HC	524 PPM	239 PPM
Vibrometer Reading	113.66 db	99.33 db

Silencer	Prescribe d CO	Measured CO	Prescribed HC	Measure d HC
Ordinary	3.5	0.93	6000	269
Aqua silencer	3.5	0.22	6000	212
SOUND TEST				
		Conventional	Aqua Silencer	
Without any load		104.5 db	75 db	
50% load		106.5 db	76.5 db	
100% load		107 db	78 db	

VI. LITERATURE GAP

Silencer Dimensions is mattered when the total weight of silencer, availability of space, material required and the position of mounting of silencer. Therefore for it is required that standardization of dimensions of outer shell or any other part of aqua silencer. It is also important that outer shell containing the lime water or solution which used as filtrate liquid. If size of outer shell get changed then liquid contain in it also get changed. So changing of size and defining new standard size of outer shell need to be properly designed.

There are many statements on construction of perforated tube but to design the perforated tube certain parameter should be set. For example, determination of holes diameter, length of tube, diameter of tube etc. these things should be somewhere calculated by certain theory of formulation. Also it may possible to selection of hole’s pattern like circular holes or rectangular holes, any other size. This is matters to avoid material selection, weight of Aqua silencer. Again the back pressure handling from the engine.

The different methods of coating charcoal layer on the perforated tube are mentioned in different research paper. Somewhere it also mentioned what should be size of charcoal particles. But it should be more standardize that how that activated charcoal actually placed on the perforated tube so that concept of inside design of Aqua silencer will clear. Also quality and quantity of charcoal should be specify.

There are too many methods included for advancement of Aqua silencer but which method is better and with its advantages and disadvantages is still not defined. Cost is an important parameter while designing any industrial or automotive component. There too many research paper are published with different cost analysis. But effective and cost efficient research should be provided so that it can be improve and implantable.

VII. REVIEW SUMMARY

1. There is no any kind of specified size for particular type of exhaust.
2. Aqua silencer works high efficient when exhaust is stationery but when dynamic exhaust is there is problem in aerodynamic analysis of automobile.
3. As Aqua silencer contain fluid it has to undergo evaporation problem.
4. If cost of aqua silencer is higher than the conventional silencer then it is not possible to install it in commercial vehicle.
5. Maintenance of Aqua silencer cause big problem to the customer.

VIII. NEED OF CHANGES

1. To reduce the size as per requirement.
2. To reduce Noise of engine.
3. To reduce the cost below conventional silencer.
4. To reduce Emissions of the Exhaust as per Government rule.
5. To increase performance of Aqua silencer in dynamic condition.
Increase efficiency of Aqua silencer beyond conventional silencer.

IX. FUTURE SCOPE

1. Conventional Silencer can be replacing with Aqua Silencer in Automobile vehicle.
2. It can use in industrial Engine exhaust.
3. It can also use in vertical chimneys of industries by making some change in arrangements.

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