

Design and Construction of Aqua Silencer

H. A. Abdulkareem¹, B. Auta², A. G. Saddiq³

¹Department of Mechanical Engineering, Kaduna Polytechnic

²Department of Applied Biology, Kaduna Polytechnic

³Department of Mathematics and Statistics, Kaduna Polytechnic

ABSTRACT: Aqua silencer deals with control of emission and noise in engine exhaust which is achieved by using activated charcoal, perforated tube and outer shell. The main pollutant contributed by engines include carbon monoxide (CO), oxide of Nitrogen (NO_x) and lead Le etc. the activated charcoal layer filters this harmful Nitrous and Sulphur content produced from the engine. Sound produced under water is less audible than its produce in atmosphere. This is mostly because of small sprockets in water molecules, which lowers its amplitude thus, sound level decreases. Due to this, water is required in this silencer and hence its name is Aqua Silencer. The final emission is analyzed using a gas analyzer and the reductions of gases Hydrocarbon (HC), carbon monoxide (CO) are measured.

KEY WORDS: Aqua Silencer, activated charcoal, perforated tube, outer shell, Sulphur, Oxides of Nitrogen, Noise.

Date of Submission: 06-10-2020

Date of acceptance: 19-10-2020

I. INTRODUCTION:

Global warming is increasing on our earth due to major increase in pollution. The main component due to which the air pollution is increasing are carbon monoxide (CO), oxide of nitrogen (NO_x) and leads (Le) which are obtain from vehicles and industrial emission. Aqua silence is one of the methods adopted in reducing the greenhouse gasses. It is fitted to the exhaust pipe of engine or any emission system. It is also served as a noise level reducer. In aqua silence the main component is perforated tube which consists of number of different diameter holes. Charcoal layer is pasted over that tube and is used in converting high mass bubbles to low mass bubbles. [1]the aqua silencer reduces emission noise because, the sound produced in aqua silencer under water having less amplitude than the sound produced in open atmosphere. These happen because, in water molecules there are small sprockets which lowers amplitude of emission gases and lower the sound level[2]. The charcoal layer which is pasted over perforated tube can control the emission using the activated charcoal and highly porous extra free valence so these layers having high absorption capacity. The aqua silence system is design on a replacement of commonly used single unit silencers in engine with its slender (thin) structure and less weight. It plays an important role in controlling the noise and emission gasses from engines. Air pollution causes dangerous physical effect on human body, animal and environment. This system reduces the dangerous exhaust gases from the exhaust. Certain percentages of the emission are absorbed by the activated charcoal layer around perforated tube and lime water. The charcoal layer having high capacity to absorb emission gases from engine [3]. These types of charcoal layer with lime water reacts chemically with emission gases and change the chemical structure of emission gases. The smoke or emission gases and noise level in aqua silence are considerably less than in conventional silence; there's no need of catalytic converter and it is easy to install.

II. BRIEF REVIEW OF LITERATURE

[4] had observed that the aqua silencer is successfully effective in reducing emission of gases from the engine exhaust,by using water as a medium, the sound levels reduces and by using activated charcoal in water, it produces almost pollution-free and smokeless emission and is cheap considering long term use. The aqua silencer's performance is almost equivalent to the conventional silencer. It can be widely used in industrial engines and with a little improvisation, in heavy weight vehicles. This project analyzed the smoke content of the exhaust gas before and after treatment and it was found that there is a considerable reduction in the emission as pointed out by the test results.

In his analysis [1] examine the contents of the exhaust gas before and after the treatment and it was found that there is a considerable difference in the percentage of harmful products in the emission. While [5] found that it 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. It is smokeless and pollution free emission and also it is very cheap. It can be also used both for two wheelers and four wheelers and also can be used in industries.

[6] had observed that by using perforated tube the back pressure will remain constant and sound level get reduced. The water contamination is found to be negligible in aqua silencer.

III. COMPONENT PARTS AND THEIR FUNCTIONS:

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[7].

Non-return valve: The non-return valve is a mechanical device which normally allows fluid to flow through it in only one direction. Check valve are two-ports valves, meaning they have two openings in the body, one fluid enters and another for fluid to leave. An important concept in check valves is the cracking pressure which is the minimum up stream pressure at which the valve will operate. Typically, the check valves designed for and can therefore be specified for a specific cracking pressure. 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 valves are used. It allows the flow of fluid in one direction[8].

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 were provided in the shell itself[9].

Flange: A flange joint is a connection of pipes, where the connecting pieces have flanges by which the parts are bolted together.

Activated charcoal: Generally, these are 4 set of holes on perforated tube. Charcoal layer is pasted over that tube and it is used to convert high mass bubbles to low mass bubbles. The aqua silencer reduces emission noise because, the sound produced in aqua silencer under water having less amplitude than the sound produced in open atmosphere. The charcoal layer which is pasted over perforated tube can control the emission using the activated charcoal and highly porous extra free valences so these layers having high absorption capacity [10].

Lime water: The water gets polluted by the dissolved gases with acids formation like carbonic acid, sulfuric acid, and nitrogen acid etc., to control this gases lime water is use which minimize the water Pollution [11].

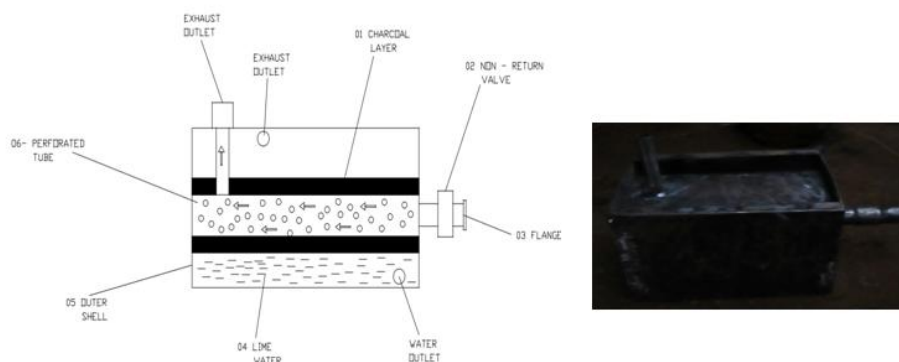


Figure 1: Schematic Diagram and Picture View of Silencer

IV. DESIGN EVALUATION AND DRAWINGS.

➤ Perforated Tube

A perforated tube of 50.8mm diameter and 431mm length was used to reduce the emission and noise from the engine.

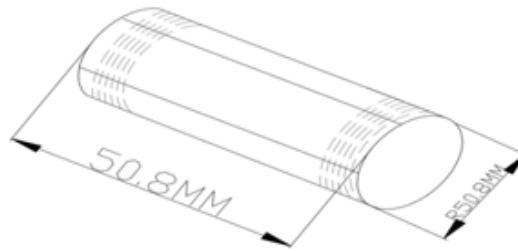


Figure 2: Perforated Tube

➤ **Outer Shell**

It serves as a casing for the silencer components. The size depends on the size of the perforated tube length and other components to be enclosed within the casing.

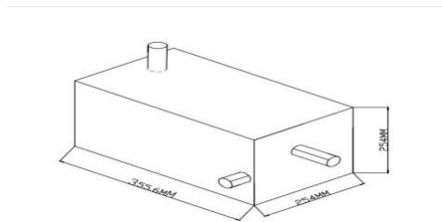


Figure 3: Outer Shell

➤ **Flange**

It is used as a connector between the engine exhaust and the silencer. The size also depends on the size of the perforated tube diameter. A standard value is been selected to meet the up with the desired requirement.

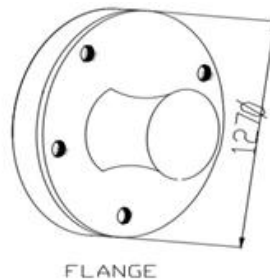


Figure 4: Flange

➤ **Activated Charcoal**

This absorbs the emission from the exhaust of an engine. For a good, activated charcoal takes up between 20 and 50% of its death weight in gaseous material. Average separating ability for gaseous material in this category is with approximate 35% of the death weight of coal. This contains most smell-forming substance. I.e. 35% of $200m^2/g$.



Figure 5: Sample of Activated Charcoal

➤ **Lime Water**

Lime water used to neutralize any acid present in water. Sodium dioxide SO_2 is removed from the five gases forming calcium sulphate. The precipitate of carbon dissolves as calcium carbonate and bicarbonate converts into carbonate.

Table I: Material Section and Component Dimension

	COMPONENT	MATERIAL USED	DIMENSION
1.	Perforated tube	Galvanized pipe	Length: 17in = 431.8mm Diameter: 2in = 50.8mm
2.	Non return valve	Galvanized pipe	Length: 2 in = 50.8mm Diameter: 2 in = 50.8mm
3.	Flange	Steel	
4.	Inner shell	Steel	Length: 14in = 355.6mm Width: 5in = 127mm Height: 5in = 127mm Thickness: 2mm
5.	Outer shell	Galvanized sheet	Length: 14in = 355.6mm Width: 10in = 254mm Height: 10in = 254mm Thickness: 2mm

V. RESULT AND DISCUSSION

The maximum accepted sound level in some selected environment is 55db [12]. The analysis of the design performance of the Aqua silencer is as presented on table 2, which also, indicates the percentages of the exhaust gases and hydro-carbon emission as compared to an ordinary silencer.

Table II: Performance Characteristics as Compared to an Ordinary Silencer.

	Prescribed Standard CO	Measured Level of CO	Prescribed Standard HC	Measured Level of HC
Ordinary silencer	4.50%	3.8%	7800 ppm	7200 ppm
Aqua silencer	4.50%	2.9%	7800 ppm	6200 ppm

VI. SUMMARY AND CONCLUSION

The aqua silencer is more effective in reducing emission from the engine exhaust using perforated tube, lime water and charcoal. By adopting perforated tube, the back pressure remains constant, fuel consumption remains same as conventional system. Noise produced in water is less and also by employing activated charcoal we can control the exhaust emission to a greater level. The water pollution is found negligible in aqua silencer as it is smokeless and pollution free emission.

REFERENCES

- [1]. P. Balashanmugam and G. Balasubramanian, "Developments of Emission and Noise Control Device (Aqua Silencer)," *Int. J. Mod. Trends Eng. Res.*, 2014.
- [2]. S. S. Pachbhai and L. P. Raut, "A Review on Design of Fixtures," *Int. J. Eng. Res. Gen. Sci.*, vol. 2, no. 2, pp. 126–146, 2014, doi: ISSN 2091-2730.
- [3]. A. Gaikwad, "Study on Development of Aqua Silencer," *Int. J. Res. Publ. Eng. Technol.*, vol. 3, no. 4, pp. 199–203, 2017.
- [4]. A. K. Akhil *et al.*, "Design and Development of Aqua Silencer," *Int. J. Eng. Innov. Technol.*, vol. 5, no. 11, pp. 35–41, 2016, doi: 10.17605/OSF.IO/PEZF3.
- [5]. A. C. Bellam, M. Raghunadh, A. Chirra, and S. Ravi Krishnamoorthy, "Fabrication and Testing of Portable Twin Filter Aqua Silencer," *Int. J. Chem. Sci.*, vol. 14, no. 2, pp. 687–693, 2016.
- [6]. S. Kumar, R. Kumar, and G. S. Mashal, "A review paper on aqua silencer," *Int. Res. J. Eng. Technol.*, vol. 07, no. 03, pp. 8–11, 2020.
- [7]. S. Thorat, "Design and Fabrication of Aqua Silencer For IC engines," *Learn Mechanical Engineering*, 2020. <https://learnmech.com/design-and-fabrication-of-aqua-silencer-for-ic-engines/> (accessed Sep. 20, 2020).
- [8]. P. Beniwal and A. Garg, "EXPERIMENTAL INVESTIGATION ON AN AQUA SILENCER," *Int. J. Adv. Res. Eng. Sci. Technol. Vol.*, vol. 4, no. 3, pp. 386–392, 2017.
- [9]. M. A. Alen, M. Akshay, P. S. R., and M. S. M., "Fabrication and Testing Of Aqua Silencer," pp. 1315–1320, 2015.
- [10]. B. J. Thirumal, "Noise Control System by using Aqua Silencer," vol. 5, no. 2, pp. 211–221, 2015.
- [11]. A. Saraf, T. Khese, T. Shah, G. Gaikwad, and S. D. Bhaisare, "Design and Analysis of Aqua Silencer," *Int. Res. J. Eng. Technol.*, vol. 4, no. 2, pp. 1432–1436, 2017, [Online]. Available: <https://irjet.net/archives/V4/i2/IRJET-V4I2280.pdf>.
- [12]. E. ToolBox, "Acceptable dBA Noise Level," 2020. https://www.engineeringtoolbox.com/decibel-dba-levels-d_728.html (accessed Sep. 26, 2020).

H. A. Abdulkareem, et. al. "Design and Construction of Aqua Silencer." *American Journal of Engineering Research (AJER)*, vol. 9(10), 2020, pp. 79-82.