



Design and Analysis of Aqua Silencer for Reducing Exhaust Emission Control

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Abstract— The exhaust pipe is equipped with an aqua silencer. CO, UBHC, NOx and Lead constitute the primary pollutants that cars contribute. Sound beneath water that is created in the atmosphere is less perceptible than the sound. This is mainly due to tiny water molecules sprockets, which reduce its amplitude, which lessens the loudness of the sound. This damaging nitrous and Sulphur content generated by the motor is filtered by the activated carbon layer. It converts high mass bubbles to low mass bubbles and lowers noise emissions. This silencer requires water and is hence called AQUA SILENCER. The aqua Silencer is used for noise reduction and management of harmful gas emissions in vehicles.

Keywords— Pollution, Aqua silencer, Charcoal layer, Reduce noise

I. INTRODUCTION

Aqua Silencer has been amended to reduce hazardous emissions from the exhaust of an IC engine into the atmosphere by use of a traditional quilted. It includes the use, via simple but efficient changes in design and manufacturing of the silencer, of cheap chemical products such as lime water, activated charcoal and water. The exhaust pipe of the engine is installed to minimize the noise [1]. Underwater sound is less hearable than atmospheric sounds. It reduces the sound intensity largely because of the little sprockets in the water molecules [2]. The emission may be regulated by the activated layer of charcoal and is very porous. Thus, absorb gas from the engine and release

it to the atmosphere considerably less. In addition to typical single-unit engine silencers put on industrial and heavy-duty motors, an aqua silencer system has been devised [3]. The sound and emission control in IC engines is employed. The sound generated can be decreased by utilizing water as a medium. It can also be employed in cars with additional development [4]. It has been identified as an excellent adsorbent for the current investigation using some inexpensive compounds. CO, CO₂, etc. are the major pollutants. We need cheap and effective technology in developing countries like India [5]. Silencer is also known as muffler. It is used to reduce exhaust noise from an internal combustion engine that is an important cause of noise pollution. When utilized in residential areas or regions where noise presents a risk, it becomes a more important problem. Noise levels of well above 80-90 dB are often harmful to people [6]. The major source of noise in a motor is separated into two sections; firstly, there is the noise of exhaust, and secondly, the noise is caused by friction of many engine elements. The most dominating motor exhaust noise is. The most effective technique to

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lessen this noise is to use an engine muffler [7]. The decrease in noise relies on the design, structure, and operation of the mufflers. In road and marine transport, agriculture, mining and many other industries diesel engines play an important role. Given the fuel resources available and the technical advancement now being developed, diesel fuel is essential [8]. In general, fuel consumption is a measure to find out about any country's economic strength. However, we cannot overlook the damaging impacts of the bulk of burned gases which daily degrade the cleanliness of our environment. The noise and emission of the IC engine are controlled using an aqua silencer. The aqua silencer reduces gas emissions from the engine exhaust most effectively [9]. The sound intensity can be reduced by employing a water medium. It is non-smoking and non-polluting. It can be utilized for two, four and industrial applications [10]. It can be used. The fuel consumption is the same via the use of perforated tubes as in traditional systems, by utilizing water, sound may be reduced as a medium, and we can also manage exhaust emissions by utilizing activated charcoal in water. Incorporating perforated tube, lime water and charcoal, the aqua silencer reduces the emission of motor gas from exhaust [11]. The backpressure remains constant and the sound level decreases with the use of the perforated tube. By employing a tube, the consumption of fuel remains the same as the conventional system by employing the sound medium, and we can manage exhaust emissions to a higher level also by employing activated wood in water [12]. Contamination of water in water silencers is determined to be insignificant. The emission of the traditional silencer is non-smoking and pollution-free [13].

II. CONSTRUCTION AND WORKING OF AQUA SILENCER

A tube, activated layer of charcoal and water that is mounted in the exhaust tube are the aqua-silent. Boxes of varied sizes consist of a perforated tube. It is intended to break down gas mass into tiny gas bubbles to provide a different diameter hole. Generally, the perforated pipe is boiled with 4 sets of holes. The opposite end of the tube is

closed with a connection. A layer of activated carbon is covered by metallic mesh around the perimeter of the perforated tube. The whole item is then put into a container of water. The exhaust gases are discarded using a tiny aperture on top of the container and the container is cleaned via a drain connector at the bottom. Also on top of the container is a filling plug placed. A non-return valve is positioned at the input of the exhaust pipe that also stops gas and water from flowing backward, as shown in figure 1.

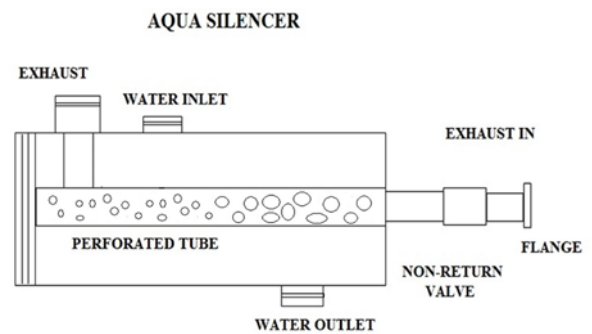


Figure 1. Aqua silencer

There are several holes with varied sizes in the perforated or drilled tube. It is utilized for converting large mass bubbles into small mass bubbles. The layer of charcoal is piled across the drilled tube. A perforated tube is a standard tube made of stainless steel that has peripheral holes.

The layer of charcoal is mounted on the perforated tube, which is more absorbent because of a greater surface area. Heat the wood over 1500oC for many hours in a furnace, which increases the surface area, it is called Activated Charcoal.

The whole installation was within the external shell. It consists of steel or iron. The input, exit and drainage tube in the shell itself was made available.

An attachment is a connection of pipes, which have flanges through which the sections are fastened. The flange here is used to connect the silencer to the motor.

A non-return valve is a mechanical device that generally permits the passage of fluid (liquid or gas) in just one way. It works on the motion of a spring. The Aqua silencer is watered and linked to the engine's exhaust tube instantly, so

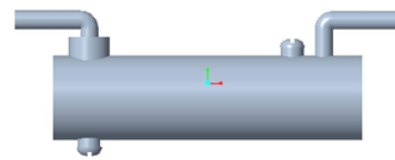
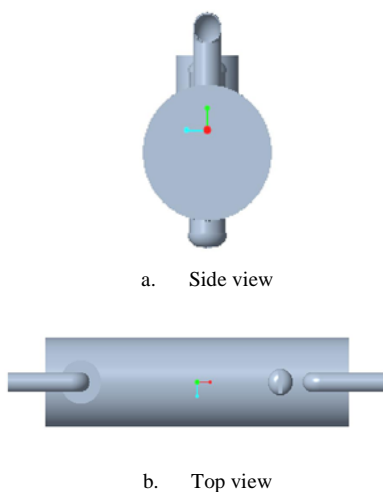
that the water may enter the engine cylinder. A non-return valve is employed to prevent this.

Available in the aqua silencer is the exhaust gases in the perforated tube that transforms high mass bubbles into low mass bubbles after which they travel through the woody layer that exonerates the gases. This layer is very porous and has additional free valences, which makes it very absorbent. The technical specification of Hero Honda Splendor Engine is given in table 1.

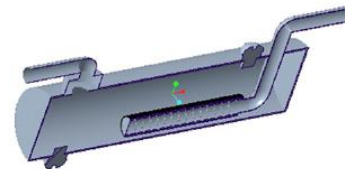
TABLE I
TECHNICAL SPECIFICATION OF HERO HONDA SPLENDOR ENGINE

Sr. No.	Parameter	Dimension
1	Bore (D)	50 mm
2	Stroke (L)	49.5 mm
3	No. Cylinders (n)	1
4	Engine power (P)	6.15kw (8.36ps) @ 8000rpm
5	Max. RPM (N)	8500 rpm
6	Allowable back pressure for muffler	Not available (in H ₂ O)
7	Transmission Loss Noise target (muffler)	30 dB.

Some of the gases can dissolve in the water after passing through the charcoal layer, and the exhaust gases release themselves into the atmosphere when open. This minimizes the level of noise and pollutants through water silencers. Figure 2 represents the three-dimensional CAD model of aqua silencer with all view and figure 3 shows the two-dimensional view with dimensions.



c. Front view



d. Sectional view

Figure 7. CAD model of aqua silencer

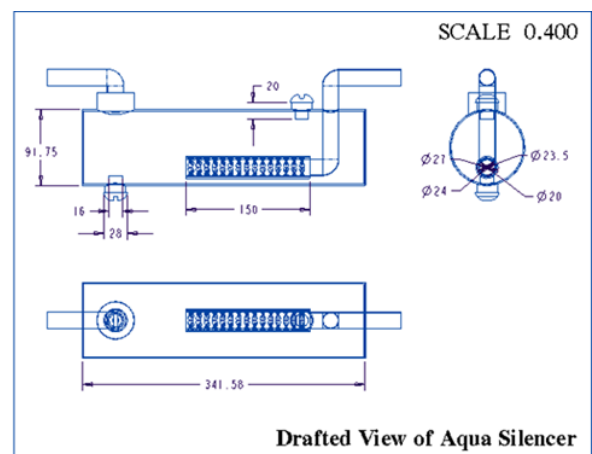


Figure 3. Two-dimension view of Aqua silencer with its dimensions

III. RESULT AND DISCUSSION

The smoke tester Hatridge is directly linked to the generator output. The quantity of HSU and the coefficient of light absorption are measured. For simple silencers, the mean value of HSU was recorded at 58,5%, and the mean coefficient of light absorption was 2,04 m-1. By employing the Active charcoal and Perforated tube, contaminants in exhaust gases are efficiently eliminated and noise is reduced; furthermore, a constant back pressure, fuel consumption is equal to the traditional silencer. It is an emission-free of smoke and pollutants. The water silencer has been experimentally observed to reduce gas emissions from the engine exhaust. The sound level has been decreased by the use of water as medium and activated charcoal in water generates almost pollution-free and non-smoking emissions and is also economical for long-term use. The performance of the aqua silencer is nearly equal to

the conventional silencer. It can be utilized extensively in industrial engines and large vehicles with minimal adaptation. The fuel consumption is equal to the traditional silencer as well. The pressure remains constant. It is an emission-free of smoke and pollutants.

To find fundamental frequency

Cylinder Firing Rate (CFR)

CFR = RPM/120 for 4-cycle engines

CFR = 8000/120 = 66.66Hz

Engine firing rate (EFR) EFR = No. of cycle x Cylinder firing rate

$$EFR = 1 \times 66.66 = 66.66\text{Hz}$$

Muffler volume calculations Swept volume (Vs)

$$= (\pi \times d^2 \times L)/4$$

$$= 97193.022 \text{ cm}^3$$

$$= 0.09714375 \text{ Lit.}$$

Volume to be consider for calculation

Volume = (No. of cylinders) x Vs = 0.0971930 Lit.

As no. of cyl = 1 for hero splendor.

Silencer Volume (Vm) = Factor* x Consider Volume
= 2.42982556 Liters

Assumed Factor = 25 for volume of silencer the factor should be at least 12 to 25 times the volume to be considered. Volume can be changed depending on the space constraint

A. Internal configuration of muffler and concept design

Diameter of muffler calculated as $V_m = (\pi/4) \times D^2 \times L$
 $2429825.5568 \text{ mm}^3 = 94.01\text{mm}$ OR $D = 94 \text{ mm}$.

Here, we take L= 350 mm after studying various muffler lengths of similar engine mufflers and overall space available on a motorcycle for mounting of a muffler and hence we select the same length.

B. Tail pipe design

Generally Tail Pipe Diameter and shape is taken the same as selected by OEM or manufacturer for lesser flow resistance and optimum flow characteristics. Hence, Tail

Pipe Diameter = 23.48mm (From Hero Honda splendor).

IV. CONCLUSIONS

By employing the Active charcoal and Perforated tube, contaminants in exhaust gases are efficiently eliminated and noise is reduced; furthermore, a constant back pressure, fuel consumption is equal to the traditional silencer. It is an emission-free of smoke and pollutants. The water silencer has been experimentally observed to reduce gas emissions from the engine exhaust. The sound level has been decreased by the use of water as medium and activated charcoal in water generates almost pollution-free and non-smoking emissions and is also economical for long-term use. The performance of the aqua silencer is nearly equal to the conventional silencer. It can be utilized extensively in industrial engines and large vehicles with minimal adaptation. The fuel consumption is equal to the traditional silencer as well. The pressure remains constant. It is an emission-free of smoke and pollutants.

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