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DESIGN AND FABRICATION OF AERODYNAMIC AQUA SILENCER

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Abstract - *The level of pollution caused by motor vehicles on our roads has been increased along with the number of vehicles on road so far, which contributes to increasing levels of pollutants in the environment. The pollutants emitted by the road vehicles are mainly CO, HC, and NOx. There are other sources such as electric power generating stations industrial processing that also play major role in increasing earth temperature. The current situation shows that high proportion of old vehicles is the major contributory factor to high vehicle emission levels. The common symptoms found in majority of population due to pollution are eye irritations, coughing, throw-ups, and odour as immediate effects. These may also lead to human suffering from Asthma, Cancer various respiratory disease. Only about half the number of vehicles that were tested and later analyzed based on there emission content were within the recommended World Health Organization standards. To control this, various alternative sources should be established so as to reduce pollution. Aerodynamic Aqua silencer is one of the step taken in that direction which is suitable for the application level. An aqua silencer is fitted to the exhaust pipe of engine through which it reduce the harmful effect of emission gases before they are given out in atmosphere.*

Key Words: Aerodynamic aqua silencer, exhaust emission, Charcoal, Small sprockets, Perforated tube.

1.INTRODUCTION

The air we breathe in is composed of various composite matter, It comprises of 78% nitrogen, 21% oxygen, and the rest being the inert gases. Over the period of time the human race has evolved and paved a way to the development of various industries and vehicles which in turn has led to increase in emission of harmful gases. The emission principally consists of nitrous oxide (NOx), carbon monoxide (CO) and hydrocarbons. Humans have come to rely on fossil fuels to power cars and planes heat homes and to run factories. These fossil fuels such as diesel, petrol emit carbon dioxide which is a major greenhouse gas that has biggest effect on global warming , nitrous oxide is the common emission from industrial, agriculture and burning of fossil fuels in vehicles carbon monoxide is the major contributor for ozen layer depletion that is located 50km above the earth's hemisphere. The HC and CO majorly contribute to GHG(green houses gases)that on reaching stratosphere deplete the protective ozone layer exposing us to the harmful cancer ultra violet UV rays. People experience wide range of health effects from being exposed to air pollution, which includes pneumonia or bronchitis they also includes discomfort such as irritation to nose , throat, eyes, skin.

The long term of air pollution can cause damage to people's nerves, brain, kidney lungs, lever and other organ. The exhaust silencer plays a crucial role to muffle out the noise coming out from the blast inside a combustion engine. It is also used to cleanse the gases with the help of a catalytic converter. The catalytic converter catalyzes the redox reaction of carbon monoxide (CO), hydrocarbon (HC) and Nitrogen oxide (NOx) which essentially help in converting pollutants to less harmful gases. The catalytic converters mainly used are: 2 way catalytic converter (CC) and 3 way catalytic converter. The 2 way catalytic converter uses oxidation reaction to bring about the change in the harmful gases using rhodium and palladium mesh whereas 3 way

CC uses reduction reaction that convert hydrocarbons (HC) into water molecules, carbon monoxide (CO) is converted into carbon dioxide(CO2) and nitrogen oxides (NOX) are broken into nitrogen gas (N2) using platinum and palladium mesh. An aqua silencer is a device that uses charcoal layer and like water to cool off and reduce harmful effects of exhaust gases from emission of the combustion chamber of an engine before they are given out in the atmosphere. These also help in noise reduction as noise produced under water is less hearable. Exhaust emission is controlled by activated charcoal layer which is highly porous and possess extra valences having high absorption properties so as to attract the harmful gases towards it and release much less position to the environment. The noise and smoke coming out of an "Aqua silencer" is much lesser than that of the conventional silencer. The exhaust gases from the combustion chamber enter the aqua silencer consisting perforated tube having n-number of holes of varying diameter, this converts the high mass bubbles into low mass bubbles. Gases are then passed through activated charcoal layer which absorbs the harmful gases. The process is repeated as the gases pass through lime water and hence the less harmful gases are given out into atmosphere. There is no need for any catalytic converter getting fitted with.

1.1 Problem Statement

Existing aqua-silencer are rectangular in shape and bulky therefore it occupies more space and installation become difficult and also increase installation cost so, in our system we will be eliminating this limitations and also we will be changing the chemicals so that emissions will be reduced to some more extent.

1.2 Objectives

To redesign aqua silencer this would be suitable for application level.

To design & fabricate a simple system, where the toxic levels are controlled through chemical reaction to more agreeable level.

To test the ability of some chemicals in removing air pollutants from automobile emission.

To make it less bulky or light in construction

To reduce emissions of toxic gases by 10 to 20 percentage than existing system.

2. Aerodynamic aqua silencer

The Aerodynamic performance criterion specifies the maximum acceptable pressure drop through the silencer (backpressure of the silencer). The exhaust flow rate and temperature from the engine manufacturer are required to accurately predict the backpressure of a silencer and piping system. Selection of an exhaust silencer based solely on the diameter of the connecting piping can often lead to improperly selected products that may present installation issues. Traditional head loss calculations utilizing standardized coefficients for sudden contraction and expansion of fluids can be used to approximate the pressure drop through a silencer and combined with the values obtained for the remainder of the piping system. More complex silencer internal structures should be analyzed using Computational Fluid Dynamics (CFD) where traditional empirical calculations or assumptions may lead to inaccurate results. The pressure drop through silencers should be obtained from the manufacturer of the product upon submission of the required flow information. Our modified system we will be eliminating this demerits, the demerits listed were that it is an bluff body made in rectangular box but in our system we will be making it aero foil or streamline body which will perform well during operation when installed on vehicle, and in all above systems lime water was used as a chemical agent from which the exhaust gases used to pass from it, lime water also have many demerits like it causes irritation to human skin & it also enhances corrosion of the silencer part, so in our system we will be eliminating the lime water as chemical and we

will be using an new chemical which will not cause effects like lime water and this new chemical can perform better then lime water & will emissions ((CO), Un-burnt Hydro Carbon (UBHC), (NOx) and Lead etc. from new system will be less as compared to existing aqua silencer

3.1Components

1) Perforated tube

Fig 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. 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. Backpressure is essential for the performance of a silencer. If the diameter of the hole increases the backpressure decreases sharply by 40%. The change in diameter of holes has remarkable effect on back pressure.

2) Charcoal layer

Fig 2. Charcoal layer

The charcoal layer has more absorbing capacity because it has more surface area. This charcoal is called as activated charcoal. Its surface area gets increased. Charcoal may be activated to increase its effectiveness as filter. Activated charcoal readily adsorbs a wide range of organic compounds dissolved or suspended in gases and chemical. It is also used to absorb odours and toxins in gases, such as air

3) **Outer Shell**

The whole setup was kept inside the outer shell. It is made up of steel. The water inlet, outlet and exhaust tube was provided in the shell itself.

Fig 3. Outer shell

3.2 Construction

Fig. Aerodynamic Aqua silencer

Basically an aerodynamic aqua silencer consists of a perforated tube which is installed at the end of the exhaust pipe. The perforated tube may have holes of different diameters. The very purpose of providing different diameter hole is to break up gas mass to form smaller gas bubbles the perforated tube of different diameter .Generally 4 sets of holes are drilled on the perforated tube. Around the circumference of the perforated tube a layer of activated charcoal is provided and further a metallic mesh covers it. The whole unit is then placed in a chemical container. A small opening is provided at the top of the container to remove the exhaust gases and a drain plug is provided at the bottom of the container for periodically cleaning of the container. Also a filler plug is mounted at the top of the container. At the inlet of the exhaust pipe a non-return valve is provided which prevents the back flow of gases and water as well.

3.3Working Principle

The high temperature high pollutant exhaust gas is allowed to pass through the inlet port in the first phase. This allows the exhaust gas to expand considerably throughout the passage. This expansion allows the gas to cool off, because the temperature is a function of pressure. As the exhaust gases enter into the aqua silencer, the perforated tube converts high mass bubbles in lo low mass bubbles after that they pass through charcoal layer which again purify the gases. It is highly porous and possess a few extra free valences so it has high absorption capacity. After passing over the charcoal layer some of the gases may dissolve in to the water and finally the Exhaust gases escape through the opening in to the atmosphere. Hence aqua silencer reduces noise and pollution.

3.4Specifications

i. Muffler – fiber glass or steel wool
ii. Reflection type silencer

iii. Spark arrestor DNV, RmRs
iv. Perforated tube no. of hole diameter = 8mm, 4mm , 2mm
v. Heat treatment temperature range = 800° to 1000°c
vi. Activated charcoal size= 0.35 to 0.80mm cylindrical palates type
vii. Stroke – Two stroke petrol engine.
viii. Type - Air cooled
ix. No. of cylinder - Single cylinder
x. Bore x Stroke - 42.6 mm x 42 mm
xi. Displacement - 59.9 cc
xii. Maximum Power - 3.5 h p at 5500 rpm
xiii. Max. Torque - 4.5 Nm at 5000 rpm

3.5**Designing Dimensions**

Shell Dimensions –

Length- 330 mm

Diameter- 120 mm

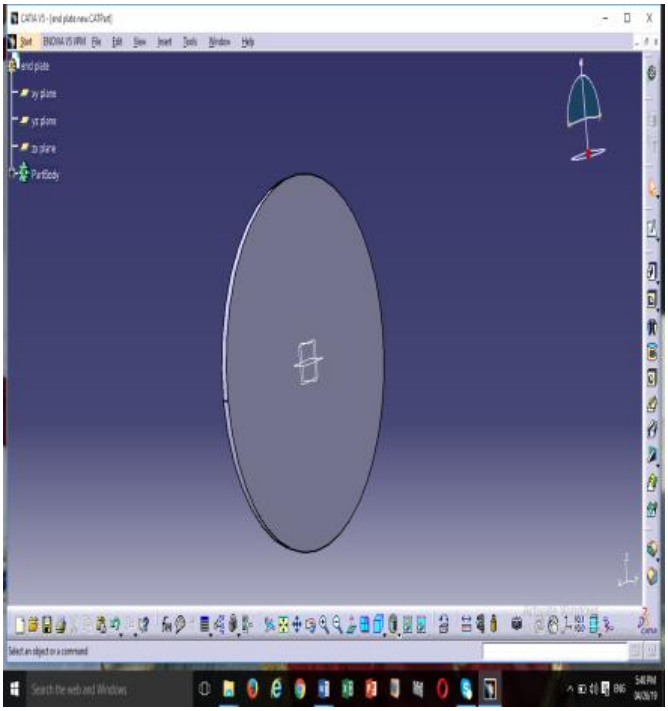
Thickness- 3 mm

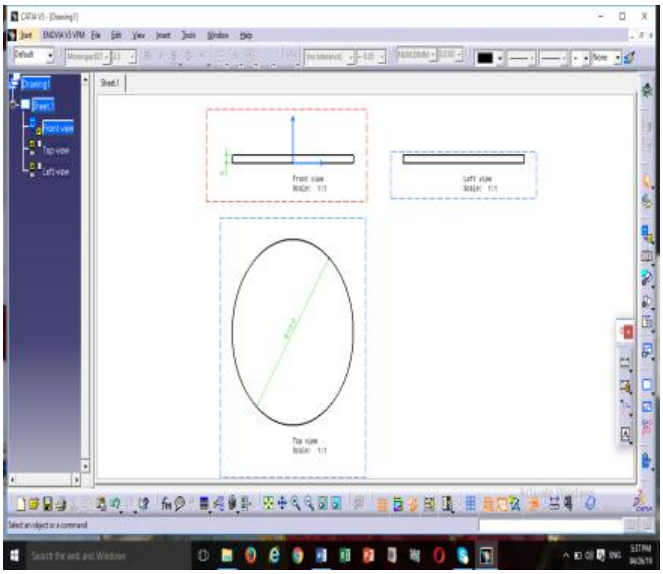
Elbow Dimensions –

Exhaust of Silencer
Height-130 mm
Length- 110 mm
Diameter-25 mm
Inlet to silencer
Height-130 mm
Length- 110 mm
Diameter-25 mm
Perforated tube Dimensions-
Diameter – 80 mm
Length – 250 mm
Thickness-1.5 mm
Hole on perforated tube Dimensions-
Thickness- 1.5 mm
Diameter- 3 mm
End Plates Dimensions –
Diameter- 120 mm
Thickness- 5 mm

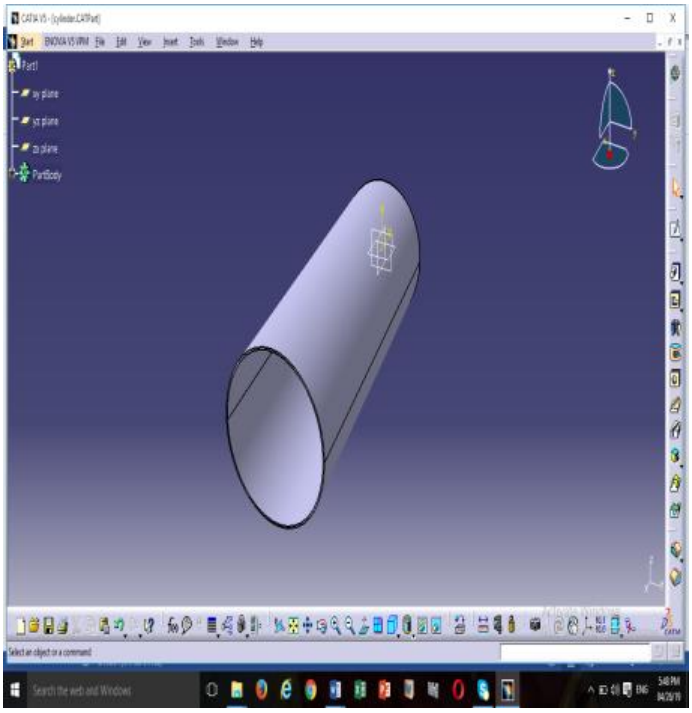
3.6**Catia Model & Drafting**

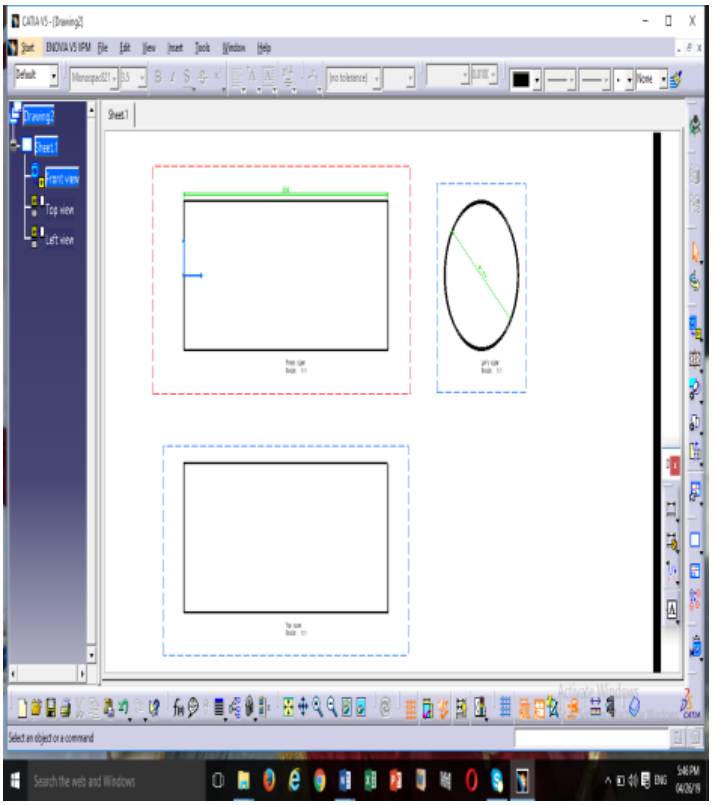
End plates



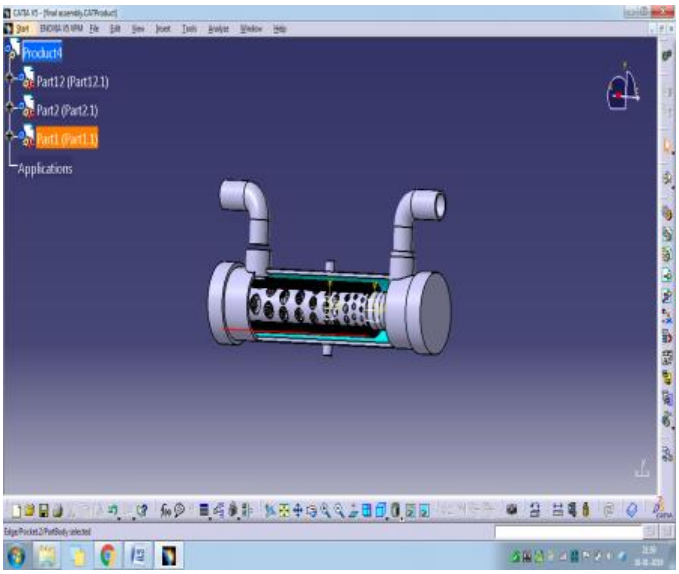


Outer shell





Final Assembly



4.New Chemical Employed

Sodium hydroxide also known as lye and caustic soda which is an inorganic compound with formula NaOH. It is white solid ionic compound consisting of sodium cation Na+ and hydroxide anions OH-. Sodium hydroxide is a highly caustic

base and alkali that decomposes proteins at ordinary ambient temperature and may cause sever chemical burns. It is highly soluble in water and readily absorbs moisture and carbon dioxide from the air . The commercially available "sodium hydroxide" is often monohydrated and published data may refer to in instead of the anhydrous compound.

5. Testing

Emission Testing

For the effect of pollutants with our innovative design real environment test has been tackle out. We had issued Pollution under Control Certificate (PUC) from registered centre for the current silencer and innovative design. This testing able to give the level of CO, CO2, HC and O2.

Image: General silencer test

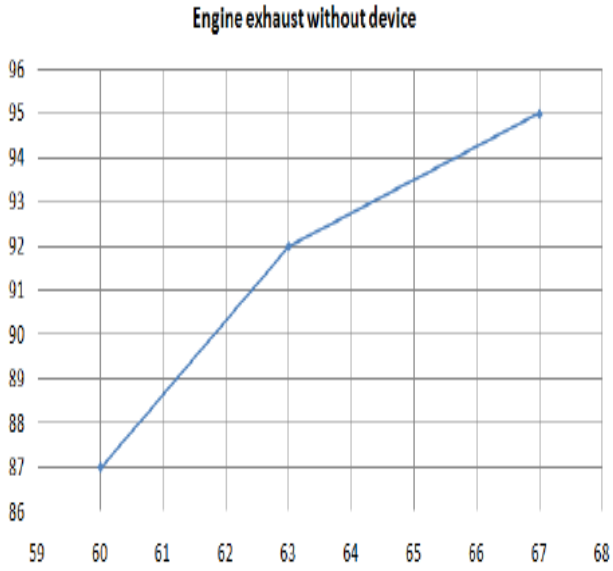
Image: Aqua silencer test

Table -1: PUC Comparison of existing silencer with our device

	With Existing Design	With Aqua Silencer
CO	1.4 %	1.2%
HC	160 ppm	120 ppm
Reactive HC	OK	OK

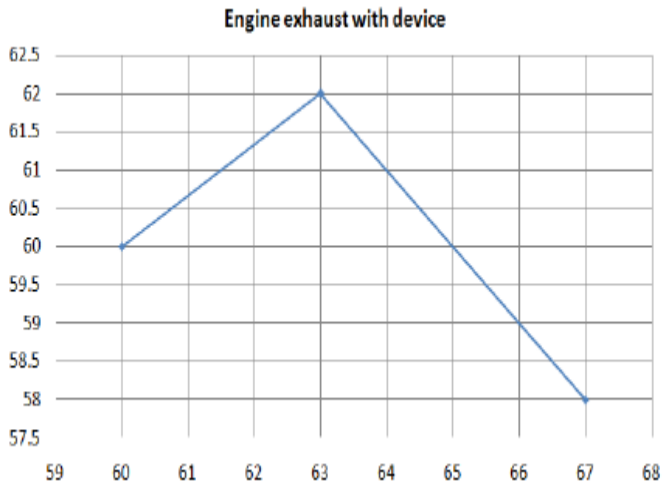
5.2 Noise Testing

For the testing of our device is to find out the reduction in the level of noise pollution. We had connected our device at the place of conventional exhaust system. With the help of decibel meter we identified the value of noise level. This experiment performed in two parts. In the first part the level of sound has been measured in the normal condition. In the second part our device is connected at the end of engine exhaust, and measured the new level of sound pollution. It has been observed that with our device sound level is reduced up to some extent. Figure, shows the reduction of sound level.



Silencer's sound VS. Engine sound without our device

The figure shows the comparison of sound at Engine (Vertical Axis) and at Exhaust of the vehicle (Horizontal Axis), the sound increases as we increase the rpm of the engine. Here we had measured the value of sound at both places (Engine and Exhaust). The graph shows the increase of sound level as the rpm of the engine.



Silencer's sound VS. Engine sound with our device

The figure shows the graph between level of sound at engine (Vertical Axis) and at Exhaust of the vehicle (Horizontal Axis) with our device installed at the end of the exhaust. The graph shows a decline after certain limit which means that at higher rpm our device is more efficient in absorbing sound. Hence from the experiment we understood that the device is capable to reduce sound pollution.

Conclusion

Automobiles are the prime source of the transportation. It is need to control the exhaust emission. It can be achieved by doing modification in silencer design. The appropriate amendment leads to reduce emission. In the present work, newly designed silencer analysed for better efficiency as well as reducing the harmful pollutants particles. It was observed that "Aqua Silencer" is enough to control the carbon footprints up to 30%. It is found to be more appropriate than existing silencer design. It is also being helpful to reduce noise level as well. P.U.C. results of existing design were compared with new silencer results, and found to be reduction in emission.

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