

“Analysis of Muffler for noise reduction and emission control by using Ammonia pulsator”

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Abstract: An Absorbitive silencer is mainly dealing with control of emission and noise in automobile exhaust. By using activated charcoal, perforated tube and outer shell it is constructed. An Absorbitive 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 in single cylinder 4-stroke diesel engine the noise and smoke level is considerable less than the conventional silencer.

Keywords: Muffler, Liquid ammonia, Perforated coal, ANSYS Software etc.

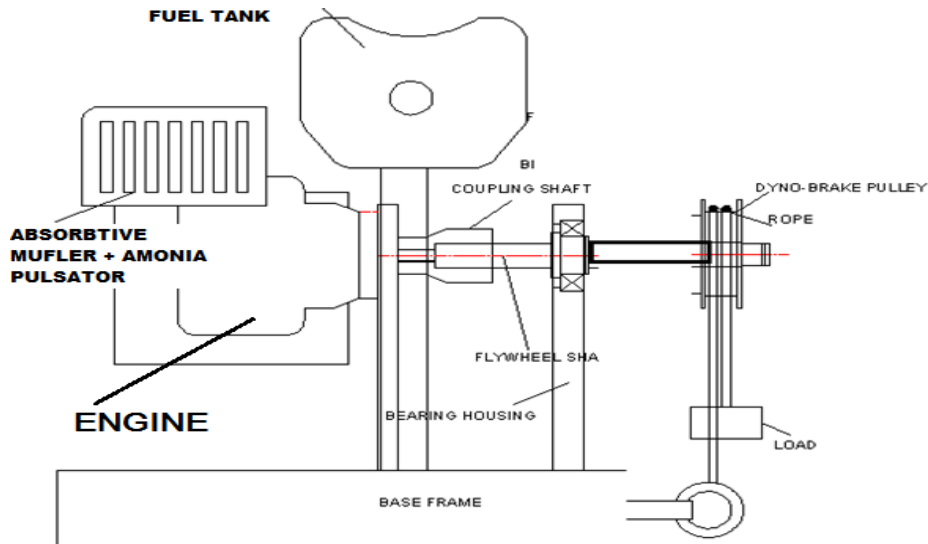
I. Introduction

An Absorbitive silencer is used to control the noise and emission in IC engines. The reason why we go for Absorbitive 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 automobiles releasing the gases like carbon dioxide, unburned hydrocarbons etc. In order to avoid this type of gases by introducing this aqua silencer. It is fitted to the exhaust pipe of 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. The emission can be controlled by using the activated charcoal layer and it is highly porous and possesses extra free valences so it has high absorption capacity. So absorb the gases from the engine and release much less position to the environment. The noise and smoke level is considerable less than the conventional silencer, no need of catalytic converter and easy to install.

II. Construction

Basically an Absorbitive 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. The other end of the perforated tube is closed by plug.

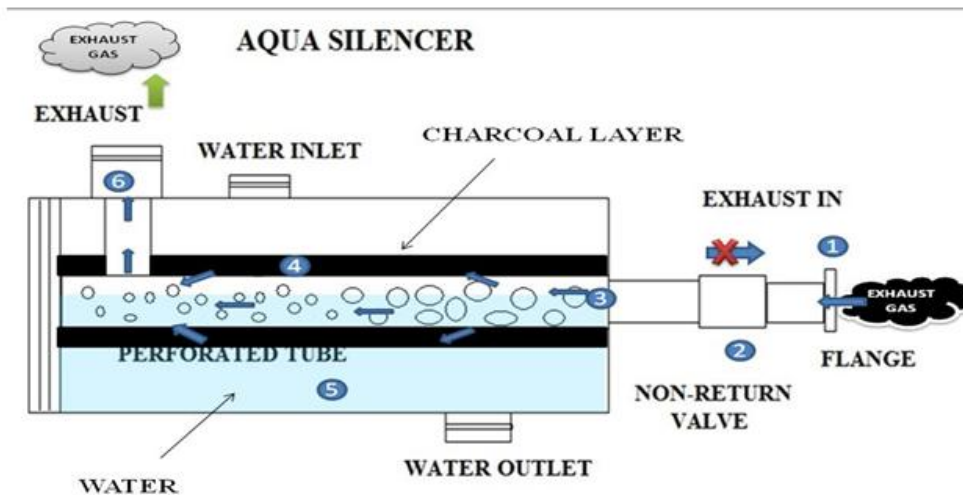
Around the circumference of the perforated tube a layer of activated charcoal is provided and further a metallic mesh covers it. The whole unit is then placed in a water container. A small opening is provided at the Top of the container to remove the exhaust gases and a drain plug is provided at the 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.



III. Working

As the exhaust gases enter in to 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 possesses extra free valences so it has high absorption capacity.

After passing over the charcoal layer some of the gases may dissolved in to the water and finally the. Exhaust gases escape through the opening in to the atmosphere. Hence Absorbitive silencer reduces noise and pollution.



IV. Description Of Ammonia Pulsator

The NOx in the exhaust gas cannot be removed easily by use of other devices like catalytic convertor , or carbon filter , hence a special device is required to remove this Nox from exhaust gas :

Principle of Ammonia pulsator:

The pulsator is a device that sprays aqueous ammonia in the path of exhaust gases such that the NH₃ combines with the oxygen in the exhaust gases and gets converted into HNO₃ in mild form. Thus the exhaust gas is freed from the Nox gases. Here the solenoid is 12 volt DC, when it is perated the piston moves down to push the ammonia through the pintle in to nozzle that sprays the liquid ammonia in atomized form into the absorbtive silencer where NH₃ combines with the oxygen in the exhaust gases and gets converted into HNO₃ in mild form. Thus the exhaust gas is freed from the Nox gases. Testing of Engine after Fitting Ammonia Pulsator Equipment Used to Measure Orsat apparatus with diluted HNO₃ as Nox absorbing reagent.

Designing and Calculation of Muffler

A muffler have been designed which is of supercritical grade type and includes all the three attenuation principles i.e., reactive, followed by absorptive type muffler, and a side branch resonator. The interesting events of the design are continuous volume reduction of chambers in the reactive part, the flow pipe cross-sectional area is maintained constant throughout, a layer of insulation outside the reactive part, the placing of side branch resonator compactly, option for tuning the resonator using a screw and cylinder.

V. Design Data

For the experiment, an existing petrol engine has been used. Calculations are done on the basis of data collected from the engine; Specifications of the engine available for testing are as follows:

Specifications of Engine:

Make: Crompton Greaves

Model: IK-35

Engine is two stroke Spark ignition engine with following specifications:

Bore „diameter : 35 mm

Stroke: 35 mm

Capacity: 34 cc

Power output: 1.2 BHP at 5500 rpm

Torque: 2.72 N-m @ 5000 rpm

Dry weight: 4.3 kg

Ignition : Flywheel magneto Direction of rotation: Clockwise. Looking from driving end Carburetor : “B” type

Cooling : Air Cooled engine

Lubrication: Mist –via petrol

However, some data are applicable to all engines. For designing, the following data are required.

1. Sound characteristics (Without silencer) Rpm of the engine= 5500

Load Sound level

Without any load 9.2 kg 104.5 dbA 50% load 15 kg 106.5dbA

100% load 24 kg 107dbA

2. Sound analysis with frequency analyzer (to obtain the Dominating frequency)

Two dominating frequencies, the low level and the high level have been obtained. These are:

Frequency Level Frequency (Hz)

Low 270 High 40000

3. Diameter of exhaust pipe of engine/inlet pipe of muffler

The Exhaust Pipe diameter: 1.0 inch (25.4 mm) this is in accordance to the standard mounting flange on the engine exhaust.

4. The theoretical exhaust noise frequency range

From various experiments is has been found that the theoretical exhaust noise frequency is 200-500Hz.

Reflective Part Design

S1 = Exhaust pipe diameter = 1.0 inch

The dimensions to determine are that of the chamber length L and the body diameter S2.

To determine L, three methods have been used. They are as follows:

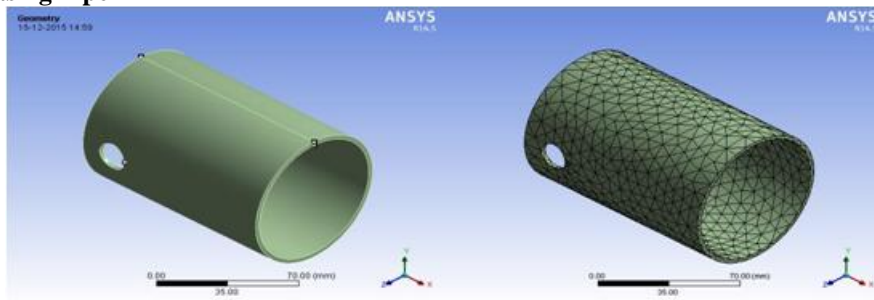
1. First method used to determine L

Maximum attenuation occurs when $L = n\lambda/4$ (1)

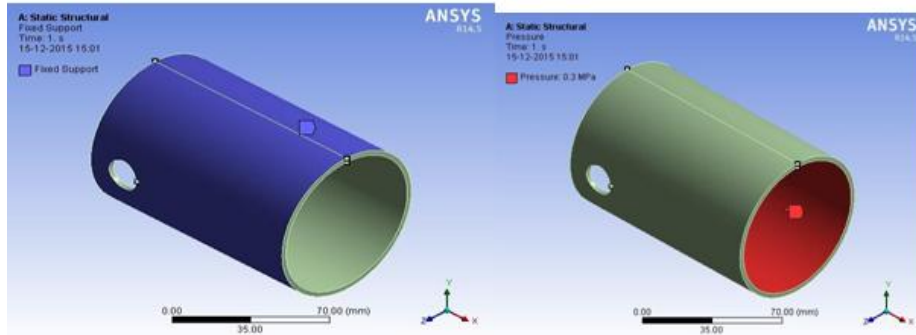
where, λ = wavelength of sound (m or ft) $n = 1, 3, 5,$ (odd integers)

Since λ is related to frequency by the speed of sound, one can say that the peak attenuation occurs at frequencies which correspond to a chamber length.

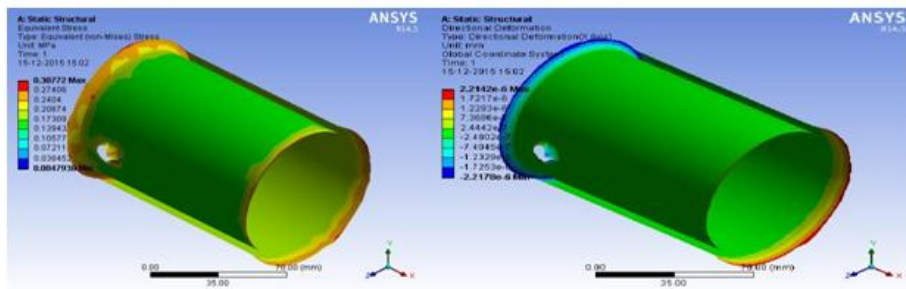
Analysis of Casing Pipe



Analysis of casing pipe geometry & Meshing of casing pipe



Fixed support static structure of casing pipe & Analysis of casing pipe for various pressures



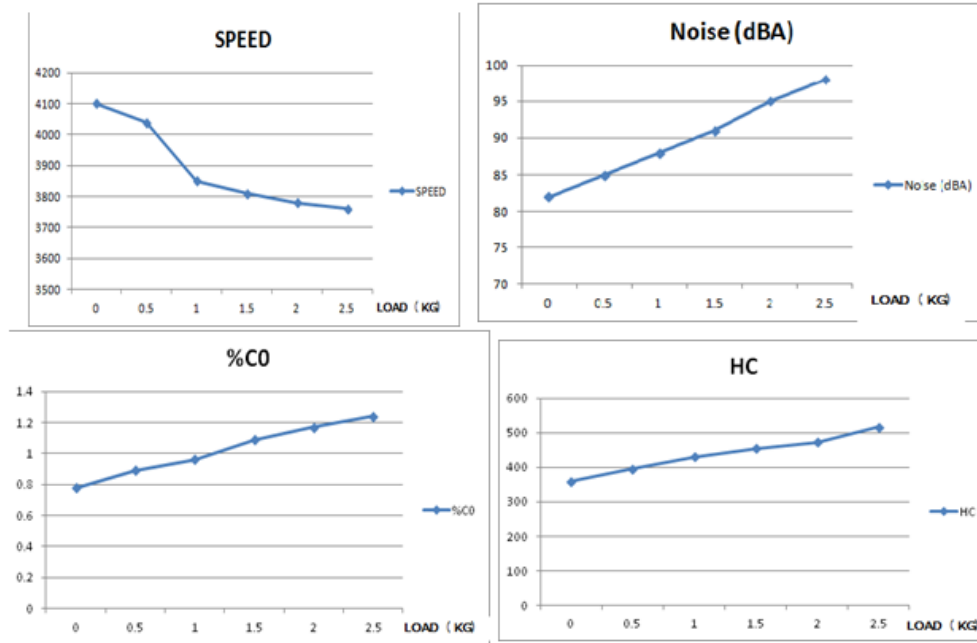
Stresses produce in casing pipe & Deformation produce in casing pipe

VI. Observation Table

%CO ---Percentage of Carbon monoxide in unit volume of exhaust gas---reference value below 4.5 % for 2/4 stroke engines in 2 wheeler vehicles HC (n-Hexane equivalent ppm) ----reference value 9000 for 2/4 stroke engines in 2 wheeler vehicles.

Table. 1 Speed,noise,% of CO and HC with verious loading condition

Load (KG)	Speed (RPM)	Noise (dBA)	%CO	HC
0	4400	86	0.68	370
0.6	4240	88	0.91	399
1.2	3960	90	0.986	435
1.8	3720	93	1.18	459
2.4	3480	96	1.21	478



% NoX--Percentage of Nitrogen oxide in unit volume of exhaust gas---reference value below 2.35 % for 2/4 stroke engines in 2 wheeler vehicle

Table 2 NOx content at various loading condition

Load (KG)	Speed (RPM)	NOx
0	4400	0.6
0.6	4240	0.62
1.2	3960	0.63
1.8	3720	0.68
2.4	3480	0.716
3	3360	0.75

VII. Conclusion

An Absorbent silencer is mainly dealing with control of emission and noise in automobile exhaust. By using activated charcoal, perforated tube and outer shell it is constructed. An Absorbent 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 in single cylinder 4-stroke diesel engine the noise and smoke level is considerable less than the conventional silencer.

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