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A REVIEW ON DESIGN & ANALYSIS OF REACTIVE TYPE SILENCER

[1] Yadav Mohit, [2]SurseRohit, [3]NikamAnanta,[4]Gojre Dipak ,[5]kshrisagar D.

[1]UG Scholar, Mechanical Engg. Dept. S.N.D. C.O.E.& R.C. Yeola- Nashik Maharashtra
[2]UG Scholar, Mechanical Engg. Dept. S.N.D. C.O.E.& R.C. Yeola- Nashik Maharashtra
[3]UG Scholar, Mechanical Engg. Dept. S.N.D. C.O.E.& R.C. Yeola- Nashik Maharashtra
[4]UG Scholar, Mechanical Engg. Dept. S.N.D. C.O.E.& R.C. Yeola- Nashik Maharashtra
[5]Asst. Prof., Mechanical Engg. Dept. S.N.D. C.O.E.& R.C. Yeola- Nashik Maharashtra
paithankarnitin@gmail.com

ABSTRACT:- IC engines are one of the major sources of noise pollution. Mufflers (Silencer) are generally found with exhaust framework. After the ignition the focused energy gas pressure through the suppressor chamber and a portion of the gases reflected again goes through the burning chamber it is gotten back to pressure. It makes vacuum pressure in ignition chamber and diminishes the motor exhibition. Decrease of weight, expanding the ability of commotion ingestion from the suppressor with insignificant back pressing factor can build the exhibition of the motor. The goal of this investigation is to optimize noise level of engine and reduce back pressure. This project mainly targets on designing a muffler to reduce the noise and back pressure. Based on new muffler design parameters, a model is fabricated and tested.

Key words :- Silencer, Automobile

I. INTRODUCTION

Noise from automobile is one of component noise pollution to the environment. Muffler (silencer) is a device to reduce the noise created inside the exhaust of an internal combustion engine. Pressure drop likewise happens inside the suppressor. Suppressor is arranged in exhaust framework after exhaust system and furthermore it is last segment appended in exhaust framework. The sole motivation behind an auto suppressor is to decrease motor commotion emanation. A vehicles running without a suppressor will have an appreciation for the huge distinction in commotion level a suppressor can make. In the event that vehicles didn't have a suppressor there would be terrible measure of exhaust commotion in our Environment. Sound is a pressing factor wave shaped from beats of substituting high and low pressing factor air. In an auto motor, pressure waves created when the fumes valve over and again opens and gives high pressing factor gas access to the exhaust system. These pressure pulses are the sound. As the engine rpm increases so do the pressure fluctuations and therefore the sound emitted is of a

higher frequency. Noise is defined as an unwanted sound. The automotive muffler is able to allow the passage of exhaust gases while restricting the transmission of sound. Back-pressure is defined as the difference between the ambient pressure and is due to a drop in stagnation pressure across various perforated elements and the sudden area discontinuities. Increase in back pressure leads to decrease in thermodynamic efficiency as well as the net power available. Back pressure is directly related with the engine performance. Increase in back pressure reduces engine net power and reduction in back pressure improves engine efficiency.

Now at the time of modification, we are influencing following. "the aim of this work is to perform a analysis of a Bajaj 150ccexhaust system. Information from the literature and experience from studying this specific exhaust system will be used to gain conclusions that may be generally useful when performing modal analyses within the product development process.

1.1 Parameters:

1. First of all we are increasing the total length of exhaust because or which the path travel by the gases increases. Now as the gases have to move long way. velocity developed in pipe diminishes when. According to the standard. Speed and pressing factor are conversely relative. So at last pressing factor will increment and stream gets (Chocking implies drop in speed of exhaust gases definitely. It doesn't mean the 0 speed. In the event that the speed becomes zero, we can't run the motor any longer. Be that as it may, as we are presenting an ever increasing number of gases in the line after each stroke, the gases finally reaches to the opening of pipe. But the velocity is too low then the required.)

2. As we are increasing the exhaust pipe length. we are introducing more bends in the exhaust pipe. Each bend causes flow restriction and friction losses in the gas flow. This leads to chocking of flow again.

3. As this two major factors result in chocking of flow. the next batch of burned gases coming out from cylinder don't find any way to move.

4. Finally the scavenging efficiency of engine reduces drastically and burned gases remain in the cylinder. These burned gases got mix with the fresh charge and burnt again and again. This process leads to generation of more emission.

II. LITERATURE SURVEY

In 2005, A.K.M- Mohumudd in presents Of noise and back pressure for silencer design characteristics. The main objective of this study was to find the relationship between the back pressure and the noise level. He concludes that the relationship between the noise and the back pressure is inversely proportional

1. **In 2010, Wang Jic**ct have study on the model analysis of an automobile exhaust muffler based on PRO/E and ANSYS in order to improve design efficiency. The solid model is created by PRO/E and model analysis is created out by ANSYS to study the vibration of

the muffler, so as to distinguish workingfrequency from naturalfrequency and avoid resonating. Data exchange between PRO/E and ANSYS using IGES (Elementary graphics exchange specification) format for data exchange specification. Muffler natural frequencies modal shapes have been calculated by the FEM analysis software named ANSYS. So the muffler vibration can be intuitive analyzed. The naturalfrequencies and mode shape are considered during the design of the muffler, so avoid the resonance occured in exhaust system

2. **In 2010, MehnEtAvcu et al**. introduce diesel engine exhaust system design with help of the three-dimensional model of the system has been constructed by using "ANSYS Workbench", the mathematical models via Finite Element Method (FEM) have been done via "ANSYS ICEM CFD" and, the Computational Fluid Dynamics (CFD) analyses covering back pressure and thermal analyses have been A Brief Review on Advance Acoustic Control System Process of Automotive Muffler DOI: 10.9790/1684-12130610 www.iosrjournals.org 9 | Page performed by using "ANSYS CFX 12" program. He Conclude, The dimensions and internal structure of the dry and wet-type silencers which are the main components of the exhaust system and the physical properties of the insulation material have been determined based on acoustic, back pressure and thermal analyses and, the layout of the diesel engine in the engine room. From the results of the back pressure analyses, it is seen that the total back pressure in the whole exhaust system is within the limits of the given diesel engine criteria and, the board outlet temperature of the exhaust system is substantially low

3. **In 2011, Ying Li Shao et al**. have a study on a Exhaust Muffler Using a Mixture of Counter phase Counteract and Split-gas Rushing. In order to solve the problems of traditional exhaust silencers with poor characteristics of noise reduction in low -frequency range and high exhaust resistance, a new theory of exhaust silencer of diesel engine based on counter-phase counteract and split-gas rushing has been proposed. In single-cylinder diesel engine CG25 the experimental engine. He measured the exhaust noise and its. By comparing the results of the new types of mufflers to those without a muffler and those with the original muffler of the engine. He conducted on this noise experiment that the CG25 single cylinder diesel engine shows new muffler's good insertion loss characteristic in the wide range of engine speed comparable to the original passive muffler especially in the range of 500Hz. The original muffler can only reduce the high- frequency noise components, it cannot reduce, even strengthen the noise of frequency below 500Hz, proved conventional muffler with poor capacity of lowering the low- frequency noise again. The new exhaust mufflers were obviously effective in controlling the low-frequency exhaust noise, which proved correctness of the new theory not only proved that the new mufflers have very good performance for low-frequency noise reduction, but also proved that using split-gas rushing can lower the air flow speed thus lowering the air regeneration noise.fig 2 shows the new design of muffler.

4. **In 2011, Shi Wu ct al**. have study on Structural Design and Testing Study of Truck Muffler. He introduces the performance evaluation method Of automobile's exhaust muffler and it's the size parameter to the noise elimination effect influence. It presents a

two chambers impedance compound exhaust muffler design method based on a boundary element method, which focuses on the truck's diesel engine, Test shows that the truck exhaust muffler has a good effect with insertion loss of 22.7dB, and by the boundary element method, calculates transmission loss under the static condition. By the experiment he conclude that By laying cotton blankets absorbing sound on the inner surface of the truck muffler, not only can we solve the exhaust noise of the mid and high frequency band, and isolate the exhaust heat out of the radiation. By blocking imports of gas to prevent gas through, the muffler avoids the high frequency noise transmission to meet the technical requirements

III. DATA COLLECTION

3.1 About Silencer

Acoustical silencers are devices mounted on the pipe lines used for the evacuation in the atmosphere of the gas from under tension working gear; motor turbines, blowers or on the ventilation pipe lines of mechanical plants, spaces exchanging spaces and so forth Silencers can be detached or dynamic. Their job is to decrease the vibrant overpressure of the gas transition, without diminishing the vital pressing factor for the upkeep of the motion course through the line lines. The passive silencers reduce the accustic over pressure based on interference or dissipation and the active silencers are based on calculus systems that act in real-time for reducing the noise through interference.

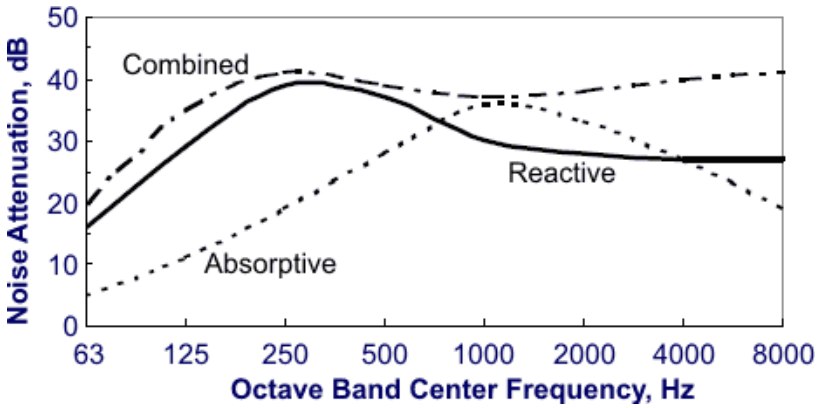

Fig 3.1, Noise v/s Frequency curve

3.2 Passive Silencers

Passive silencers that are treated in this paper are in general rigid structures. They avoid resonance by the vibrations caused by gas flux, so that their natural vibrations don't contribute to the amplification of the noise contained by the evacuated gas flux. There are two types of passive silencers: a) reactive: b) dissipative. Because of the design of the reactive silencers (tig.3.1. a) a reflected current appears in them. that interferes with the direct current and

contributes to the reduction of the acoustic overpressure level. The dissipative silencers arc pipes lined with sound absorbing materials (fig.3.1. 1)) or pipe lines with punctured walls: behind these walls there are empty spaces (lig.3.1, c) that contribute to the dissipation of the acoustic energy contained by the gas flux

3.3 Active silence

Active silencing, or sound cancellation systems, employ detectors used in sensing the noise in an exhaust pipe and a loudspeaker that is used to reintroduce an inverted signal have been developed to reduce low frequency noise. The theoretical effect of reintroducing an inverted signal will result in compete elimination of sound from the exhaust silencer. Although the idea of sound cancellation is very simple and attractive, there are a variety of complications and problems arising from erratice fluctuations in the sound source. Active silencing is relatively expensive at the present time, and its acoustic attenuation performance at high frequencies is also limited. Widespread use will be dependent upon continued development of lower cost systems with improved performance realized through the use of better analytical algorithms, transducers and processors.

3.4. Passive Type

3.4.1 Reactive Silence

The reactive silencer has in general a cylindrical shape; the calculus dimensions of the silencer with two compartments are indicated in figure 3.1. Dimensions of the reactive silencer with two compartments. The reduction of the pressure is attained by the growth of the flowing section (a), the decrease of the part (b) and the reflection on a superficial level that is opposite to the accompanying course of the gas current (c) for the assurance of TL with the exchange networks technique the computation of the matrics relating to certain areas of the silencer is required, as indicated by the components with various shapes from the investigation of the tow outlines clearly the qualities of the silencer in the circumstance b) are worked on in contrast with circumstance), in light of the fact that a superior weakening is achieved on the recurrence range v = (500, 3500) Hz for the responsive constriction exhibitions in a limited recurrence range. There are really resonators and the useful arrangement displayed in figure 4. Along these lines, openings (a,b) can be applied on the chief line, a resonator (c) can be mounted sidewise or a concentric cylinder can be mounted on the principal pipe line, that is foreseen with punctured pipes can be diversified in shape in order to combine the reaction effect obtained through interference with the energy dissipation effect, by control the flux to flow through the route with holes.

3.4.2 Dissipative Silencer

These silencers have a wide range of use for the noise reduction through the pipe lines through which the relatively low velocity gas flux flows and in which a minimal reduction necessary is of the pressure along the pipe line sari. They are used on the admission or evacuation of the gas turbines, on the ventilation or air-conditioning pipe lines, on the access apertures of the

acoustic enclosures, resulting in a pressure reduction of (125 1500) Pa. The shapes of these silencers are varied; depending on the companies that produces them they have a modular framework attained in order to be mounted according to the available space. The most types are granted with bafflers parallel to the flowing flux or give shaped bafflers that have aerodynamic shape in order to avoid the appearance of turbulence in the gas current. The most used silencers are the ones with parallel bafflers because of their high acoustic performances and their low cost

IV .STUDY AND ANALYSIS OF PULSAR 150 SILENCE

Many bikers uses modification in there exhaust to get so called exhaust tune and sporty look. We sow pulsar's and other bikes with modified exhaust. Then we decided to observe the effect of this modification also, we had performed one trial on pulsar 150 silencer. In the wake of gathering the exhaust information it was tracked down that the length of silencer was 390 mm. The inside parts were notices and look at the need and capacity of each parts. It was inside devided in 3 sections. Initially beginning from the delta of exhaust framework there was an empty cone shaped construction. In center the two buffle plates were fixed with the holed and pipe were attached to them.

There are mainly two types of bike silencer as follows.

1. Absorptive type

2. Reactive type

4. 1 Absorptive Type :

The muffler design uses only absorption of the sound wave to reduce the noise level without messing with the exhaust gas pressure. Ti is known as glass pack muffler and it reduces back pressure but producing higher noise. The sound produced by this type of muffler is much higher compared to the other type of mufflers.

4.2 Reactive Type :

In this type inlet and outlet are extended in chambers. Reactive muffler generally consist of several pipe segments that interconnect with a number of large chambers. The noise reduction mechanism of reactive type silencer is that the are discontinuity provides an a impedance mismatch for a sound wave travelling along the pipe ,this mismatch impedance result in reflection of part of the sound wave back toward the source or back and forth among the chambers. The reflective effect of the silencer chambers and piping (typically referred to as resonators) essentially prevents some sound wave elements from being transmitted past the silencer. The reactive silencers are more effective at lower frequencies than at high frequencies, and are most widely used to attenuate the exhaust noise of internal combustion engines.

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V. MANUFACTURING PROCESS AND PROCESS SHEETS

Cutting process:- All the cutting process is done by hand grinding machine.(by using cutting wheel)

Polishing and cleaning process:- All the polishing and cleaning process is done by hand grinding polish paper and by using acids

Welding operation :- All the operation is done by co2 operation

Turning and machining operation:-All the turning and machining operation is done on lathe machine.

Drilling operation:- all the drilling operation is done on drill machine

Taping :- it is done on the holes by tap tool

Manufacturing Process And Process Sheets

- Disassemble and cut all the internal part of silencer
- Cleaning all the internal part of the silencer and removing the carbon which has been deposited on the parts
- Calculating the specific dimensions of parts of the silencer
- The manufacturing of the outer body of the silencer is done by mild steel (MS) pipe.
- The modification is done on the outer body by dividing the pipe in 3 different part
- First starting from the inlet of exhaust system there was a hollow conical structure is weld to the inlet of the pipe with decided dimensions.
- The end part of silencer from which the exhaust gas is exerted to the atmosphere .the Muffler is attached in the pipe by welding
- Finally the middle and most important part of the silencer is manufactured in which the two round baffle plate were made with holed in it.
- The round baffle plates were made from 2mm MS sheet by cutting it round by means of hand grinding machining .
- and also coupling. The taping is done in every hole to fix the belt and provides the strength and fix the pipe at a fixed place
- inlet pipe of exhaust to the body of the silencer were wielded and on the same piper other side the flange is attached
- the flange is going to be attached at the outlet of the then the collar were made on the same baffle plate by lathe machine.
- Such 8 plate were made each two plate for different assembly.
- In 2 plate single hole were provided away from the center
- Cut round sheet metal plate of 2mm with grinding operations

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- Making the collar on the plate by RND (Research and Development) on bearing and using it to press while rotating both chuck and bearing on lathe machine.
- Making hole on the same plate as per the modification by drilling operation.
- Making collar on the hole of the plate by draw.
- Cutting the pipe as per dimension size of the holes.
- Assemble the two plates on fixed sized by joining the pipes in it (co2 spot welding operation)
- This assemble is placed is the middle of the silencer body.
- This assembly is totally responsible to make changes in the sound by fluctuation the length between two plate (baffle plate)
- The pipe is lap on the smaller size pipe making an internal coupling .this coupling is provided on both parts (starts and the end)of the silencer to attach the centre assembly
- The hole were provided on both the pipes exhaust of the engine.
- It is manufactured by boring operation on lathe machine.

5.1 Assembly 1

The silencer is modifier in 3 different assemble

1. As it was absorbed on the practical on the pulsar 150cc silencer

2.Modification in the baffle plate by increasing numbs of holes and pipe in it.

3.Modifying the first assembly by making the change in the length of pipe and distance between two plates.**(**analysis as it was in the Bajaj pulsar 150cc by considering as a standard**)**

After collecting the external data it was founded that the length of silencer was 390 mm.the internal parts were observes and examine the need and function of each part .it was internally divided parts.

- **Part first (inlet of exhaust system)**

First part the inlet of exhaust system there was a hollow conical structure as given in (fig 6.1.2).it is made of MS.it consist of many small holes. the length of the cone is 160mm and the diameter it is 97mm.The holes are provided to expand the air and change velocity into pressure energy.The exhaust air get sudden expanded and start depositing in first part. Due to this pressure get increases. The increases air pressure forced the air to entering to the tuning chamber through the pipes of the baffle plate.

- **Part second (tuning chamber)**
The middle part of an assembly is called as tuning chamber.it consist of two baffle plates. the baffle plates are made as it is was in the pulsar 150 cc silencer as per the standard design. These plates were made up of M.S sheet 1.5 mm thickness. The diameter of plate is 98mm with tolerance if -0.3 to-0.5. One of the plate consist of three holes and other with an only one hole. As shown in (fig.6.1.3) the holes were provided on plate to insert

the pipe in it. The plate were fixed with pipe. Pipe were fixed on plate to flow the exhaust air from it. The distance and length of pipe between two plate were design in such a manner to obtain the variation and tunes the sound of the exhaust air. Hence it is called as tuning chamber.

Fig No.5.1.1 PART SECOND (turning chamber)

- **Part third**

It is the final stage of silencer which consist of muffler it is connected to the center to the baffle plate (fig 6.1.4) which have three hole. The pipe of muffler is inserted in that plate as show in fig. the increase pressure in tuning chamber force the air to flow through the pipe of the muffler as the basic principle of atmospheric pressure that is pressure of level always flow to low level hence the air escape out from the silencer to the atmosphere.

Fig.No.5.1.2 PART THIRD

5.2 Assembly 2

(Modification is made by increasing the number of holes and pipes between the both plates)

- **Part 1 (inlet of exhaust system)**

First part of the inlet of exhaust system of there was a hollow conical structure as given in (fig 6.1.2). it is made by M.S. it consist of many small holes. the length of of the cone is 160mm. and the diameter of it is 97mm.the holes are provided to expand the air and change the velocity in to pressure energy the exhaust air get sudden expand and start depositing in first part.due to this pressure get increases . the increase air pressure force the air to entering to tuning chamber through the pipe of the baffle plate.

- **Part 2 (tuning chamber)**

The middle part of the assembly is called as tuning chamber. it consist of two baffle plates the baffle plates are made by it was in pulsar 150cc. silencer as per standard size. these plates where made up of M.S. sheet of 1.5 mm thickness. the diameter of plates is 98mm with tolerance if -0.3 to -0.5.

The modification is made in the standard baffle plate by increasing the number of holes in the plates that is one of the plate which consist of three where replace by five holes and other plate which have only one hole is replace with two hole in second assembly. as shown in fig. the holes where provided on plate to insert the pipe in it . the plates were fixed with the pipe. pipes were fixed on plates to flow the exhaust air from it. the two (long) pipes of length 140mm. where fully passed from both the baffle plate and the other two (small) pipe of length 70mm. where placed only in one baffle plate which have five holes. The center hole is provided for the pipe of muffle .

- **Part 3**

It is the final stage of the silencer which consist of muffler. It is connected to the center of the baffle plate which have a five holes. the pipe of muffler is inserted in that plate. as shown in fig. the increase pressures in the tuning chamber forced the air to flow throw the pipe of muffler. As the basic principle of atmospheric pressure that is the pressure of high level always flow to the low level. Hence the air escape out from the silencer to the atmosphere

5.3 Assembly 3 (Modification is made by increasing the distance between both the plates)

- **Part First (Inlet of exhaust system)**

First part the inlet of exhaust system there was a hollow conical structure
as given in (fig 6.1.2). It is made of M.S. It consists of many small holes. The length of the come is 160mm And the diameter of it is 97 mm. The holes are provided to expand the air and change the velocity into pressure energy. The exhaust air get sudden expanded and start depositing in first part. Due to this pressure get increases. The increase air pressure forced the air to entering to the tuning chamber through the pipes of the baffle plate.

- **Part Second (Tuning chamber)**

The middle part of an assembly is called as tunings chamber. It consist of two (2) baffle plates. The baffle plates are made as it was in the pulsar 150cc silencer as per the standard size. These

plates were made up of M.S sheet of 1.5 mm thickness. The diameter of the plate is 98 mm with tolerance if – 0.3 to 0.5.

The modification is made in the standard baffle plate by increasing the distance between the plates i.e. the standard distance between two baffle plates were 90 mm. And now it is replaced (increases) by length 110 mm. Also the length of the pipe is increase. The plates holes were kept as standard i.e., One of the plate which consist of three 3 holes & other plate consist only one 1 hole in the second assembly, as shown in (fig 6.3.1). The holes were provided on plate to insert the pipe in it. The plates were fixed with the pipe. Pipes were fixed on plates to flow the exhaust air form it. The one (long) pipes of length 160 mm were fully passed from both the baffle plate and the other one (small) pipe of length 90 mm were place only in one baffle plate which have three 3 holes. The center hole is provided for the pipe of muffler. The distance and length of pipe between two plate were design in such a manner to obtain the variation in the sound of the exhaust air.

- **Part Third**

It is the final stage of the silencer which consists of muffler. It is connected to the center of the baffle plate which have Three 2 holes. the pipe of the muffler is inserted in that plate. As shown in (fig 6.3.1). The increase pressures in the tuning chamber force the air to flow throw the pipe of muffler. As the basic principle of atmospheric pressure i.e. the pressure of high level always flow to the low level. Hence the air Escape out from the silencer to the atmosphere.

5.4 Result

Exhaust noise measurement were made at 1ft and 45 degrees angle from the end of the exhaust outlet with the precision sound level analyzer at the exhaust outlet level. Sound level is measured old and new muffler installed at different speeds Table .

In this project sound recorded by silencer 1 is louder than silencer 2 & silencer 3.

Engine Speed (R.P.M)	1000	2000	3000
Silencer Assembly 1 (dB)	76.7	79.5	82.9
Silencer Assembly 2 (dB)	70.5	72.8	75.7
Silencer Assembly 3 (dB)	73.8	76.1	78.5

You can judge the result what if all the factors contribute together. This is what generally happens when we modify our exhaust with local dealers or garages. We blindly are increasing pollution and fuel consumption of our bikes. Many calculators are available on net for calculating correct required back pressure for your bike engine. You have to insert some technical specification and it will provide you the correct back pressure.

VI. CONCLUSION

For all three various congregations we notice distinctive audio cue recorded by dB meter for various motor speed the sound recorded is diverse due to various design of tuning chamber and by altering it we can get number of tuned silencer as required. for each of the three setup of silencers as the RPM of the motor expands the sound level likewise increments. Consequently by this venture in the wake of planning and investigation receptive sort silencer of 150cc motor and by recorded sound we conclude that In this project sound recorded by silencer 1 is louder than silencer 2 & silencer 3.

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