



Modifications in Two-Wheeler silencer for noise Reduction

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Abstract : In 21st century, automobile industries are booming at an unimaginable space. An inbred snag of IC engines is that it is a main root cause of noise pollution. That is the reason mufflers are used to muffle the noise produced. The major cause of noise pollution is due to the noise. Noise pollution has hazardous effect on human health. In traffic noise, the major cause of noise is two wheeler vehicle noise. In order to minimize two-wheeler noise, we are modifying two wheeler silencer for noise reduction by introducing Absorptive and reflective Muffler or introducing new Hybrid Muffler.

Keywords :- Vehicle noise; Mufflers; Sound pressure level; Insertion loss.

I. INTRODUCTION

Noise is defined as an unwanted sound and is of random in nature. Noise pollution has hazardous effects on human health. Two Wheeler are becoming increasingly prevalent as a means of transportation. The major sources of noise in two-wheeler are engine exhaust noise which can be minimized by using effective muffler. Most mufflers use fiber glass or steel wool packing material to absorb sound energy. Exhaust flows through a perforated tube and exhaust noise exits through the holes in the tube to be absorbed by the packing material. Some performance "chambered" mufflers use a series of metal baffles and chambers that cause sound waves to bounce back on themselves and cancel out. Mufflers are designed to reduce sound, but they do it at the cost of horse power and fuel efficiency. Removing the muffler can only stand to increase engine performance. There are 3 types of conventional Mufflers.

- a) Reflective type Muffler :- Reflective mufflers are those type of muffler in which different cross-sectional area is designed at different location to minimize the noise and fluctuation in noise
- b) Absorptive type Muffler :- In this type of muffler some absorbing material (mineral wool, fibre glass, sintered metal composites, white wool) is used which absorb the noise and minimize the sound. The important tools of absorptive muffler absorber modelling and numerical computation.
- c) Free flow muffler: This type of muffler is simply a pipe with resonating chamber. There is no any reflective or absorptive material used in this type of muffler.

In this project work we are studying how to modify silencer for noise reduction which is known as Hybrid Muffler. And inspecting it for knowing its performance as comparing with other conventional Mufflers by using Pressure Level meter.

II. LITERATURE REVIEW

Jashanpreet Singh, S. P. Nigam, L. K. Bhagi researched on Effectiveness of Muffler on a two wheeler vehicle noise. Barhm Mohamad researched on acoustic effect on commercial Automotive Muffler and used methods and materials. Potente discussed absorptive and reflective type mufflers and further calculated the insertion losses. Snehasis pal research on the design and acoustic analysis of Hybrid Muffler. Chan and Too investigated the effects of sound elimination in a cylindrical duct. In this work, a combined adaptive algorithm is adopted and results show the hybrid system has more advantages over the traditional muffler.

III. OBJECTIVE

Design Exhaust System For Two Wheeler Silencer. To Select Modification In Muffler Grade Implementation of Absorptive-Reflective Principle For Chamber Modification. The Main Objective Of These Project is To Reduce Exhaust Gas Noise Level.

IV. TERMS AND PARAMETERS CONSIDERED FOR MUFFLER DESIGN

A muffler performance is generally defined in terms of insertion loss or transmission loss. Exhaust muffler is designed to reduce sound levels at firing frequencies. Some of the important design parameters for muffler are as follows -

1. Sound absorption :- (1) The process by which sound energy is converted into heat, leading to the reduction in sound pressure level. (2) The sensation perceived by the sense of hearing.
2. Sound insulating material :- Material designed and used as partitions in order to minimize the transmission of sound.

3. Sound insulation :- The reduction or attenuation of sound by a solid partition between source and receiver. This may include a building wall, floor, barrier wall or acoustic enclosure.
4. Sound power :- The sound energy radiated per unit time by a sound source, measured in Watts (W)..
6. Sound pressure :- The fluctuations in air, measured in Pascals (PA).
7. Sound Pressure Level, L_p (SPL) :- Sound pressure measured on a decibel scale.
8. Insertion loss :- The reduction of noise level at a given location due to placement of a noise control device in the sound path between the sound source and that location. Usually rated in octave bands or 1/3-octave bands. It is defined as the difference in sound pressure or sound power level at the termination with and without a muffler or silencer installed.
9. Back pressure :- Backpressure is a resistance or force opposing the desired flow of fluid through pipes, leading to friction loss and pressure drop. Back pressure should be kept to a minimum to avoid power losses and for better performance. $\text{Back Pressure} = \text{Atmospheric Pressure} + \text{Pressure Drop}$.
10. Transmission loss :- Measure of the airborne sound insulating properties, in a particular frequency band, of a material. Transmission loss is defined as the difference between the average sound pressure level occurrences at the entry to the muffler to that of the transmitted by the muffler
11. Selection of size :- The available space has a great influence on the size and therefore type of muffler that may be used. A muffler may have its geometry designed for optimum attenuation however if it does not meet the space constraints, it is useless.
12. Cost :- A major factor in any component is the cost to the consumer. Silencers not only have to be effective in performing their task they need to be affordable otherwise the product will fail in the marketplace.
13. Weight :- Generally the larger a muffler is, the more it weighs and the more it costs to manufacture. For a performance vehicle every gram saved is crucial to its performance/acceleration, especially when dealing with light open wheeled race vehicles. Therefore a small lightweight muffler is desirable.

V. COMPONENTS AND METAL USED FOR MODIFICATIONS OF MUFFLER

a) Perforated sheet :-

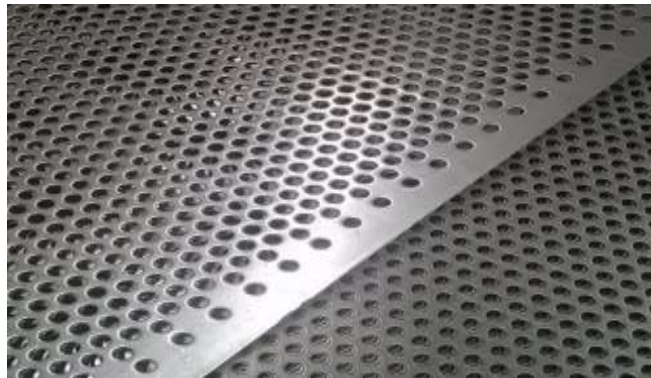


Fig.1. Perforated sheet.

Uniform welds and good pressure resistance..Accurate roundness and straightness. Smooth and flat surface. High filter precision. Also can cut the noise and ventilate. Resist acid, alkali, low and high temperature, so has along service life.

b) Glass wool :-

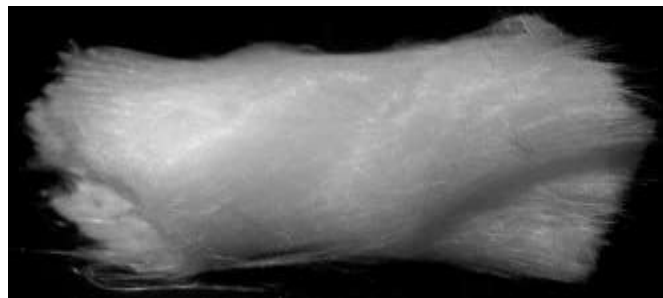


Fig.2. Glass Wool

Acoustic Glass Wool or acoustic fiber glass is light weight and has excellent acoustic absorption even at low densities. Glass wool is created through a unique process, as small pockets of air are trapped by fine glass fibres to produce a reliable insulating material.



c) Tungsten arc welding :-



Fig.3. Welding Components

Offering high quality, versatility and longevity, TIG is the most commonly used stainless steel welding process. This welding process creates a low heat input, which makes it perfect for thin material. To prevent oxidation and increase resistance to corrosion.

d) 409 grade Stainless steel Metal used for Automotive Muffler :-

Grade 409 stainless steel is a Ferritic steel it contains 12% chromium and 0.5 % nickel that offers good mechanical properties and high-temperature corrosion resistance. It is commonly considered as a chromium stainless steel, with applications in exhaust systems of automobiles and applications that demand weldability. Grade 409 stainless steels offer scaling resistance at temperatures up to 675°C during continuous operation, and up to 815°C under intermittent conditions.

VI. MODIFICATIONS IN MUFFLER



Fig.4. Cut View of Original Reflective Muffler



Fig.5. Cut View Of Reflective Muffler.



Fig.6.Cut View of Free Flow Muffler.

Mufflers are used for comparing and inspecting Effectiveness of Hybrid muffler.

In the present work, a hybrid muffler is fabricated by Using the techniques of absorptive type and reflective type muffler.

a) Reflective Muffler :- These use as resonating chambers target specific frequencies to control noise.



Fig.7. Cut View of Reflective Muffler.

b) Absorptive Muffler :-An absorptive silencer reduces noise considerably over the entire spectrum and more so at higher frequencies.

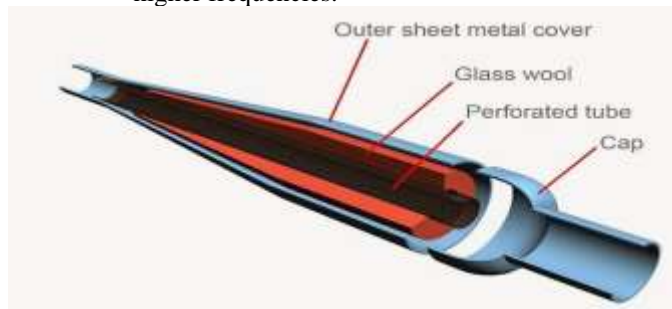


Fig.8.Cut view of Absorptive Muffler.

Stepwise Muffler Modifications :-

1) Old Muffler Cutting.



Fig.9.Muffler Cutting.

2) Perforated sheet Cutting.



Fig.10.Perforated sheet Cutting.

3) Bending of perforated sheet.

4) Insertion of Perforated sheet.



Fig.11.Bending of Sheet.

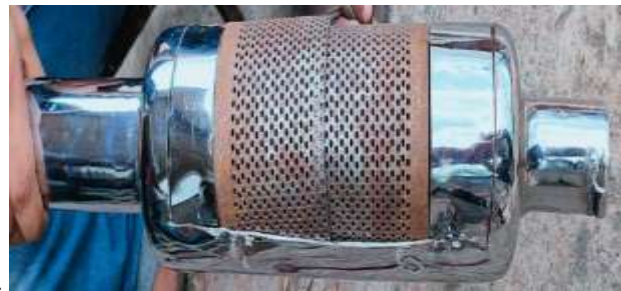


Fig.12.Insertion of Sheet.

5) Applying Glass Wool On perforated sheet.



Fig.13. Applying Glass-wool .

6) Welding for Joining Cutting Parts :-



Fig.14. Welding of Cutting Parts.

7) Final M4 Hybrid Muffler :-



Fig.15. Final Hybrid Muffler.

Specifications of Motorcycle used for checking effectiveness of Hybrid Muffler :-

1) Engine :- Petrol.,2) Number Of Cylinders :- one.,3) Horsepower (B.H.P.) :- 19.8.,4) Weight in(kg) :- 175.,
5) Stroke :- Four.,6) Displacement :- 350 cc.

Pressure Level Measuring Instrument :-

The measurements were taken by sound pressure level meter it has been measured by using different four mufflers at 1 meter away from the tail pipe of the muffler at 45°angle.



Fig.16. Pressure Level Measuring Instrument.

V||. NEW HYBRID MUFFLER PERFORMANCE DISCUSSION

A. Observation of Acoustic power :-

Evaluation of acoustic power was carried out on original reflective Muffler and new modified Hybrid mufflers at different engine speeds. The value of acoustic power increases continuously as the engine speed increases in both muffler.

B. Observation of sound pressure level :-

In this work comparison is made between sound pressure level with out and with different mufflers at different engine speeds. The values of Pressure Level without Muffler is upto 75.04 db, for Absorptive Muffler is upto 70.02 db, for New modified hybrid Muffler is upto 66.06 db. At constant engine speed, value of sound pressure level, noise level is maximum without muffler and minimum with new modified hybrid muffler in all the cases.

C. Observation of Insertion loss :-

The insertion loss of different mufflers is calculated by subtracting the sound pressure level without muffler and with using muffler. Insertion loss for original reflective Muffler is upto 9.4 dB(A), For free flow muffler is 4.6 dB, For reflective Muffler is 5 dB, For New modified hybrid Muffler is 10 dB. The value of insertion loss increases with increase in engine speed. It is found that maximum value of insertion loss is obtained with Hybrid muffler.

V|||. CONCLUSION

The acoustic power of Hybrid muffler is found to be less than conventional muffler at engine speed. While studying modified Muffler Sound Pressure Level is much more less than conventional muffler and also Maximum insertion loss observed in Hybrid Muffler on that basis minimum sound pressure level which means that Hybrid Muffler is the best as comparing other Mufflers.

|X. REFERENCE

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