DESIGN AND ANALYSIS OF CAT POSITION MODIFICATION INMUFFLER

Kalaiselvan, Guru Prashanth,
GUIDE: Eshwaran , Mani

ABSTRACT

Two-wheeler silencers are used to silence the noise generated by engine while throwing out hot flue gases from the combustion chamber. The technique of silencing the noise is to pass flue gases through the silencer and reduce the flow speed. Hence the noise gets silenced. It also helps to discharge hot flue gases into atmosphere. Inside the silencer the flue gas allows to flow through different sections. During this flow the nature of flow needs to study well to understand the silencing phenomenon. CFD Analysis will help to learn this flow. Practically it is very critical to study flue gas flow inside the silencer. Hence CFD method is very popular and widely used in research and development of silencer.

In this review paper, we have studied literature of two-wheeler silencer. The temperature distribution, pressure variation, velocity gradient and the turbulence etc. are studied well to know the phenomenon of silencing the sound produced due to exhaust gases. Also, the improvements in design can be suggested based on the CFD analysis. Keyword: - CFD Analysis1, Silencer2, Temperature Distribution3, Heat transfer4.

Keywords – CFD Analysis, Silencer, Temperature Distribution, Heat transfer, Cost Reduction

INTRODUCTION

Now a days everywhere people are using diesel and petrol engines for transportation, power generation applications. Also known that diesel is not a renewable energy source and it will not be there after some years. To replace the work of diesel today we invented lot of technologies and innovative things like alternate fuels, solar energy system, etc. There are two possible solutions available for the above told problem, first thing is to utilize the available resource in an effective way and the second thing is to shift to next technology. We were concerned on the first thing “effective utilization of available resources & Save A environment”. So, in this project designed a number of piston crown shapes to get an optimum level of air fuel mixture with the help of that, efficiency of the diesel engines can be improved. In this project designed a set of crown shapes using Creo software and analyzed them with the help of openfoam to find which will become an effective piston crown shape for the selected diesel engine.

2. EXPERIMENTAL ARRANGEMENT

2.1 IMPORTANCE OF MUFFLER IN VEHICLES

They **aid in dampening vehicle emissions and engine noise**. They are made of steel and are coated with aluminum to provide protection from the heat and chemicals released from the exhaust system. Mufflers are used mainly to dissipatethe loud sounds created by the engine's pistons and valves.

Every time your exhaust valve opens, a large burst of the burnt gases used during your engine's combustion is released into the exhaust system. This release of gases creates very powerful sound waves. To understand how a muffler dissipates the sound waves created by your engine, one must understand how sound is produced. Sound is a pressure wave formed by vibrations. These vibrations are pulses of alternating high and low air pressure. So, every time your exhaust valve opens, a very high-pressured gas enters into the exhaust system. These high-

vi

pressure gases will collide with low-pressure molecules, create pressure waves (sound), and travel through the exhaust system. Now, how exactly does a muffler dissipate these loud sound waves? Sound can actually be cancelled out. If you can introduce a pressure wave that is the exact opposite of the initial sound wave, meaning their wavelengths, or high- and low-pressure points, are opposite, they cancel each other out, and there is no sound. Another way to describe what happens is when one sound wave is at its maximum pressure, the other sound wave is at its minimum pressure; so, they cancel each other out. This is called destructive interference and is what occurs inside your muffler. A muffler design is very simple yet very precise. Inside a muffler there are tubes with perforations that direct the sound waves through the inside of the muffler and out the end. Sound waves will enter through a central tube, hit the back wall, pass through a hole and enter the center chamber. Then the sound wave will travel through another hole and enter the resonator chamber, which is back towards the front of the muffler where the sound waves first entered. Now, some of the sound wave will reflect off the center chamber's wall, while the rest will pass through the hole and into the resonator chamber.

2.2 NEED OF MUFFLER

Muffler, also called silencer, device through which the exhaust gasesfrom an internal-combustion engine are passed to attenuate (reduce) the airborne noise of the engine. To be efficient as a sound reducer, a muffler must decrease the velocity of the exhaust gases and either absorb sound waves or cancel them by interference with reflected waves coming from the same source.

A typical sound-absorbing material used in a muffler is a thick layer of fine fibres; the fibres are caused to vibrate by the sound waves, thus converting the sound energy to heat. Mufflers that

attenuate sound waves by interference are known as reactive mufflers. These devices generally separate the waves into two components that follow different paths and then come together again out ofphase (out of step), thus canceling each other out and reducing the sound.

2.3.1 BAFFLE TYPE MUFFLER

It consists of a number of baffles spot welded inside the cylindricalbody. the purpose of these baffles is to close the direct passage of the

exhaust gases, thus the gases travel a longer path in the muffler.

There are many designs of the baffles used in the muffler. The image shows two types of such mufflers which have low efficiency. Due to the restricted flow of the exhaust gases, back pressure increases causing the loss of engine horsepower.

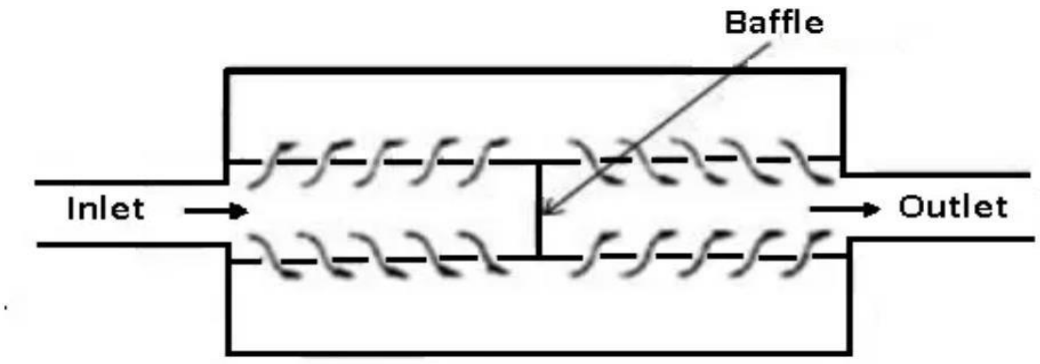


FIGURE 1.1 Baffle Type Muffler

2.3.1 WAVE CANCELLATION TYPE MUFFLER

In this type of muffler, the exhaust gases entering the mufflers are dividedinto two parts to flow in the muffler. The lengths of these paths are so adjusted that after they come out of the muffler, crests of one wave coincide with the troughs of the second wave.

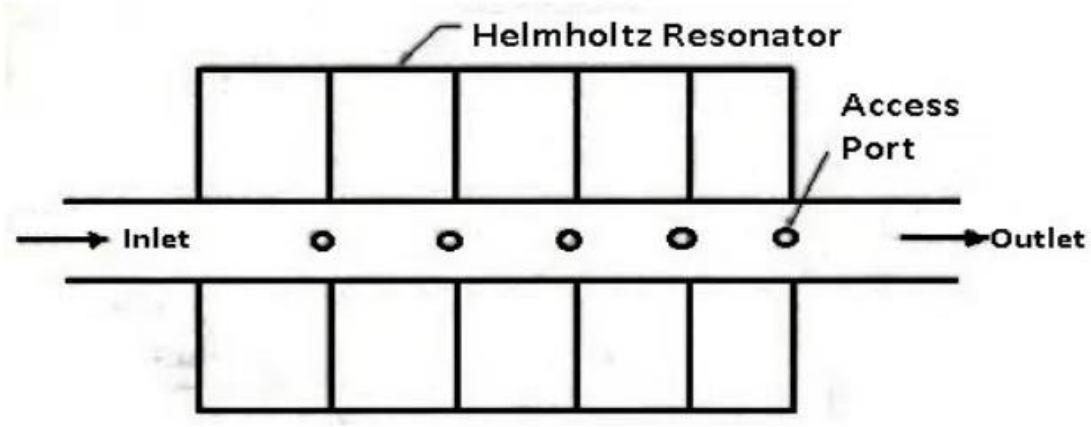


FIGURE 2.3.2 Wave Cancellation Type Muffler

Thus cancelling each other and reducing noise to zero theoretically. This is achieved if the lengths of the two paths differ by half the wavelengths. But this is not achieved practically, because the noise produced by exhaust gases is acombination of different frequencies at different engine speeds. However appreciable noise is reduced.

RESONANCE TYPE MUFFLER

It consists of a number of Helmholtz resonators in series through which a pipe having access port passes.

Helmholtz is the name of a person who originated the idea of this type of muffler. The exhaust gases flow through this pipe. This resonator eliminates the fundamental and higher harmonics of the engine noise.

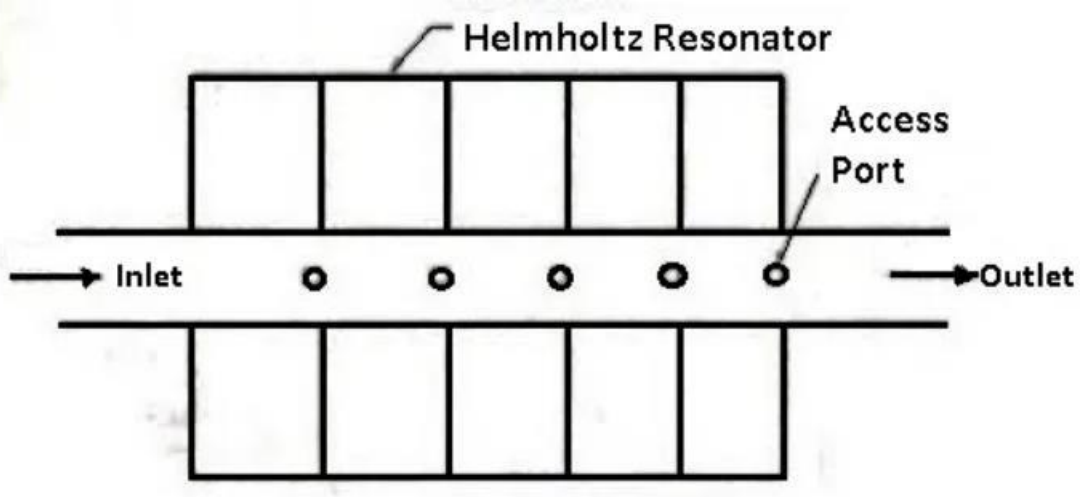


FIGURE 2.3.3 Resonance Type Muffler

2.3.3 ABSORBER TYPE MUFFLER

It consists of a perforated tube, around which a sound absorbing thematerial like fiberglass or steel wool is placed.

The exhaust gases pass through the perforated tube. the sound-absorbing material reduces the high-pressure fluctuation of the exhaust gases thus reducing the noise intensity. These mufflers may be either straight-through typeor reverse flow type.

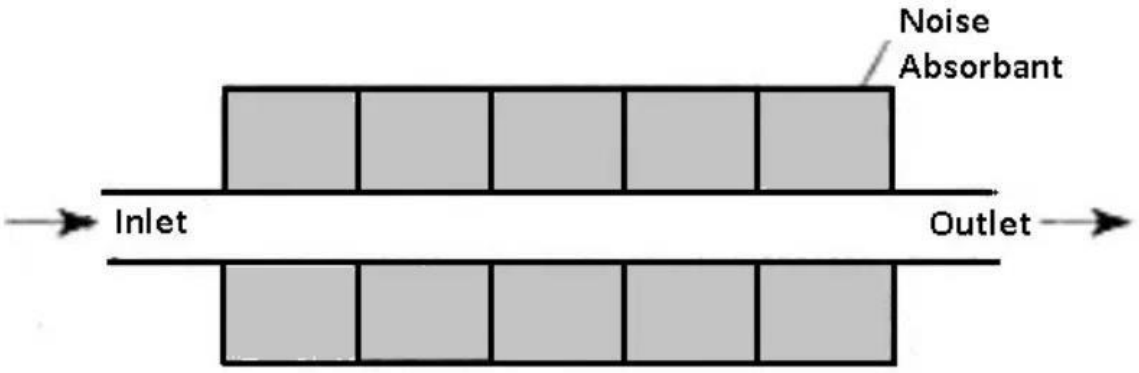


FIGURE 1.4 Absorbe$^{i}r^{x}$ Type Muffler

2.3.4 Combined Resonance and Absorber Type Muffler

Sometimes, a resonance chamber is provided at one end or in the middle of thestraight through absorber type muffler, to reduce the pressure and noise still further.

In some designs, a resonance chamber is a separate unit called a resonance,which is connected in series to the muffler.

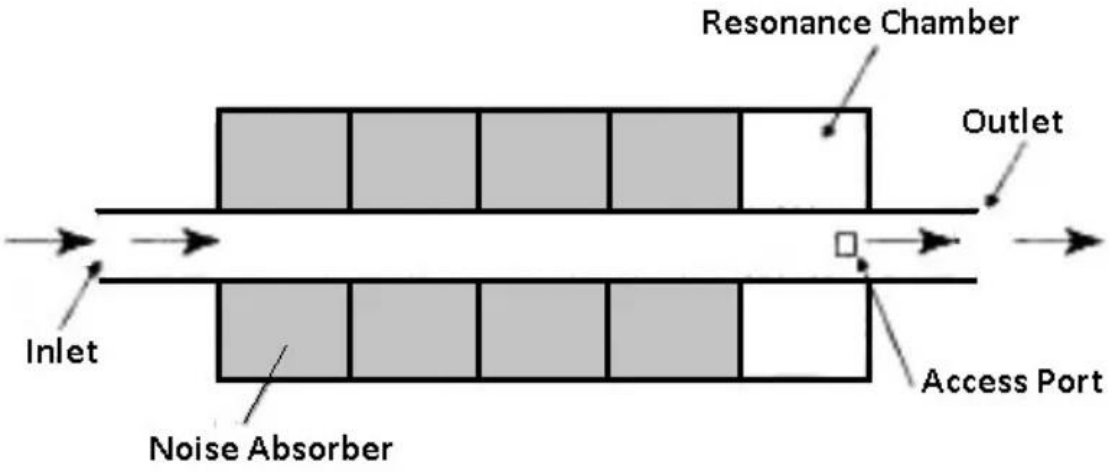
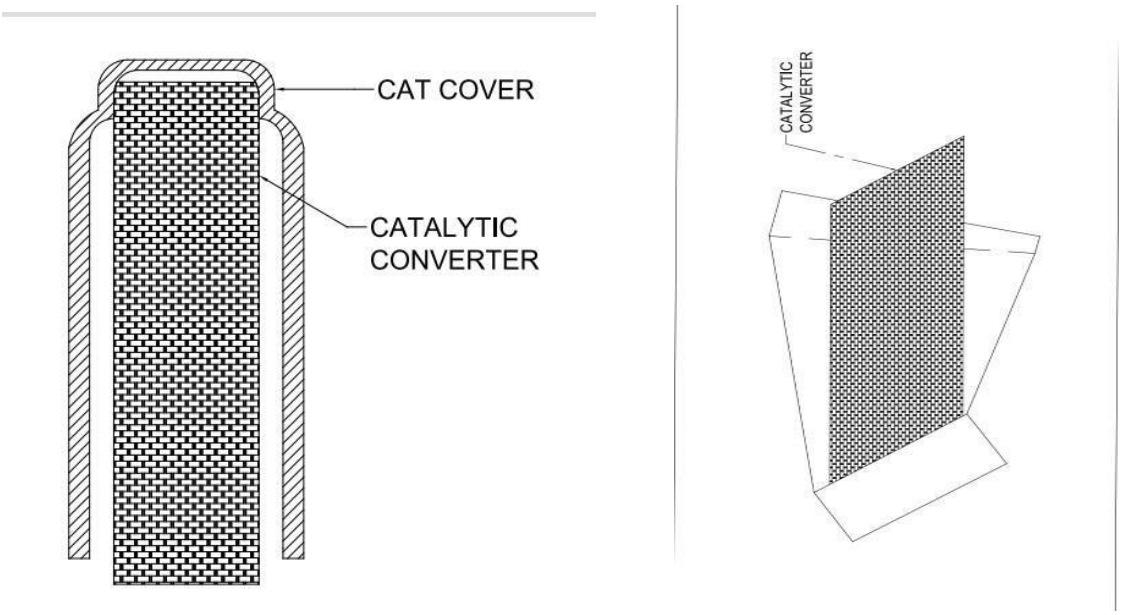


FIGURE 2.3.5 Combined Resonance and Absorber Type Muffler

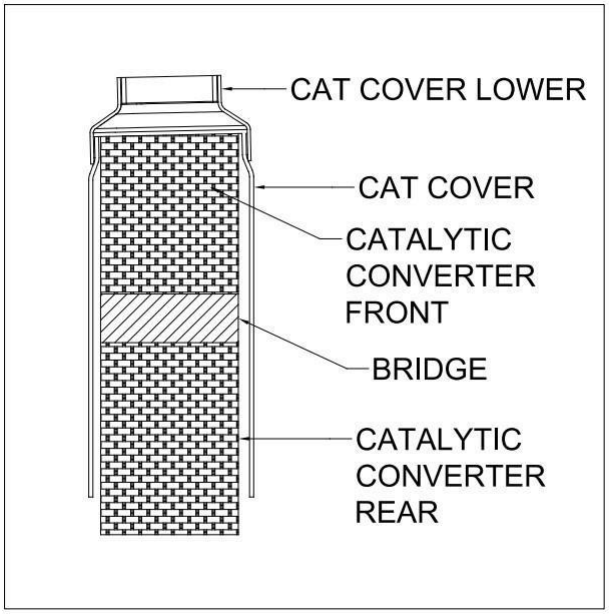
3.0 RESULTS AND DISCUSSION

The present study has investigated literature related to modified Rear CAT Position in diesel, petrol engines. Based on the review, following conclusionsare drawn.

- Modified Rear CAT Position helps to increases minimum pressure drop,maximum amount of pressure is distributed in first chamber then in next chamber such pressured gas is allowed to pass through less porous pipe.
- To get an optimum Exhaust flow From Engine Continually withoutEfficiency loss.
- Cost Reduction & Supplier Rejection Control



BS 6 Muffler Cat Position at Two Places



Two CAT Placed at Single Place Drawing

4.0 FUTURE WORK

- Identification of different modified CATALYTIC CONVERTERPosition change.
- Developing a part model using Pro-E
- Analyzing a part model using CFD (Computational fluid dynamics).

REFERENCES

[1]. Sudarshan Pangavhane et al, "Experimental and CFD analysis ofperforated inner pipe muffler for prediction of backpressure", in IJET Vol.5 No.5, pp. 3940-3950.

[2]. S. Krishnan, "Exhaust System Muffler volume optimization of LCV by CFD simulation", in Proc. Materials Today 5, 2018, pp. 8471-8479.

[3]. S.S. Mane, "Backpressure Analysis of engine muffler using CFDand experimental validation", in IERJ special issue, pp. 828-834.

[4]. Xiaofeng Shi, Cheuk-Ming Mak, "Sound attenuation of a periodic array of micro-perforated tube mufflers", in Applied Acoustics 115, 2017,pp. 15-22.

[5]. Yoha Hwang et al, "New active muffler system utilizing destructive interference by difference of transmission paths", in Journalof Sound and Vibration 262, 2003, pp. 175–186.

[6]. K. Suganeswaran et al , "Design and Optimization of Muffler forManufacturing" , Volume 3, Special Issue 4, April 2014