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A REVIEW ON TRANSMISSIO LOSS IN MUFFLER BY USING PERFORATED TUBE

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ABSTRACT

Now days the serious issue as far as the residential area is Sound pollution produced by the vehicles and the location where the noise is hazardous and effective. Therefore, it is necessary to have an effective noise control device. Muffler is the device which is used for minimizes the amount of noise produced by the exhaust system of the engine. Perforated tubes is used in muffler to increase the transmission loss and it controls the noise. There are methods for evaluation of transmission loss in muffler such as analytical method, computational method, and experimental method. This study discusses the effect of perforated tube on transmission loss.

Keyword: muffler, perforated tube, transmission loss.

1. INTRODUCTION

A muffler or silencer is a device used in vehicles to minimize the amount of noise emitted by the exhaust system of internal combustion engine. As the backpressure increases, the efficiency of engine decreases. Therefore to improve the performance of engine perforated tube is used. Perforated tube is a tube made of stainless steel with a number of small holes drilled around its periphery is placed inside the muffler. These metal tubes guide the flow inside the muffler in order to reduce backpressure. As the flow passes through small holes, these tubes convert the sound energy into heat energy and hence increase the transmission loss of muffler. Therefore perforated tubes are the good for noise control..

1.2. TYPES OF MUFFLER

(a) Dissipative Muffler – a muffler is based on the principle of converting the exhaust noise energy because of pressure waves into heat.

(b) Reflecting Muffler – the construction of this muffler such that it create a mismatches with incoming exhaust stream in the sense to cancel out the progressive pressure wave.

1.3.Transmission Loss

Transmission loss is the ratio of the sound power of the incident (progressive) pressure waves at the inlet of muffler to the sound power of the transmitted pressure wave at the outlet of the muffler. Mathematically it is represented as

$$TL = 10 \log \frac{(\text{incident energy})}{(\text{transmitted energy})}$$

$$TL = 20\text{Log}\left(\left|\frac{P_{inc.}}{P_{trans.}}\right|\right) + 10 \text{ Log}\left(\frac{S_o}{S_i}\right)$$

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Where; Si, So-cross sectional area of inlet and outlet respectively

2.APPROCH FOR CALCULATING TRANSMISSION LOSS IN MUFFLER USING PERFORATED TUBES

There are many methods for calculating transmission loss under this approach.

EXPERIMENTAL APPROACH

I. Calculation of TL by acoustic measurements.

Equipment used for measuring transmission loss are

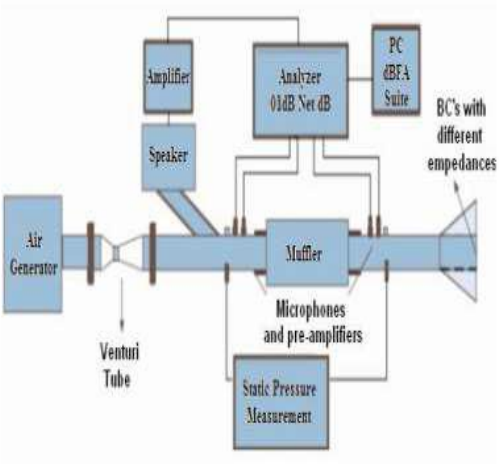
1.4-channel FFT Analyzer

2. Pressure type microphone

3. Power amplifier

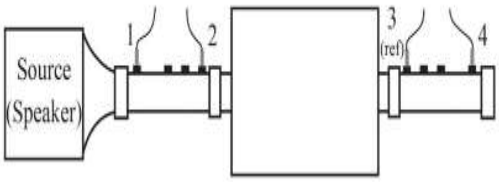
4. Adapter and connection pipes

5. Sound source



I] Two Source Location Method

In this method, the source is moved from inlet to outlet location. This technique is the most accurate and stable measurement and consists of microphones having variable spacing between them. Larger microphone spacing will more accurately lower frequency TL due to large wavelength and the shorter microphone spacing will more accurately calculate the higher frequency TL due to short wavelength. Here the frequency-microphone spacing combination should be avoided for accurate results. There is analytical approach to predicts transmission loss.



II] Finite Element Approach:

The finite element method can be performed by using the Galerkian method or by the variational formulation method. This is the most advanced technique used for the muffler analysis. The acoustic waves in the chambers

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are complex so this technique is used. The finite element method was originally developed for the structural analysis but it was later extended to the acoustic analysis by scientists. This technique was implemented in mufflers by scientists. This method is used in the muffler for its dominant three dimensional effects. The finite element analysis procedure consists in discretizing the chamber into number of finite elements of equivalent length. A field function is selected for the exact and approximate field analysis within the element. The element matrices are evaluated by the variational principle or residual methods. The algebraic equation for the finite element system is formulated and the various unknown pressures and velocities at the nodes are calculated. Finally after computing the acoustical performance parameters in the form of four pole parameters, the transmission loss is determined

III] Boundary Element Method:

It is a method for solving numeric computational problem and also linear partial differential equation. It is generally used in the fields having linear homogeneous media. Transfer matrix method can also be used for solving BEM.

3. LITERATURE REVIEW

[1] Taylor W. Le Roy in his study found that the effect of perforated tube on transmission loss of the muffler. He added a perforated tube to the single expansion chamber. From the result obtained he concluded that addition of perforated tube improves the transmission loss of muffler at higher frequencies. The addition of perforated tube increases the transmission loss by 4.5dB to 6dB . the perforated tube is beneficial especially when expansion chamber is not used effectively.

[2] Haluk Erol and Ozan Ahmetoglu studied the effect of amount of perforation and porous material thickness on the transmission loss of the muffler. they concluded that at lower frequencies transmission loss is independent of the number of perforated holes but at higher frequencies, the transmission loss increase in number of perforated holes.

[3] F.D Denia found the acoustic behavior of perforated dissipative circular mufflers. They shoed that the use of perforated tube leads to quarter wave resonances which improved the acoustic performance of the muffler at low to mid frequencies.

[4] Ovidiu Vasile and Nicolae Enescu investigated the acoustic performance of reactive muffler by using numerical and experimental techniques. They had considered only the non dissipative mufflers. Their result shows those five lines of perforated holes of muffler configuration gives higher transmission loss in comparison to single line or three lines of perforated holes.

[5] Ayse Dincer in his study discussed the effect of perforated tube on transmission loss of the muffler and he concluded that pattern of holes do not have much effect on transmission loss of the muffler.

[6] Zhuoliang Li in his study, effect of perforated tube on transmission loss of muffler. he concluded that when perforated tubes is replaced by solid tube, then transmission loss of the muffler reduce at all frequencies.

[7] Fangsen Cui studied the effect of porosity, length and diameter of perforated tube on the transmission loss of muffler. Result shows that transmission loss for large porosity is good for low frequency and small porosity is good for high frequency.

Nitin S. Chavan in research shows the effect of length to diameter ratio of perforated tube on the transmission loss of muffler. His result shows that transmission loss increases as ratio of length to diameter of tube increases.

4. CONCLUSION

various design of the muffler with various number of perforated holes, different perforated hole pattern and different operating condition were observed and studied. From the observation it has been studied that the number of holes and the size of the holes in the perforated tube affects the amount of transmission loss in the mufflers. Greater the diameter of the hole, smaller will be the back pressure and hence lower will be the

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transmission loss. Length of perforated tube also has a considerable effect on transmission and it increases with increase in length of tube. Transmission loss also increases with increase in length to diameter ratio of perforated tube.

REFRENCES

[1] Taylor W. Le Roy: "Muffler Characterization with Implementation of the Finite Element Method and Experimental Techniques". 2011

[2] Haluk Erol and Ozcan Ahmetoglu: "Acoustic Attenuation in Fully Filled Perforated Dissipative Muffler with Extended inlet/Outlet". 2006

[3] F.D Denia ,A. M. Pedrosa and F. J. Fuenmayor: "A Finite Element Approach for the Acoustic Modeling of Perforated Dissipative Mufflers with Non-Homogeneous Properties". 2013

[4] Ovidiu Vasile and Nicolae Enescu,: "The Acoustic Multi-Chamber Muffler Performance". 2009

[5] Ayse Dincer, : "Numerical and Experimental Analysis of Dissipative Silencer Coupled with Quarter Wave Tube". 2013

[6] Zhuoliang Li: "Effect of Perforation on Acoustic Attenuation Characteristic of Triple Chamber Muffler". 2014

[7] Fangsen Cui, Ying Wang and Richard Chao: "Improving Muffler Performance Using Simulation-Based Design". 2014

[8] Nitin S. Chavan and Dr. S. B. Wadkar: "Design and Performance Measurement of Compressor Exhaust Silencer by CFD". 2013