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A REVIEW ON A NOISE REDUCTION SYSTEM IN IC ENGINE

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ABSTRACT

The study focused on practical methods of reducing noise levels in automobile engine. Noise reduction is one of the highest prior targets for IC engine development because of the more and more strict engine noise limits. After burning the fuel the many poisonous exhaust gas such as CO₂, SO₂, NO₂, are generated, such types of harmful exhaust gases are generate noise and air pollution. In this paper the noise measurement of IC engine is described by different method like as acoustic intensity and lead covering technique described. Muffler or silencer is a device which is used for reducing the amount of noise emitted by the exhaust of an internal combustion engine. It is an acoustic soundproofing device designed to reduce the noise of the sound pressure created by the engine.

KEYWORD: - Exhaust gas, noise pollution, sound pressure, IC engine

INTRODUCTION

A noise is generally harmful and serious health hazards, with the need of our modern society for various machines for human, comfort, fast travel and appliance for routine job in home and office has led to increase in the level of noise pollution almost. The harmful effect of high noise level can cause hearing losses [1]. The muffler is an acoustic sound profile design to reduce the loudness or highly intensive sound of the sound pressure created by the engine. The exhaust noise is usually obtained by passive muffler. Traditional muffler noise reduction in engine with transmission losses due to exhaust dust. A great pressure drop between the inlet and outlet section of the exhaust pipe rise up. Thus engine efficiency decreases [2].

Exhaust and intake noise are major contributors to the overall noise pollution and need to be significantly reduced. Sound transmission and generation in silencers and at the open ends of the exhaust will have to be improved or re-developed. In particular, reduction of noise from the exhaust is essential for reaching the pass-by noise targets.. This study investigates the effect of inlet pipe sizes, resonating chamber's length and orifice sizes on the level of noise generation in automobile silencers as an insight to optimizing the reduction of noise from automobiles on our roads [3].

ENGINE NOISE

Pulses released by the exhaust are the cause of engine noise. When the expansion stroke of the engine comes near the end, the outlet valve opens and the remaining pressure in the cylinder discharges exhaust gases as in pulse into the exhaust system. These pulses are between 0.1 and 0.4 atmospheres in amplitude, with pulse ration between 2 and 5 milliseconds. The frequency spectrum is directly correlated with the pulse duration. The cut-off frequency lies between 200 and 500 Hz. Generally, engines produce noise of 100 to 130 dB depending on the size and the type of the engine [4].

CLASSIFICATION OF ENGINE NOISE SOURCE

1. Exhaust system noise
2. Intake system noise
3. Cooling system noise
4. Engine surface radiated noise

1. Exhaust system noise

The exhaust system noise include the noise from exhaust gas pulses leave the muffler or trail pipe and noise emitted from vibrating surface of the exhaust system component. Noise emitted from the surface of exhaust system component result from two different type of excitation force. Those generated by the pulsating exhaust. Gas flow and thus transmitted from the vibrating engine to exhaust system component.

2. Intake system noise

Intake system noise include generated by the flow of air through the system air inlet and noise emitted from the vibrating surface component. In many instance in engine air cleaner will provide significant attenuation of intake air noise. If additional attenuation required an intake air silencer can be added to the system. To minimize intake system surface radiated noise, proper design, selection and mounting intake system component are essential.

3. cooling system noise

Water cooled engine are typically cooled by using a radiator as a heat exchanger with an axial flow fan is used to draw cooling air through the radiator. Air cooled engine generally used a centrifugal fan in conjunction with shrouding to direct cooling air across the engine. Fan noise consists of both discrete frequency tones and broad hand noise. The broad hand component of fan noise is caused by the shedding of sorties from rotating fan blades and turbulence in the fan air system.

4. Water cooled engine

A variety of design parameter affects at the sound emission level of axial flow fans but fan blades tip speed is the dominate factor to minimize fan tip speed. While still providing sufficient engine cooling. The cooling system efficiency must be as high as possible to maximize cooling system efficiency in water cooled engine [5] .

5. Engine Surface of Noise

Engine surface noise refers to sound emitted from vibrating surface of engine component and accessories and other thus item included in the engine exhaust. Intake and cooling system techniques use to reduce engine surface radiated noise include a reduction in running clearance and machining tolerances of the engine. Component acoustical treatment or redesign of engine component use of acoustic treated shields and vibrating isolation and damping of engine covers and diesel engine than for gasoline engine turbo charging of a diesel engine can result in some reduction of engine surface radiated noise at high engine load [6].

6. Classification by Noise Characteristics

One typical engine noise classification technique separates the aerodynamic noise, combustion noise and mechanical noise.

1. Aerodynamic noise.
2. Combustion noise.
- 3 Mechanical noise.

1.Aerodynamic Noise

Aerodynamic noise includes exhaust gas and intake air noise as well as noise generated by cooling fans, auxiliary fans or any other air flow.

2.Combustion Noise

Combustion noise refers to noise generated by the vibrating surfaces of the engine structure, engine components and engine accessories after excitation by combustion forces.

3.Mechanical Noise

Mechanical noise refers to noise generated by the vibrating surfaces of the engine components and engine accessories after excitation by reciprocating or rotating engine components [7].

NOISE MEASUREMENT METHOD

Noise sources of engine are normally identified as some cover component as oil pan, valve cover and front gear cover etc. the radiated noise sources of diesel engines are identified with two methods lead covering technique and noise grid.

1. Lead covering technique
2. Acoustic intensity techniques (Noise grid)

6.1. Lead Covering Technique

Lead covering technique is also called partial exposure technique and is a traditional noise source identification technique for engines. It is still the most reliable, although it is rather costly and time consuming. This is simply covering the whole engine or all of the components with an acoustic high transmission loss material (usually lead). [8] It is mounted on fiberglass wool for insulation and to prevent reverberant buildup to give considerable noise reduction. A component is then uncovered and the noise increase is noted. The process is repeated for each component.

6.2. Acoustic Intensity Techniques (Noise Grid Method)

In order to identify the sources sound intensity mapping was done on the engine and gearbox assembly in the hemi anechoic chamber. There are two methods available for intensity mapping which is Grid Method. Here Grid Method is used in order to identify the noise sources from the sound intensity mapping results. The noise radiating components are ranked based on the above calculated sound power level and it has identified that the following components Oil Sump, Rocker Cover, Inlet Manifold, Timing Cover, Crank Case and Gearbox Casing are the critical sources for noise radiations. Critical frequencies of noise radiations can also be extracted from the intensity mapping results. In order to quantify the structural resonances parallel vibration measurement has been done and following is the list of components and its resonant frequencies.



Fig 6.1. Noise Grid Method.

NOISE REDUCTION TECHNIQUE

Muffler or silencer is a device which is used for reducing the amount of noise emitted by the exhaust of an internal combustion engine. After burning the fuel the many poisonous exhaust gas such as CO₂, SO₂, NO₂ are generate.

A modern exhaust muffler is normally manufactured by a combination of an expansion chamber, perforated pipes and perforated boards. This noise resistance as the combustion gases flow through the pipe holes and boards but the combustion gasses cause exhausts resistance as a side effect. The two most important design objects for a muffler are to obtain noise reduction greater than the required lower value and also back pressure lower than the maximum

permissible value. Mufflers can be classified in reflective, absorptive and hybrid mufflers depending on the working principle.

7.1. Reflective muffler

Reflective mufflers are those mufflers that uses for sound attenuation by changing cross sections in the duct. Reflection mufflers attenuate the sound by reflection and interference. The important tools of Reflective mufflers are analytic modeling and evaluation of network theory. The reflective muffler is shown in Fig7.1.using silencer.



Fig7.1.(a) Reflective muffler in closed condition. (b) Reflective muffler in cut condition

7.2. Absorptive Muffler

Absorptive mufflers are those mufflers that uses for sound attenuation by sound absorbing materials. They dissipate the acoustic energy into heat energy through the use of porous materials as mineral fiber. The important tools of Absorptive mufflers are absorber modeling and numerical computation. The absorptive muffler is shown in Fig7.2.

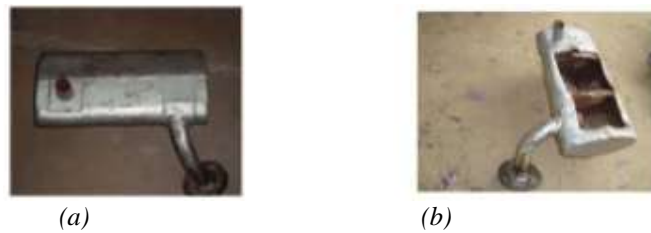


Fig7.2. (a) Absorptive muffler in cut condition, (b) Absorptive muffler in cut condition

7.3. Hybrid Muffler

Mufflers that combine the working principle of a reflective muffler and an absorptive muffler are called hybrid mufflers. This type of muffler is the best muffler to reduce the noise. In this study, three different types of mufflers are used out of which two are Reflective mufflers and one is Hybrid muffler. Silencer No. 1 is Hybrid type of muffler shown in fig. 7.3 .[9].



Fig.7.3. Hybrid muffler in cut condition and Hybrid muffler in closed condition

FRF MEASUREMENT OF OIL SUMP

The Frequency Response Function (FRF) measurement was conducted for various critical components based on noise source ranking. The components were tested with and without damping treatment in free-free condition in order to find FRF using simple hammer test and the results are explained as below

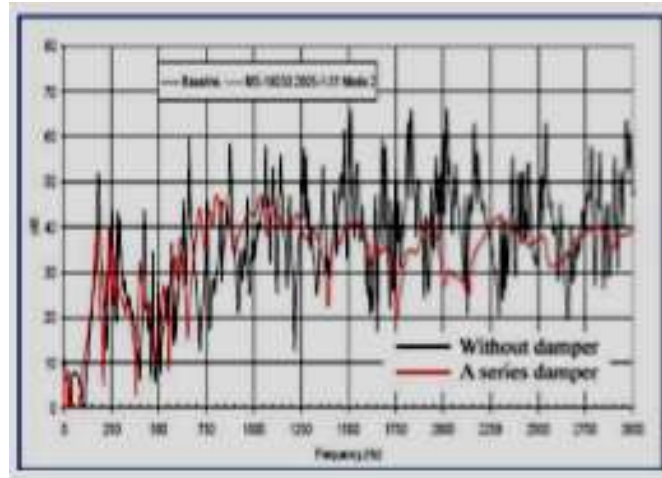


Fig 8.1. FRF oil sump

ALUMINUM FOAMS

Metal foam is a cellular structure consisting of a solid metal, for ex. aluminum, containing a large volume fraction of gas-filled pores. The pores can be sealed (closed cell foam), or they can form an interconnected network (open-cell foam). Metallic foams typically retain some physical properties of their base material. Foam made from non-flammable metal will remain non-flammable and the foam is generally recyclable back to its base material. Al foams are very effective in terms of acoustical absorption, effective in terms of electromagnetic shielding and structural damping, absorb impact energy regardless of impact direction, much more stable than organic materials like wood or plastics and are decorative are completely and hence do not cause any harm to our environment [10].

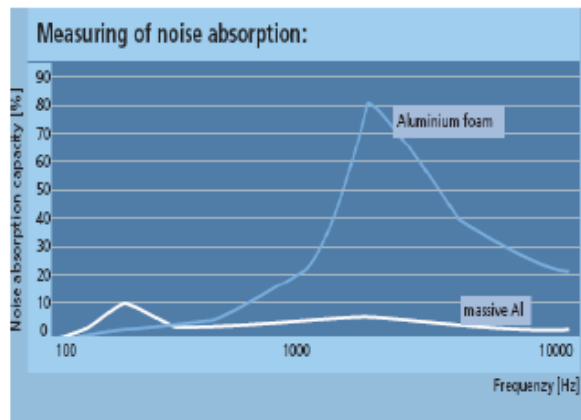


Fig9.1.Noise comparison for aluminum foam

RESULTS

By using muffler or silencer the various observations is taken as shown in fig. at constant load the acoustic power can be reduce 10 db to 15 db and also reduce the sound pressure level 8 db to 12 db as compare to without silencer.

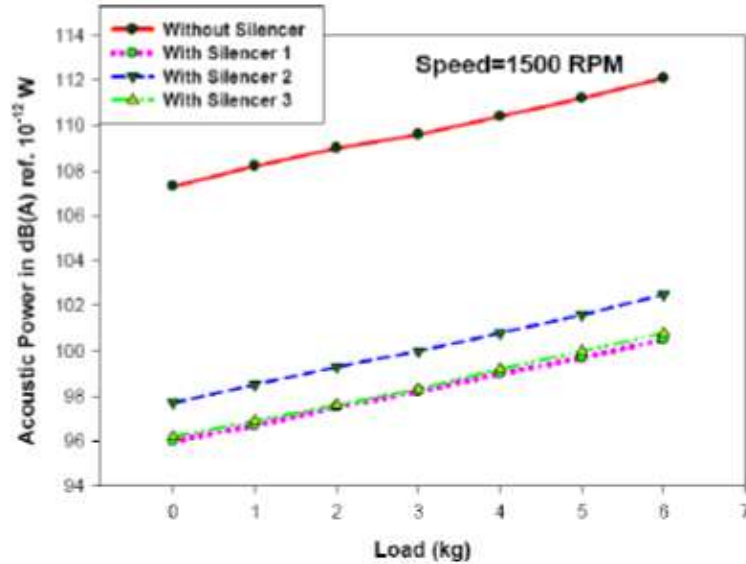


Fig. Acoustic power Vs load

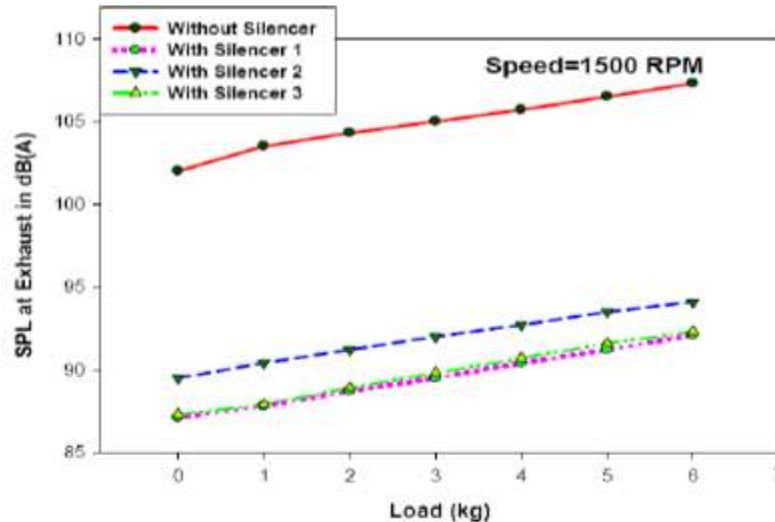


Fig. SPL at exhaust Vs load

CONCLUSION

In this paper effect of variation in build-up parameters on noise reduction in automobile engine silencers has been investigated. The noise is control to the extent possible by properly designing machines and appliances by suitably locating machines. Mainly mufflers are generally used to increase the engine efficiency and reduction in noise pollution and all types of exhaust emission. Flow linearization through design can considerably reduce noise level generation in automobile silencers and subsequently, improve the performance of the silencer. Silencer parameters such as inlet-pipe size, orifice size, resonating chamber length affects the silencer performance. By using mufflers we can save the power and reduce the knock in the IC engine. Muffler can reduce sound pressure 8 db to 14 db.

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