IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Design Modification to Reduce the Noise Level of Silencer Used for Single Cylinder Water Cooled Diesel Engine: A Review

Mr. Sachin S. Morti[1], Mr. Amit G. Dangi[2]

[1,2]*Lecturer, Department of Mechanical Engineering, Sant Gajanan Maharaj Rural Polytechnic, Mahagaon, Maharashtra, India.*

Abstract – *The single cylinder water cooled diesel engine is used for various applications such as in agriculture as well as in domestic purpose. This diesel engine having too much noise level; this is irritating not only for operator but also for external environment. High noise level is harmful for human beings. For the reduction of noise level 'silencer' is mounted on this diesel engine, which attenuates the noise. The noise level of this water cooled single cylinder diesel engine can be reduced further by modifying its design. This review is conducted to study the variety methods used by various researchers for noise reduction of silencer through modification of its existing shape. In this study the recent developments on design modification of silencer for diesel engine exhaust manifold, their performance evaluation using various methods such as computational fluid dynamics (CFD), acoustic software, various geometrical types of exhaust manifold and their impact on the diesel engine performance have collected and discussed.*

Key Words: Silencer, noise level, diesel engine

1. INTRODUCTION

The silencer is a device for reducing the amount of noise emitted by the engine. It is manufactured as an acoustic soundproofing device designed to reduce the loudness of the sound pressure created by engine by the way of acoustic quieting. Due to increased environmental concerns requiring less noise emissions combined with reduced emission of harmful gases, it is becoming very crucial to carefully optimize the design of exhaust system silencers.

It is well known that the acoustic performance of silencing elements decreases with increase in exhaust gas flow through it. If the high pressure exhaust gases were allowed to enter atmosphere directly from the exhaust manifold, a loud unpleasant noise will be heard like firing of a gun. This noise is due to the large difference in pressure between the exhaust gases and the atmosphere. For quite operation of the engine, it is desirable to reduce this noise as much as possible. This is done by using a silencer in the exhaust system. So, the silencer is connected at the exhaust of the engine. The function of the silencer is to reduce the pressure of the exhaust gases sufficiently to permit them to be discharged to the atmosphere silently. To reduce the pressure, the exhaust gases are permitted to expand slowly in the silencer. The capacity of the silencer should be sufficiently large to permit the gases to expand to nearly atmospheric pressure before they are discharged into the atmosphere. Also, the silencer should not have any appreciable restriction to flow that will raise back pressure excessively, which affects the engine efficiency. In this work, a single cylinder water cooled diesel engine experimental set up is selected, having a silencer. The main aim of this review is to study the variety of methods used by various researchers for the reduction of noise through modification of its design parameters.

1.1 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.

2. LITERATURE SURVEY

The following literature survey is carried out to study the various methods used to design modification of silencer used for diesel engine for the reduction of its noise.

Mr. Sachin S. Morti et al. (2021) have found that investigation of backpressure of silencer used for single cylinder water cooled diesel engine through CFD simulation. The main objective of silencer is to attenuate a sound by reducing exhaust gas pressure, but it causes back pressure which effects on engine efficiency. The exhaust system being a critical system of any engine plays the role of improving its work quality by attenuating the noise from the engine without deteriorating the engine performance by ensuring an optimum value of back pressure. The major concern for a designer is to ensure that the backpressure should as minimum as possible. This work is mainly concerned with the simulation of flow through the silencer followed by the prediction of the exhaust back pressure of the silencer using computational fluid dynamics (CFD). The comparison of backpressure between two different designs of silencer is carried out with the help of CFD simulation method. The

diesel engine silencer is simulated at different velocities, the flow field of a given geometry of silencer is simulated and the total back pressure inside the silencer is calculated. It is resulted out that the arrangement of perforated plate or baffle plate inside the silencer is the most critical parameter from back pressure point of view.

Sachin Morti et al. (2019) have presented that the reduction of noise is current issue in today's life. Silencer collects exhaust gas from diesel engine, reduces the noise level of it and leave to atmosphere. The engine efficiency is depends on how the exhaust gas is removed from the cylinder. The main objective of silencer is to attenuate a sound by reducing exhaust gas pressure, but it causes back pressure which affects engine efficiency. Design of silencers is a multifarious function that affects noise characteristics and fuel efficiency of engine. It is observed that CFD can be used as a tool for back pressure analysis of silencer. Change in diameter of silencer minimizes the backpressure, which improves the engine efficiency.

Rajendra Kumar Kaushik et al. (2015) have 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 stricter 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 research study the noise measurement of IC engine is described by different method like as acoustic intensity and lead covering technique described. 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. The 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 to14 db.

S. Ramu et al. (2017) have The environment affected inherent drawback from IC engines is concerned to the major mankind of exhaust noise pollution and air pollution. However the exhaust noise can't be identified, but the human being affected by without destiny. This paper decided to done the research work depend on the noise pollution for optimum design and construction of the muffler and internal sections. The muffler section has changed but back pressure replied to the engine, might increase and hampered to the engine. The present work done by improving the thermal efficiency and improved the combustion efficiency by exhaust silencer. In addition that, the performance test and engine efficiency results were compared with existed method in term of brake thermal efficiency and brake specific fuel consumption, temperature measurement of engine performance and drop of pressure measurement these drop of pressure and temperature measurements are observed.

Neamat keramat siavash et al. (2015) has discussed that fuel type has a direct effect on the quality of IC engine's combustion phenomenon. One of the most important quality parameters that can be fluctuated by fuel type is engine noise. The purpose of this study is to analyse the noise parameter of a diesel engine using B0, B5 (5% vol., biodiesel and 95% vol., diesel blends), B10, B15, B20, B25 and B30 biodiesel–diesel blends. This study was carried out at stationary position and at three positions such driver's left ear position (Drivers Left Ear Position-DLEP), 1.5 meter (1.5 meter Away From Exhaust-MAFE) and 7.5 meters (7.5 meter Away From Exhaust-MAFE) away from exhaust at 6 engine speeds (1200, 1400, 1600, 1800, 2000 & 2200 RPM). The results proved that the lowest and highest Sound Pressure Level (SPL) of power tiller takes place at B10, and B30 respectively. The SPL increased by 7.8 dB for increasing engine speed from 1200 to 2200 RPM. The test results showed that the average SPL at DLEP was 4.3 dB higher than 7.5 MAFE position. The dominant frequency of engine noise was315Hz that exhaust structure is the source of it. In this frequency SPL of B10 was, 23%lower than thefuelB30 (a mixture of 30percentbiodiesel and70percentdieselfuel, respectively). The slightest and strongest sound by using theB10, B30 fuel mixture was produced respectively.

In the present work, experimental tests were conducted on a single cylinder diesel engine in order to investigate the combustion noise radiation during stationary state for various diesel and biodiesel fuel blends. The experimental test matrix included seven different fuels, namely neat diesel fuel and six blends of diesel fuel with either bio-diesel.

For the used engine at this experiment, by optimizing muffler design it's possible to reduce SPL of engine in this frequency peak point. By applying A-Weighted filter that matches with human hearing system, frequencies between 300 and 3000 Hz are the effective range. Combustion and exhaust (muffler) design are the source of this range.

Lalit Zipre et al. (2018) have presented in their study that, in the automobile industry, exhaust emission control and optimizing and using of non-conventional materials is major challenge for the research and development department of every company. Practical weight reduction and making the system compact and personalization of single exhaust system are the main. Introduction of the active back pressure control valve is the main feature of this research study. From the study of above research papers a brief overview of the exhaust system noise attenuation techniques and the various processes for designing an exhaust system or muffler, the parameters for designing a muffler, effects of hardware configuration of the engine on the noise and flow characteristics, how to exercise control over the NOx emissions in a number of ways for an IC engine is obtained. Exhaust system design is key factor for the recent years to increase the efficiency of an I.C. engines. Also it is very helpful for the noise damping for better ergonomics of the driver and improvement of ride quality. Controlling emissions and reducing environmental pollution for achieving higher euro norms in lesser investments.

Jun Fu et al. (2015) have shown that to improve the acoustic attenuation performance of an exhaust muffler of a 175 series of agricultural diesel engine, automatic matched layer method of finite element is adopted on the basis of LMS Virtual. Lab software to simulate the non-reflecting boundary conditions, which can avoid the complex calculation and then figure out the value of propagated sound power directly and finally obtain the transmission loss of the exhaust muffler. Compared with the experimental data, it can be found that the error between the simulation and measured values is small, and it can be accurately simulated for the acoustic performance of the exhaust muffler at the frequencies smaller than 3000 Hz, which verifies the validity of the acoustic solution. An improved

design that properly distributes the insertion length of intubation, increases the length–diameter ratio, and adds the length of the first expansion cavity is proposed for the poor acoustic attenuation performance in low and medium frequencies. Compared with the original design, the transmission loss value at low and medium frequencies obviously increases, so the acoustic attenuation performance at the frequencies becomes better.

3. OBSERVATIONS

From the study of various papers following observations are carried out:-

1. The CFD simulation software can be used as a tool for reduction of noise reduction of silencer used for single cylinder water cooled diesel engine.
2. Environmental pollution can be controlled in the silencer by using catalytic converter.
3. Virtual lab software also used for design modification of the silencer used for agriculture diesel engine.

REFERENCES

[1] Sachin Morti, Pravin Sawant "Design Modification and Acoustic Analysis of Silencer for Agriculture Diesel Engine – A Literature Review", International Journal of Engineering Development and Research, 2019, 7(1), 267-269.

[2] Mr. Sachin S. Morti, Mr. Santosh M. Magdum "Backpressure Investigation and Design Modification to Reduce Noise Level of Silencer Used for Single Cylinder Water Cooled Diesel Engine through CFD Simulation", International Research Journal of Engineering and Technology, 2021, 8(1), 971-977.

[3] Rajendra Kumar Kaushik, Prakash Kumar Sen, Gopal Sahu "A REVIEW ON A NOISE REDUCTION SYSTEM IN IC ENGINE", INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY, 2015, 4(10), 796-802.

[4] S. Ramu, R. Srinivasan, S. Somasundaram, Tariku Achamyeleh "DESIGN OF EXHAUST SILENCER MUFFLER FOR TRANSMISSION LOSSES WITH THE PERFORMANCE OF A FOUR STROKE DIESEL ENGINE WITH AND WITHOUT MUFFLER SECTION", International Journal of Mechanical Engineering and Technology, 2017, 8(1), 139-145.

[5] Neamat keramat siavash, Gholamhassan Najafi, Reza Hasanbeigi, Barat Ghobadian "Acoustic analysis of a single cylinder diesel engine using biodiesel fuel blends", The 7th International Conference on Applied Energy – ICAE, 2015, 893-899.

[6] Lalit Zipre, Prathmesh Aher, Prathmesh Jalgaonkar, Mohammad Altaf, Prof. T.Z. Quazi "DESIGN AND OPTIMIZATION OF EXHAUST SYSTEM FOR INTERNAL COMBUSTION ENGINES", International Journal of Scientific & Engineering Research, 2018, 9(5), 409-411.

[7] Jun Fu, Wei Chen, Yuan Tang, Wenhua Yuan, Guangming Li and Yu Li "Modification of exhaust muffler of a diesel engine based on finite element method acoustic analysis", Advances in Mechanical Engineering, 2015, 1-11.