

Performance Analysis of Multi Chamber Reactive Silencer

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Abstract: With the increase in population day by day the number of vehicles also increases which have more contribution towards the increase in noise and air pollution. To reduce the same or to maintain it within the limit the researchers are taking efforts for finding some solution or alternate method, which leads to the development of new things or some modifications in the existing thing. As the major source of pollution are the vehicles, therefore by limiting the scope of pollution to the vehicles only the three different configuration of reactive silencer is designed by modifying the tuning chamber which is the main cause of attenuation and the result recorded for noise level production, back pressure and pollutant produced and by compared with the standard silencer provided by the manufacturer and the optimum design of reactive silencer is proposed which has comparatively less noise at low back pressure with producing low pollutant.

Keywords: IC engine, noise reactive silencers, back pressure, tuning chamber, pollutants, pollution, and configuration.

1. Introduction

To have the solution to the noise and air pollution problem, the performance analysis of a multi-chamber reactive silencer is done by taking the reactive silencer of Bajaj Pulsar 180CC bike and by modifying its exhaust muffler to three different configuration by modifying tuning chamber the different reading were recorded and compared with the standard silencer provided by the manufacturer and the optimum silencer design is proposed.

2. Documentation Review

A.K.M.Mohumuddin, Mohd Rashidin Ideres And Shukari Mohad Hashim, "Experimental Study Of Noise And Back Pressure For Silencer Design Characteristics", Journal Of Applied Science 5 (7) :1292-1298, 2005Issn1812- 5654.
Chandrasekhar Bhat, S.Sharma, Jagannath K, NSMohan, Sathisha S.G., "Design And Analysis Of An Expansion Chamber Mufflers".World Journal Of Engineering,Volume7, Supplement3, 2010, ISSN: 1708-5284.

3. Design and Development of Multi-Chamber Reactive Silencer

Any reactive silencer has three main parts muffler, tuning chamber and end pipe section. The all three mentioned have their own function towards noise pollution and air pollution. To reduce such pollution with back pressure control two configurations is made in tuning chamber by keeping muffler and end pipe section as it is.



Fig. 1. Standard assembly of muffler

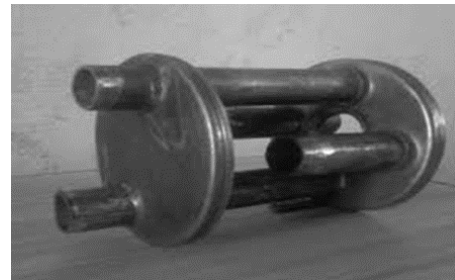


Fig. 2. Multi-chamber silencer

4. Problems Definition and Need

The need for analysis of the dynamic behavior of exhaust systems in the automotive industry has increased primarily due to increased sound pollution level as the vehicles are increasing day by day. Also the increasing vehicles contributing to the increase in air pollution which is the most critical problem world facing today. The researchers are continuously finding the solutions to limit these two parameters or to maintain it

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within the limits. For maintaining this pollution level within the limits there is continuous development of new thing or modification are carried in existing things so as to give a satisfactory results. Therefore in this work the modification of bike reactive silencer is made by modifying the tuning chamber and the results are measured and recorded so as to satisfy the requirements also considering increased demands on comfort, it is easily realized that designing exhaust systems has become much more difficult. To have the solution to the noise and air pollution problem, the performance analysis of a multi-chamber reactive silencer is done by taking the reactive silencer of Bajaj Pulsar 180CC bike and by modifying its exhaust muffler to three different configuration by modifying tuning chamber the different reading were recorded and compared with the standard silencer provided by the manufacturer and the optimum silencer design is proposed.

5. Methodology

For the solution of noise and air pollution level the three different configuration of silencer is made by modifying the tuning chamber to three different assemblies named as configuration one, two and three. In the first configuration of tuning chamber the number of holes present on both the baffle plates is increased while the distance between plates is made constant as standard assembly. This increased hole allows the exhaust gases to pass more quickly and easily which leads to exhaust at minimum back pressure. In second configuration the length between the baffle plates is increased, the increase in length leads to increase in the total length of exhaust because of which the path travel by the gases increases. Now as the gases have to move long way, velocity developed in the pipe decreases by the time. As per the rule, velocity and pressure are inversely proportional. The third configuration is made by providing extra chamber by inserting an extra baffle plate between two which causes the increase in flow area and the reaction produced is much more. As the flow length increases the more bends are introduced in the exhaust pipe. Each bend causes flow restriction and friction losses in the gas flow. All these three different assembly of tuning chamber then kept inside a silencer making other assembly remains same and the exhaust noise is measured with dB meter and recorded. Similarly by keeping one after another configuration the back pressure and pollutant emitted also recorded by U tube manometer and PUC testing respectively.

6. Construction and Working

A. Construction

1) Configuration

In the first configuration of tuning chamber modification is made in standard baffle plate by increasing number of holes in that plate in which first hole comprises of three holes which were replaced by five holes and another whole have on hole which is replace by two holes.

2) Configuration 2

In this second configuration tuning chamber modification is made in standard baffle plate by increasing distance between

plates. Initial distance was 90mm and it is replace by length 110mm. also pipe length has been increased. Holes size were kept standard.

7. Result

The all vehicle manufacturer has specified the maximum allowable values for noise level emitted, back pressure value and the pollutant emitted as per the Bharat norms. By making different configuration of silencer the values for all stated parameters is recorded at different engine RPM and compared with the standard silencer so as to have the values within the range and the design for optimum silencer geometry is proposed.

1) Back pressure Measurement

The values of back pressure obtained analytically using cfd is ranging from minimum to maximum and the values obtained experimentally are within this range and the values of back pressure measured analytically and experimentally are very close to each other. The measured back pressure values when plotted with engine frequencies shows the back pressure values with change in the silencer configuration at three different frequencies. It is cleared that the standard silencer has much more back pressure value compared with the other modified configuration and the second silencer configuration has the minimum back pressure value compared with these entire three silencers.

2) Advantages

- Less Pollution.
- Cost effective.
- Easy setup.
- Less maintenance price.
- Construction is simple.
- No want of trained operator.
- Smooth operating.
- Controlling of operation simple.

8. Conclusion

With the data recorded and measured for back pressure for different configuration of tuning chamber it is observed that these three modified configurations of tuning chamber has different reading for the back pressure. It means that by designing the silencer with different configuration the said parameters can be increased or decreased. Also the measured value when compared with the value measured for standard silencer the optimum design of silencer can be proposed. With the plotted graph it is observed that with changing configuration the back pressure value is reduced. Therefore by observing the plot it is concluded that the back pressure level of silencer configuration is comparatively lower with the other configuration hence can be considered as an optimum design.

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