Study and Investigation of Engine Muffler

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Abstract— The main drawback of the automobile engine exhaust system is producing excess noise and it is hazardous to human being causes headache, stress etc,. The maximum allowable noise level for automobile is 85 dB. The noise pollution is reduced by using well design muffler. The reactive mufflers are used for reducing noise by using the expansion chambers. The main factor, which is considered in noise reduction is minimizing back-pressure and it should not affect the engine performance. The computational fluid dynamics analysis is used for predicting the muffler performances. In this study, the geometry the perforated holes are varied and the fluid flow analysis is carried out. The three mufflers (muffler I muffler II and muffler III) are considered with different geometrical parameters and the number of the perforated holes are varied. From the result the maximum pressure drop is obtained while increasing the number of perforated holes. Due to the increase in pressure drop reduce the exhaust noise. The pressure and velocity of the mufflers are compared in this study. The ANSYS fluent 14.5 version software is used for the fluid flow for the exhaust muffler.

Key words: Back- Pressure, Noise, CFD

I. INTRODUCTION

Internal combustion engines are generating the acoustic pulse by the Combustion process. This noise is controlled through the use of silencers and mufflers. A silencer has been the traditional name for noise attenuation devices, while a muffler is smaller, mass-produced device designed to reduce engine exhaust noise. Continuous development has been made in improving performance of the silencers used for automotive exhaust systems. Exhaust mufflers are widely employed to muffle the noise of an engine body or the noise of other predominant sources in vehicles. In order to maintain a desired noise and comfortable ride, the modes of a muffler need to be analyzed. The factors considered in design are

- Number of chambers
- Diameter of Inlet and outlet pipe Holes on the pipe
- Size of muffler

Computational fluid dynamics, usually abbreviated as CFD, is a branch of fluid mechanics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the calculations required to simulate the interaction of liquids and gases with surfaces defined by boundary conditions. With high-speed supercomputers, better solutions can be achieved.

II. MODELING

The Eicher 10.40 engine muffler is considered for the flow analysis. The mufflers are modeling by using the PRO-E Creo software. The diemension of the muffler are

Major length	220mm
Minor length	170mm
Length	450mm
Inner diameter	46mm
Outer diameter	50mm
Perforated hole diameter	5mm
Thickness	1mm

Table 1:

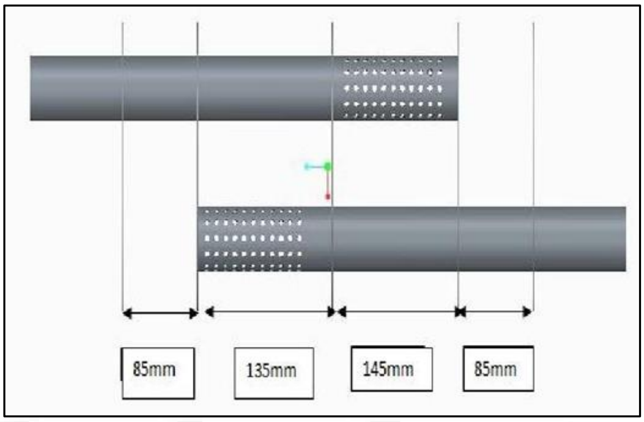

Fig. 1: Top view of Muffler I

A. *Muffler I*

The above image shows the top view of muffler I. It consists four chambers and the dimension of the expansion chambers are given above.

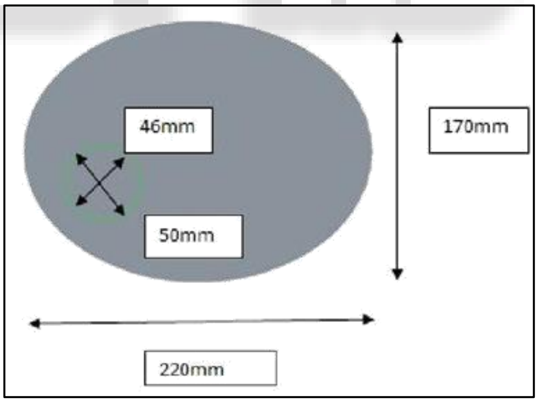

Fig. 2: front view of muffler

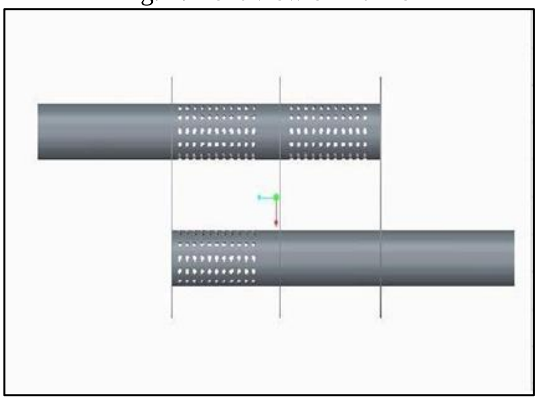
Fig. 3: Top view of Muffler II

B. Muffler III

In this muffler III the perforated holes of diameter 7.5mm is made near the inlet and outlet pipe for obtaining maximum pressure reduction.

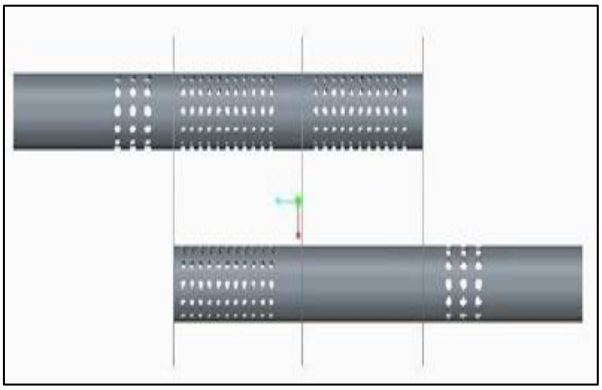

Fig. 4: Top view of Muffler III

III. RESULT AND DISCUSSION

The ANSYS workbench 14.5 version software is used for analyzing the muffler. The pressure and velocity of the mufflers are compared in this study. The input velocity of the fluid is 70m/s.

A. Pressure

The inlet condition of 70m/s input velocity is applied. The corresponding outlet pressure in the mufflers are 126, 306 and 72 pascal respectively

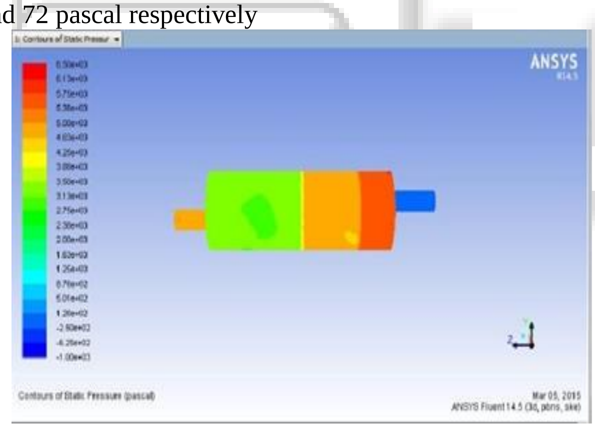

Fig. 5: Pressure distribution in Muffler I

The diagram 3.11, 3.12 and 3.13 shows the pressure distribution of the mufflers. From the analyzing result the pressure drop in the mufflers are obtained and the suitable muffler is selected for fabrication.

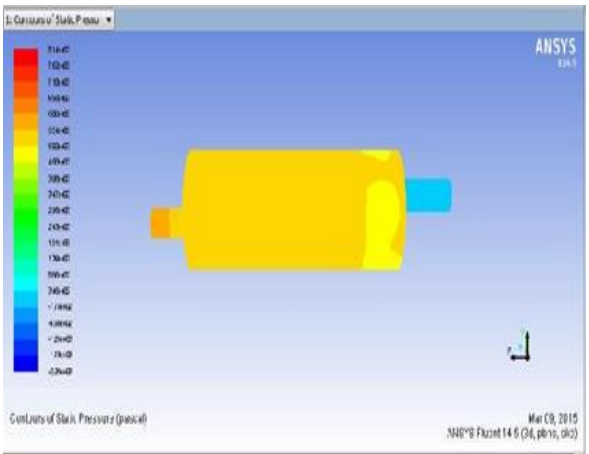

Fig. 6: Pressure distribution of Muffler II

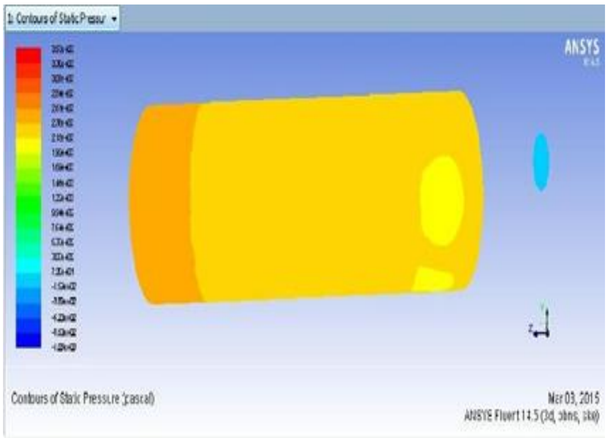

Fig. 7: Pressure distribution of Muffler III

B. Velocity

The inlet condition of 70m/s input velocity is applied. The corresponding outlet velocity in the mufflers is 53, 47 and 34 m/s respectively. Normally the velocity of the fluid at the engine outlet is high that should be convert into laminar flow to reduce the pressure and noise. The perforated holes play a major role for reducing the noise by decreasing velocity.

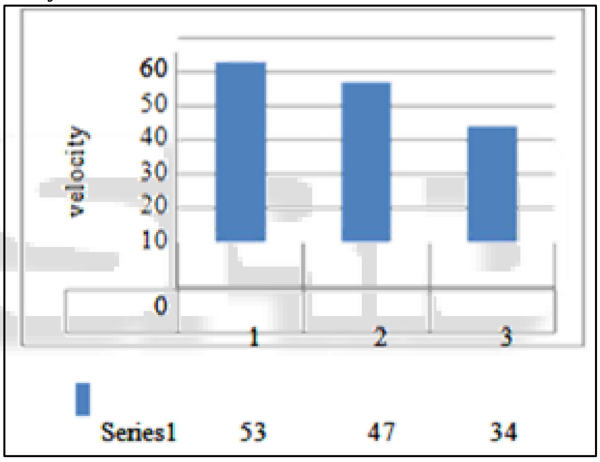

Fig. 8:

From the above analyzing result the maximum pressure drop is obtained in the muffler III. The velocity of the muffler is also decrease based on the other mufflers. Reduction in the outlet flow velocity leads to the tuning of the exhaust noise. The pressure and velocity of the muffler III are 72 pascal and 34 m/s respectively. Thus decrease in the pressure leads to reducing the exhaust noise

IV. CONCLUSION

The analyzing result shows that increasing the perforated holes for the fluid can minimizing the back pressure and increasing the pressure drop and also it creating resonator in the muffler chambers. This resonator reduce the noise from muffler The output pressure in the muffler III is 72 pascal this pressure provides laminar flow and it is less than the other mufflers.

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