ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Design and Analysis of Perforated Muffler in Automobile

Palavalasa Bala Krishna
M.Tech, Thermal Engineering Student,
Department of Mechanical Engineering,
NSR Institute of Technology,
Sontyam, Visakhapatnam.

Mr.P.V.S.Murali Krishna, ME
Associate Professor &HOD (Project Guide),
Department of Mechanical Engineering,
NSR Institute of Technology,
Sontyam, Visakhapatnam.

Abstract:
A muffler is a device for reducing the amount of noise emitted by an automobile. To reduce the noise, the engine drain is connected via output pipe to silencer called muffler. The muffler makes a major contribution to reduce the noise. Mufflers are connected to the exhaust pipe of internal combustion engine to suppress the acoustic flow of the engine in combustion process. Mufflers form an integral part of automobile. Mufflers are designed to increase the back pressure so as to reduce the noise level. In this study, attempt has been made to improve the design of muffler for reducing noise. The design of a muffler is to reduce the noise, for that an existed automobile muffler has modified and compared with the arrangement of plates inside the muffler where the noise emitted by the muffler gets changed and to improve the acoustic efficiency of the modified design. Modelling has performed by using CATIA V5.Analysis has to be performed in ANSYS Fluid Flow (Fluent)simulation, can be used to analyse the acoustic power level flow in the muffler, Pressure developed while air flows through the muffler, Velocity of air inside the muffler, Strain rate of the Muffler. By varying the muffler design parameters the flow will be analysed.

Keywords:
Muffler, Catia modelling, Acoustic Power level, Back Pressure,

I. Introduction:

The muffler is defined as a device for reducing the amount of noise emitted by vehicle or engine exhaust. To reduce the exhaust noise, the engine exhaust is connected via exhaust pipe to silencer called muffler. The muffler gives major contribution in the noise reduction of the exhaust of the vehicles Mufflers are connected with exhaust pipe of internal combustion engine to suppress the acoustic flow of the engine in combustion process. All internal combustion engines produce noise, depending on the vehicle some produces more noise some produce less than others. The intensity and magnitude of the noise will depend on the development of the vehicle that will vary with the many factors some of them are by means of scavenging, type of fuel used, number of cycles whether two cycles or four cycle engine etc. Exhaust noise is one of the principal noise sources of any engine installation. The purpose of the silencer is to reduce the noise of the exhaust before it is released to the atmosphere. The performance of the muffler is mainly dependent on the values of back pressure. Pressure drop in the engine exhaust system includes losses due to so many parameters some of them are due to piping, muffler addition, and termination. High backpressure in the engine causes decrease in engine efficiency it also effects on the other characteristics such as overheating of the engine it also affects in increase in fuel consumption. High backpressure may result in a complete shutdown of the engine which may cause significant damage to the vehicle.

II. LITERATURE:

Jianmin Xu et al. [1] analyzed the influence of the distance between the main and sub-muffler on the flow field of exhaust system. Yunshi Yao et al. [2] evaluated performance of reactive muffler and how it effects the power loss of engine. The flow field inside the muffler was discussed. They used computational fluid dynamics simulation and compared with experimental results and the design of reactive muffler was optimized. The velocity field coincided with the pressure fieldwhich showed the optimized muffler has improved aerodynamic characteristics. Puneetha C G et al. [3]studied and analysed four different models of exhaust. muffler and concluded that the best possible design for least back pressure drop. Back pressure was obtained based on the flow pattern analysis and was also compared with all muffler design. In their work they used numerical simulation to observe the back-pressure. The model and mesh was generated using finite element and hyper mesh as the preprocessor. The function of exhaust system was observed and disposed the exhaust gases emitted by the engine with a maximum reduction in exhaust noise and minimum effect on the efficiency, life and maintenance of the engine [4]. A.K.M. Mohiuddin et.al. Huang, L [5, 6], explained that the exhaust emissions from diesel engines are more harmful than petrol engines to environment, which adversely affects the human health especially on lungs, eyes and nerve system. Jay A. Bolt et.al. [7] performed a detailed study on various exhaust equipment, including catalytic converter, muffler and resonator in diesel engine which helps in reduction of engine emissions.

Results showed that the increase in exhaust back pressure decreases nitric oxide, due to the exhaust gas remaining in the cylinder and un burnt hydrocarbon emissions because of reduction in exhaust back pressure. Mohd Rashidin Ideres et.al.[5] explained the performance and emissions of a diesel engine can be controlled by backpressure. The long term application of the muffler causes significant effect on engine performance and emissions. The backpressure is build due to particulate matter and other exhaust products in flow passage of exhaust systems there by reducing the gas path. J.E. Bennethumet.al.[8] elaborated on effect of excessive backpressure in the exhaust system. It creates extra heat, low engine power output and more fuel consumption in the engine cylinder, results the damage of the engine parts and poor performance. They concluded that the backpressure is one of the parameter to improve the engine performance and reduces emissions. In this point of view the exhaust system is installed with muffler. C.G.Puneetha et.al. [9] described the important function of a muffler. It creates a path to the exhaust gases from the engine exhaust manifold while reducing the noise and backpressure. In automotive industry the reduction in noise is an emerging concern. Reduction in backpressure enhances the fuel economy of the engine. Murari Mohon Royet.al. [10] conducted experiments on effect of back pressure in compression engine, on performance and emissions. The pressure exerted on a moving fluid by obstructions against its direction of flow is called back pressure. They explained that the pressure is a scalar quantity, not a vector quantity, and has no direction. The gas flows in only one direction which is driven by pressure gradient.

III. Designs and Analysis:

Design and modelling of Existing muffler. The design of existing muffler is done by using 2D model drawings, the dimensions of this model are to be taken directly from the muffler which has used in current bikes and some of the critical dimensions are to be taken from the various literature survey.

Preparation of 3D model of existing muffler:

In the preparation of 3D model first we have to prepare the parts of the muffler such as cylinder, cap, pocket, plates. The outer cylinder is prepared by using catia v5design by giving thickness as 1.5mm and then by drawing we can pregpare the cylinderThe plates are also prepared in the sheet metal workbench by giving thickness and suitable drawings. There are three similar plates were prepared and same are used for the assembly process.The pockets are prepared by using part design with different length as mentioned in the above drawing. The cap is also prepared by part design and also used for the assembly. We can prepare the cylinder .The plates are also prepared in the sheet metal workbench by giving thickness and suitable drawings. There are three similar plates were prepared and are used for the assembly process.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

The one pocket is prepared by using the Boolean operations and another one is prepared by using part design The cap is also prepared by part design and also used for the assembly gas by compressing it to a sufficiently high pressure.

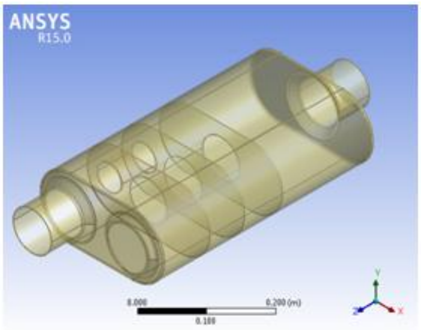
IV. MATERIALS & METHODOLOGY:

To estimate the performance parameter that is pressure variation in muffler the following methods should be done:

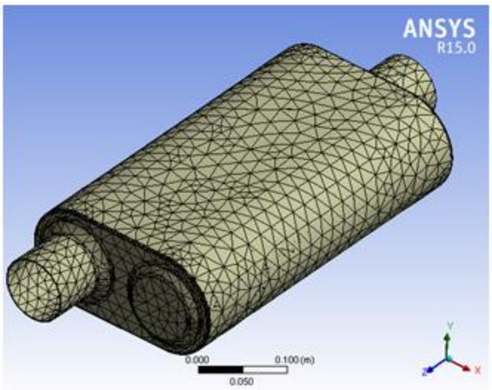
- Flow pattern CAD model of muffler is created in catia v5
- Analysis is carried out in Flow simulation with boundary conditions.
- Results are noted and compared to further change in designs of muffler.

These methods are carried out for study of backpressure in chambered exhaust muffler and results are discussed.

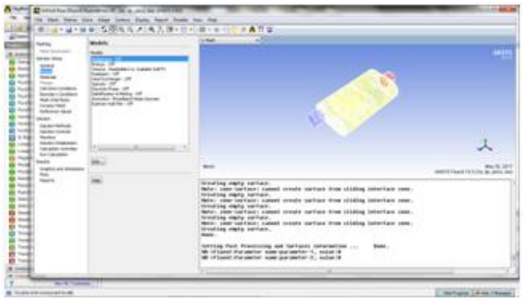
MODEL1:



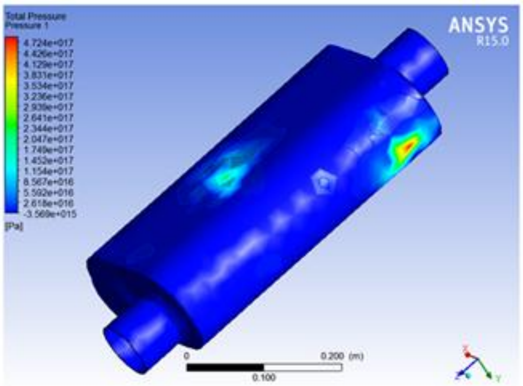
Initial Stage of the Muffler when no loads acting on it



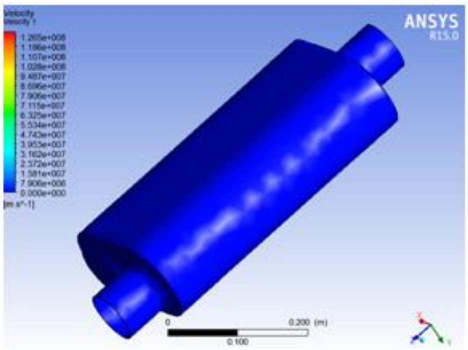
Meshing the Muffler for applying loads



Applying load conditions in ANSYS Fluid Flow (Fluent) for the Muffler

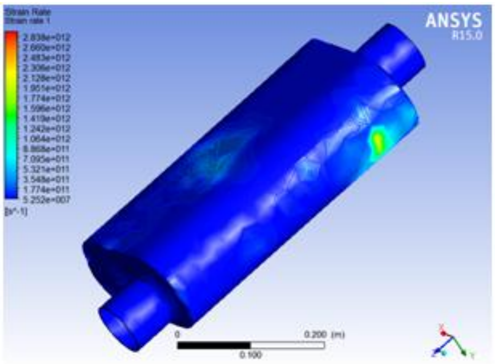


Pressure acting on the Muffler

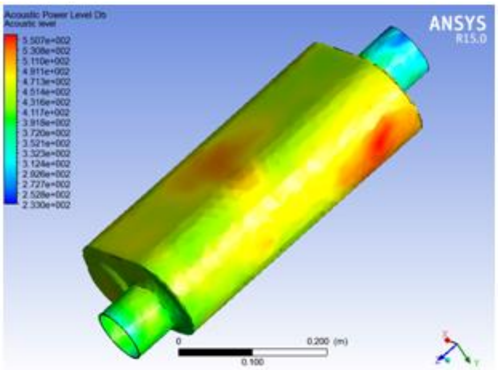


Velocity of air flow through the Muffler

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

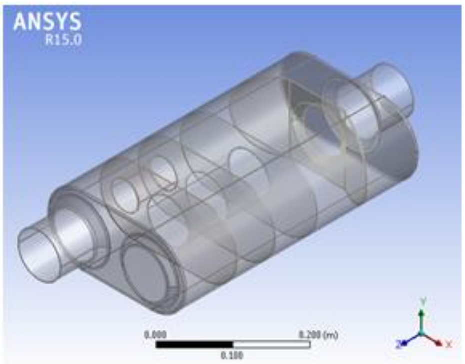


Strain rate of the Muffler when air passes through it

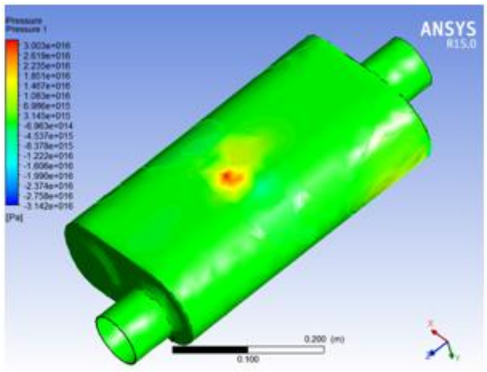


Acoustic Power level (Sound travelling from inlet to exhaust)

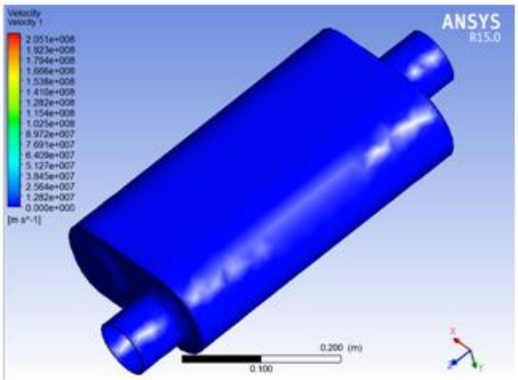
Model 2:



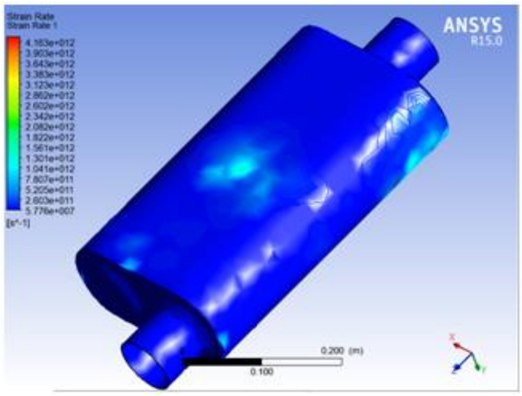
Initial Stage of the Muffler when no loads acting on it



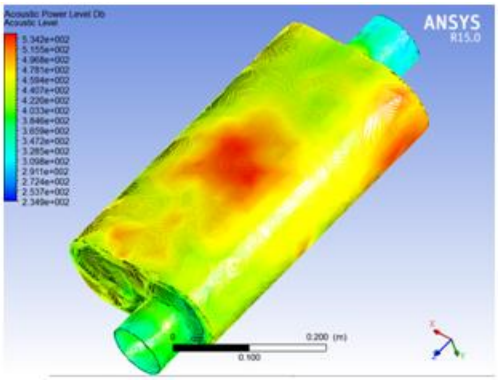
Pressure acting on the Muffler



Velocity of air flow through the Muffler

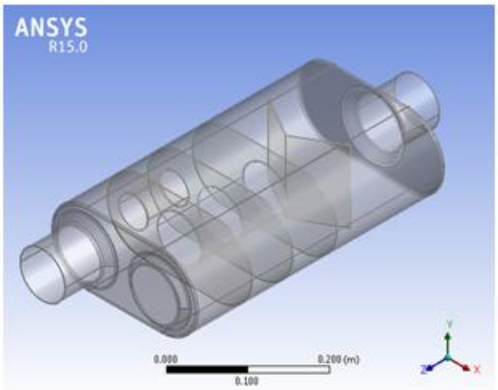


Strain rate of the Muffler when air passes through it

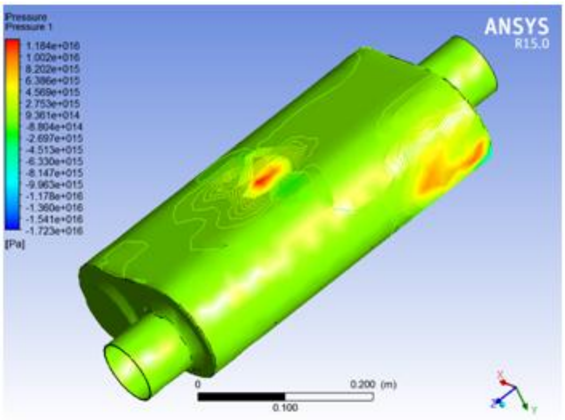


Acoustic Power level (Sound travelling from inlet to exhaust)

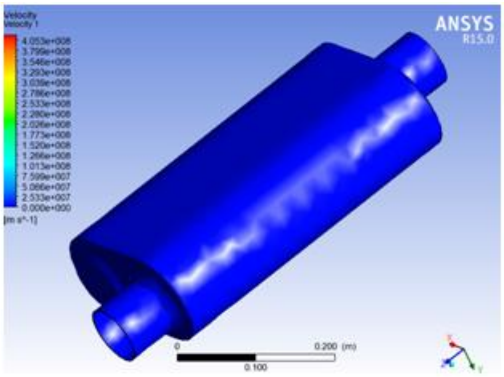
Model 3:



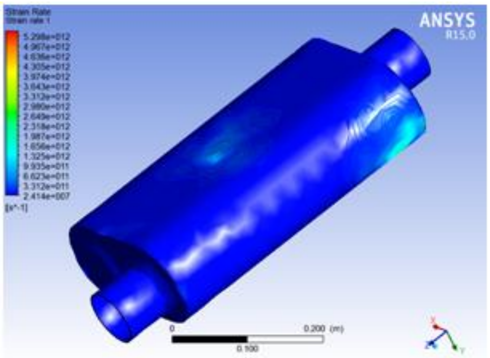
Initial Stage of the Muffler when no loads acting on it



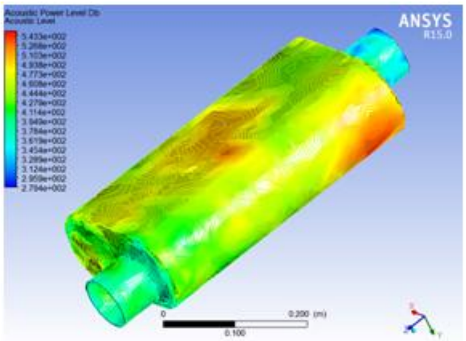
Pressure acting on the Muffler



Velocity of air flow through the Muffler



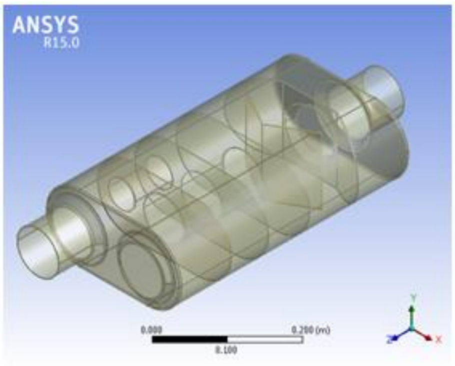
Strain rate of the Muffler when air passes through it



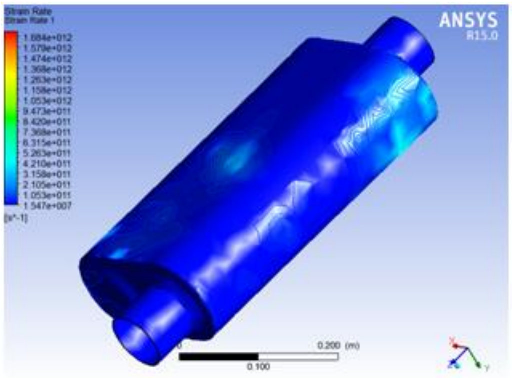
Acoustic Power level (Sound travelling from inlet to exhaust)

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

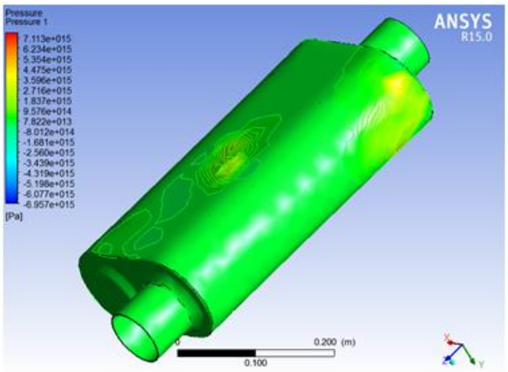
Model 4:



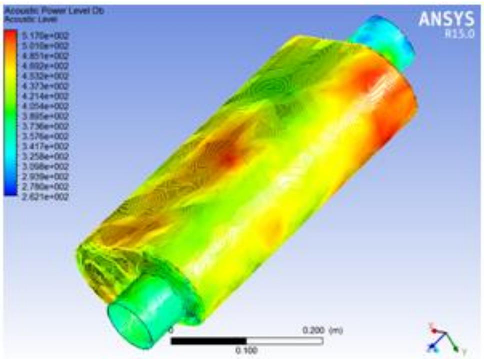
Initial Stage of the Muffler when no loads acting on it



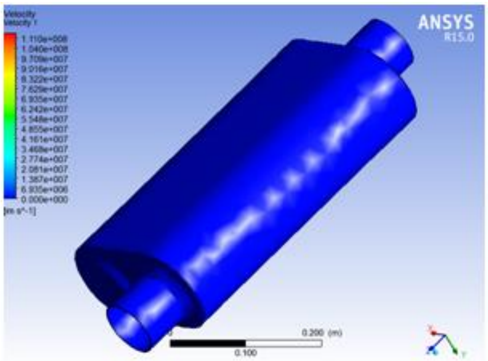
Strain rate of the Muffler when air passes through it



Pressure acting on the Muffler



Acoustic Power level (Sound travelling from inlet to exhaust)



Velocity of air flow through the Muffler

V. Results & Conclusion:

After analysing the muffler in Ansys 15.0 It has been noticed that 4 model has less sound output i.e. better sound reduction compared with other three models.

Model No.	Pressure (pa)		Velocity (m/s)		Acoustic level (Db)		Strain rate(per sec)
	Inlet	Out let	Inlet	Out let	Inlet	Out let	
1	2.6 E+16	8.5E+16	7.9 E+6	1.5 E+7	3.9 E+2	3.9 E+	5.3 E+11
2	3.1 E+ 15	1.08 E+16	3.8 E+7	1.02 E+8	3.4 E+2	2.9 E+	5.2 E+11
3	9.3 E+ 14	2.7 E+15	7.5 E+7	1.01 E+8	3.9 E+2	2.8 E+	6.6 E+11
4	9.5 E+ 14	1.8 E+15	2.08 E+7	3.46 E+7	3.4 E+2	2.6 E+	7.3 E+11

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

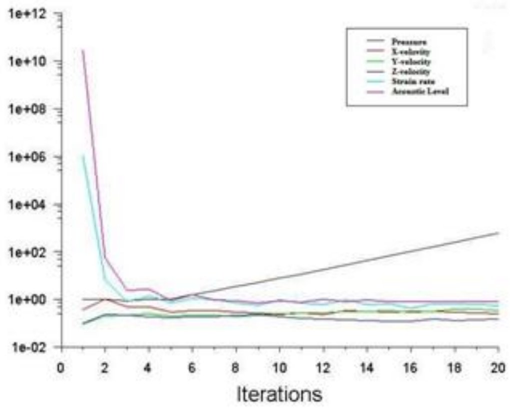


Fig. Model - 1 Graph

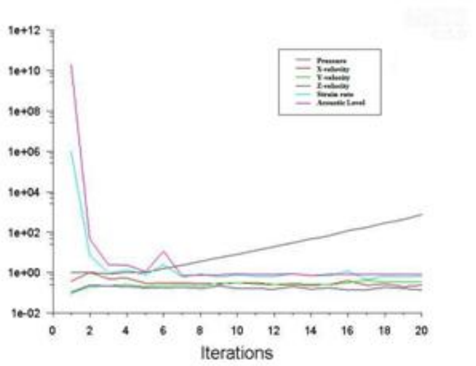


Fig. Model - 2 Graph

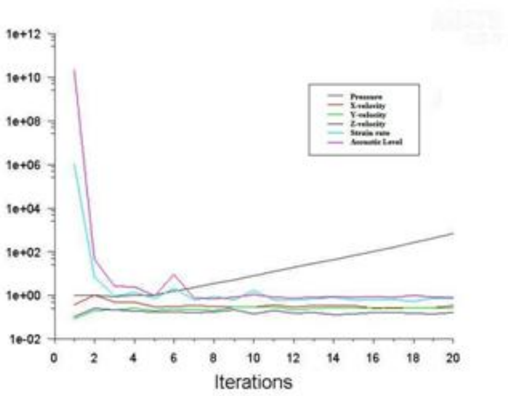


Fig. Model - 3 Graph

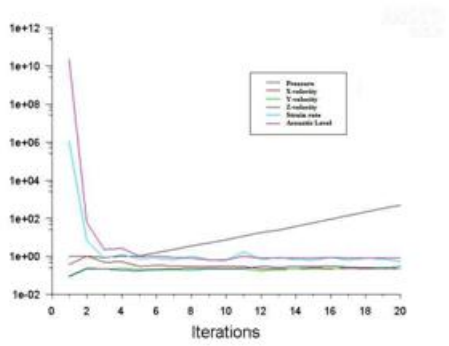


Fig. Model - 4 Graph

REFERENCES:

[1]. JianminXu and Shuiting Zhou, Analysis of Flow Field for Automotive Exhaust System Based on Computational Fluid Dynamics The Open Mechanical Engineering Journal, 2014, 8, 587-59.

[2]. Yunshi Yao, Shaodong Wei, Jinpeng Zhao, ShibinChen, ZhongxuFeng and JinxiYue, Experiment and CFD Analysis of Reactive Muffler, Research Journal of Applied Sciences, Engineering and Technology 6(17): 3282-3288, 2013.

[3]. Puneetha C G, Manjunath H and Shashidhar M.R, Backpressure Study in Exhaust Muffler of Single Cylinder Diesel Engine using CFD Analysis, Altair technology conference, 2015, India.

[4].http://www.enginehistory.org/Wright/InstallMan/Sec1Ch06.pdf.

[5] A.K.M. Mohiuddin, Mohd Rashidin Ideres and ShukriMohdHashim 2005.Experimental Study of Noise and Backpressure for Silencer Design Characteristics. Journal of Applied Sciences 5(7): 1292- 1298.

[6]Huang, L., 2004. Parametric study of a drum-like silencer. Journal of sound and vibration, 269;467- 488.

[7]Jay A. Bolt, Stephen P. Bergin, Frederick J. Vesper 1973. The Influence of the Exhaust Back Pressure of a Piston Engine on Air Consumption, Performance, and

Emissions. SAE International, Document Number: 730195.

[8]J.E. Bennethum, and R.E. Winsor, 1991. “Toward improved diesel fuel”, SAE paper No. 912325.

[9]C.G.Puneetha, H.Manjunath and M.R.Shashidhar 2013. Backpressure Study in Exhaust Muffler of Single Cylinder Diesel Engine using CFD Analysis.

[10] MurariMohon Roy, Mohammad Uzzal Hossain Joardder and Md. Shazib Uddin Effect of Engine Backpressure on the Performance and Emissions of a CI Engine.

[11]Mayer, A., 2004. “Number-based Emission Limits, VERT-DPF-Verification Procedure and Experience with 8,000 Retrofits”, VERT, Switzerland.

[12]Peter Hield, The Effect of Back Pressure on the Operation of a Diesel Engine.

[13]Pradyumna Saripalli, K. Sankarnarayana, CFD Analysis on Flow Through a Resistance Muffler of LCV Diesel Engine.