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Investigation On The Effects Of Exhaust Back Pressure Of A Marine Engine Silencer And Exhaust Flow Design Using Cfd

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ABSTRACT

This study aims to find the relationship between the exhaust backpressure levels occurred in exhaust flow design as well as silencer position and yet propose the best design to ensure the optimization of engine performance. The actual dimensions of the exhaust system are used to perform the computational fluid dynamic (CFD) simulation and analysis. The performance of an exhaust system is based on velocity and exhaust backpressure. Investigation in CFD was performed on four parameters comprises manifold temperature, manifold pressure, exhaust piping system temperature and atmosphere pressure. Results of CFD simulation was showed in the form of pressure and velocity contours and streamline. This study found the modification of exhaust piping design of the 4-stroke marine diesel generator increased the backpressure.

INTRODUCTION

A Diesel marine generators produce up to 180 kW at 60 Hz and 150 kW at 50 Hz, while remaining compliant with the latest emission requirements. Each is fitted with a sound housing for remarkably quiet operation.

A **diesel generator** (also known as diesel genet) is the combination of a diesel engine with an electric generator (often an alternator) to generate electrical energy. This is a specific case of engine-generator. A diesel compression-ignition engine is usually designed to run on diesel fuel, but some types are adapted for other liquid fuels or natural gas.

Diesel generating sets are used in places without connection to a power grid, or as emergency power-supply if the grid fails, as well as for more complex applications such as peak-lopping, grid support and export to the power grid.

COMMERCIAL GENERATORS

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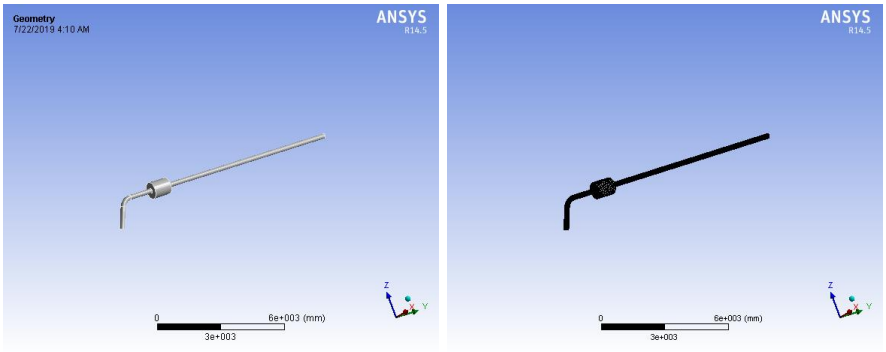
A commercial generator is similar to residential generators that are used to power homes in the event of a power outage or blackout. These generators are larger in size and have a higher power output that allows the generator to power larger business facilities, including key systems and equipment to help maintain regular operations even in the event of a power outage.
Commercial generators are generally built sturdier with components that differ from consumer generators. Some of the qualities include stronger metals, larger engines, cooling components to dissipate greater heat, and electronics system that produce higher power wattage outputs.
The most commonly used commercial generators are natural gas and diesel generators.
That is the basic explanation of a commercial generator, but why don't we break them down at a component level?
There are three main parts to a commercial generator, which are the engine, radiator, and generator end (also sometimes called alternator).

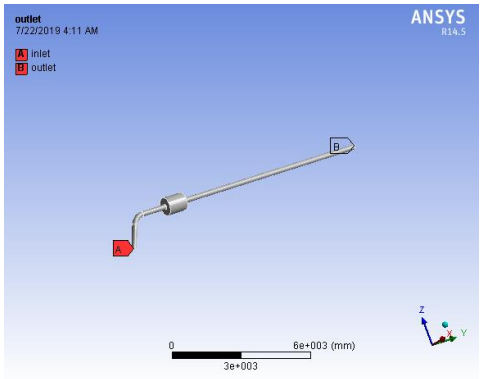
Advantages and Disadvantages of Diesel Gensets:
Electricity is an integral part of our lives. The advancements in modern science and technology would be unachievable without the contribution of power. Be it the manufacturing industries or the computer systems, electricity is the sole basis on which these function. But what happens when there is a power outage? The productivity decreases and it hampers the functioning of the devices.
So how do we overcome this problem? This is possible by the use of alternative sources of power like the generators. The generators use fuel like gasoline, gas or diesel to produce electricity. The diesel generators fulfill the need of power supply during a black out. They are the popular lot when compared to other fuel sources. So what is it that gives the diesel gensets an edge over others? And also what are the disadvantages that one needs to consider when selecting the diesel genset?

ORIGINAL MODEL

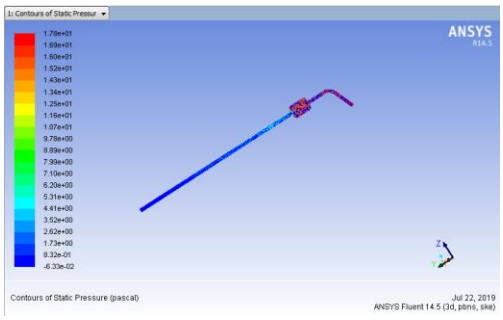
GEOMETRY



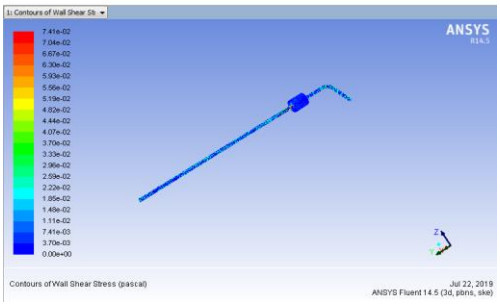
BOUNDRY CONDITIONS



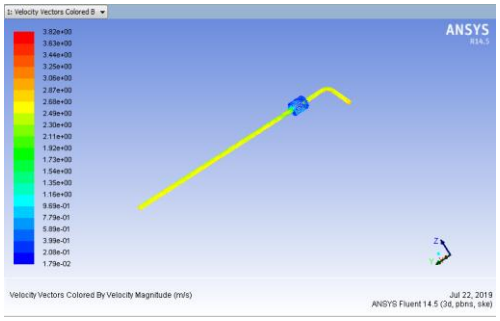
PRESSURE



SHEAR STRESS



VELOCITY



TEMPERATURE

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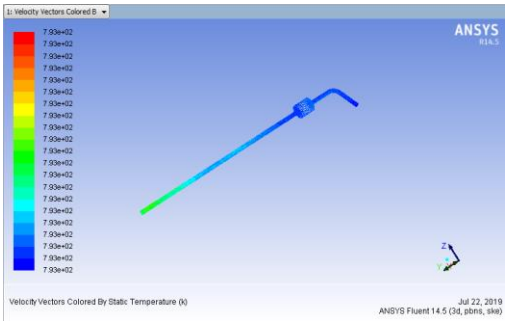

MASS FLOW RATE

Mass Flow Rate	(kg/s)
inlet	0.088890016
outlet	-0.088862278
Net	2.7738512e-05

TOTAL HEAT TRANSFER RATE

Total Heat Transfer Rate	(w)
inlet	44283.488
outlet	-44270.16
Net	13.328125

TABLE
CFD
ORIGINAL MODEL

PRESSURE	SHEAR STRESS	VELOCITY	TEMPERATURE	MASS FLOW RATE	TOTAL HEAT TRANSFER RATE
1.78E+01	7.41E-02	3.82E+00	7.93E+02	2.7738512E-05	13.328125

MODIFIED MODEL
PRESSURE

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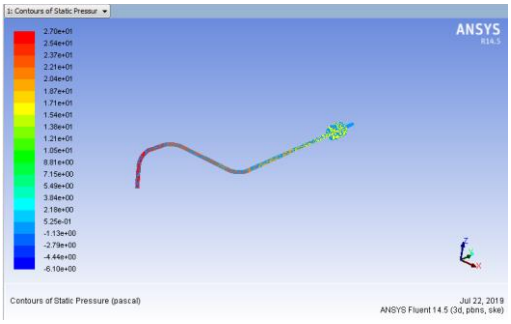
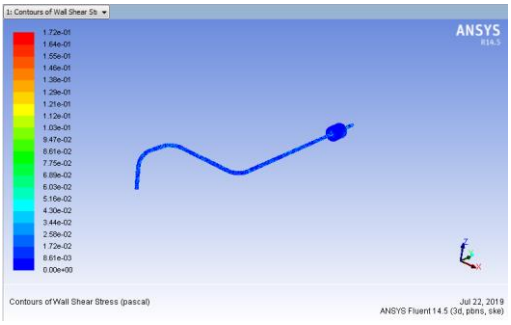
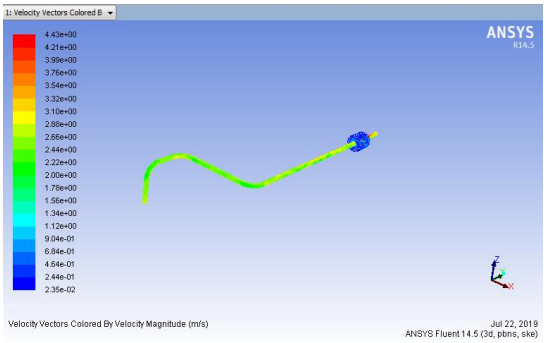


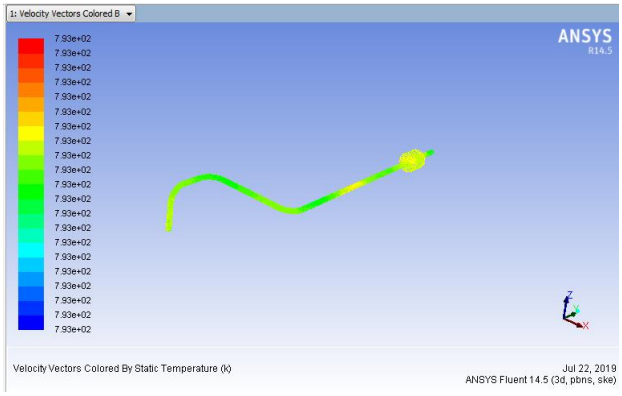
SHEAR STRESS



VELOCITY



TEMPERATURE



MASS FLOW RATE

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Mass Flow Rate	(kg/s)
inlet	0.088890016
outlet	-0.088914551
Net	-2.4534762e-05

TOTAL HEAT TRANSFER RATE

Total Heat Transfer Rate	(w)
inlet	44283.48
outlet	-44295.848
Net	-12.367188

TABLE
CFD
MODIFIED MODEL

PRESSURE	SHEAR STRESS	VELOCITY	TEMPERATURE	MASS FLOW RATE	TOTAL HEAT TRANSFER RATE
2.70E+01	1.72E-01	4.43E+00	7.93E+02	2.4534762E-05	12.367188

The Basic concept in FEA is that the body or structure may be divided into smaller elements of finite dimensions called “Finite Elements”. The original body or the structure is then considered as an assemblage of these elements connected at a finite number of joints called “Nodes” or “Nodal Points”. Simple functions are chosen to approximate the displacements over each finite element. Such assumed functions are called “shape functions”. This will represent the displacement within the element in terms of the displacement at the nodes of the element.

The Finite Element Method is a mathematical tool for solving ordinary and partial differential equations. Because it is a numerical tool, it has the ability to solve the complex problems that can be represented in differential equations form. The applications of FEM are limitless as regards the solution of practical design problems.

Here after completing the CFD analysis we are going to do the thermal analysis, as here there are two types of thermal analysis models i.e. steady state thermal analysis and transient thermal analysis

As the word it explains that the steady state thermal analysis gives the result when the object is at a steady state and when the working is completed.

But here in our project we are going to use transient thermal analysis as here the results obtained from this analysis gives the result with the time variations and we can find out the how the object

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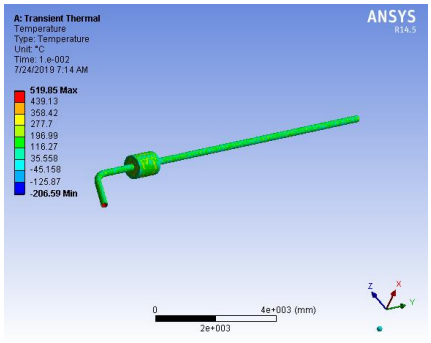
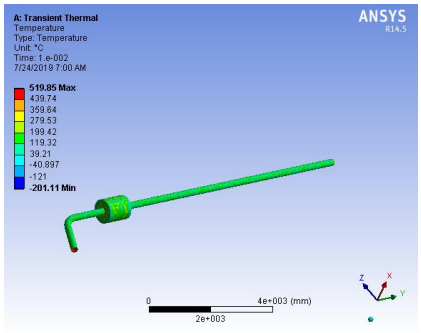
is at the initial position and while at the working. So here for this project we are going to choose transient thermal analysis model.

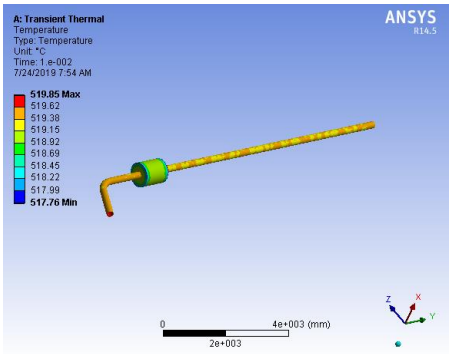
THERMAL ANALYSIS OF AN ORIGINAL MARINE DIESEL GENERATOR SILENCER
AT TIME 1E-2 SEC
TEMPERATURE RESULT
STAINLESS STEEL



HOT ROLLED STEEL



ALUMINUM 2024



HEAT FLUX RESULTS
STAINLESS STEEL

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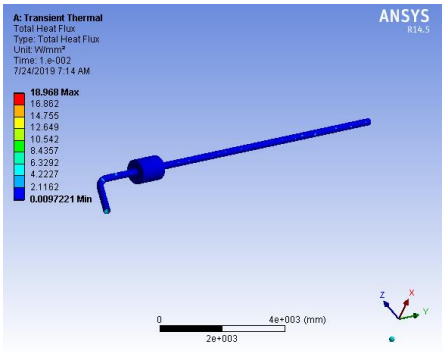
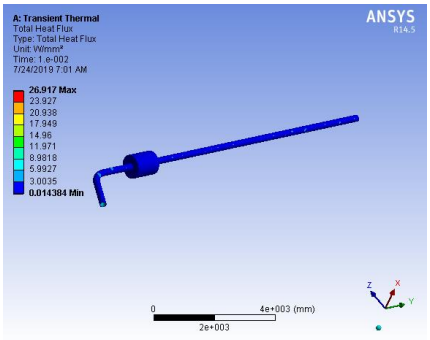


HOT ROLLED STEEL



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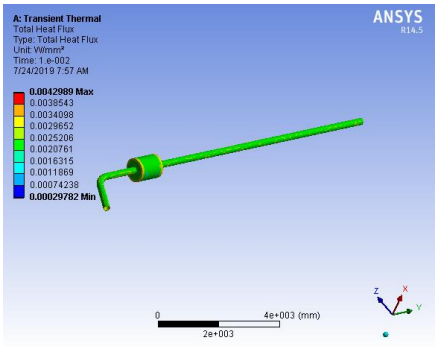

THERMAL ANALYSIS GRAPHS
TEMPERATURE
AT TIME 1E-2 SEC

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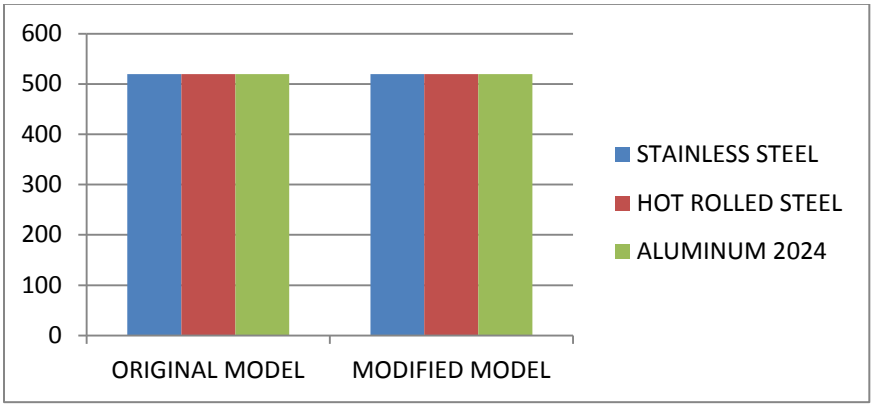
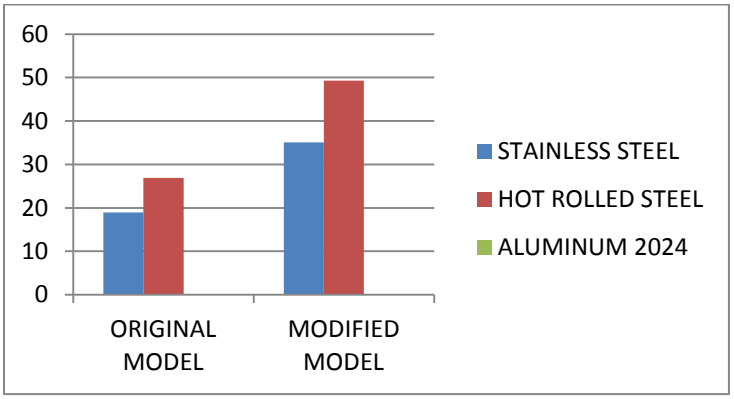
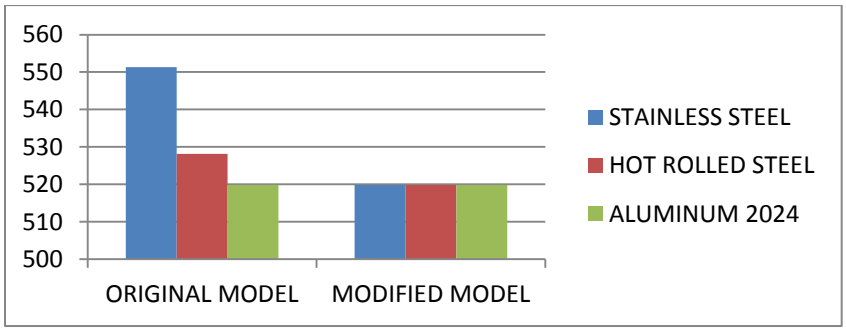


HEAT FLUX
AT TIME 1E-2 SEC



TEMPERATURE
AT TIME 2 SEC



HEAT FLUX
AT TIME 2 SEC

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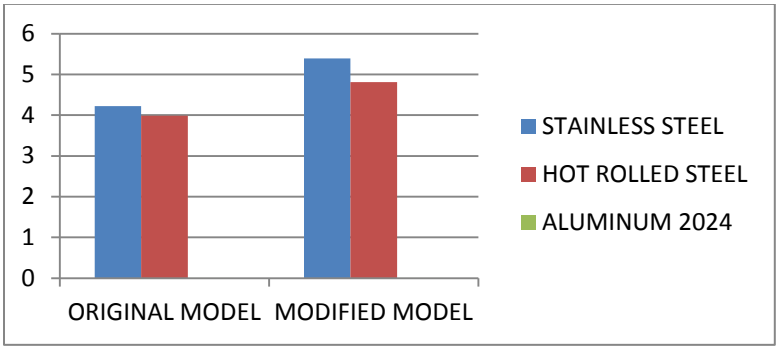
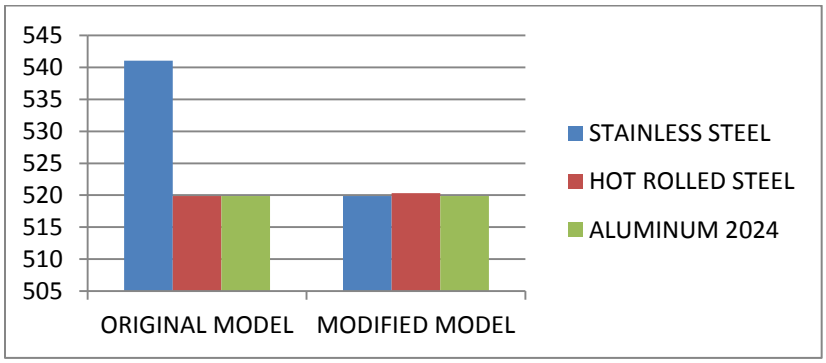
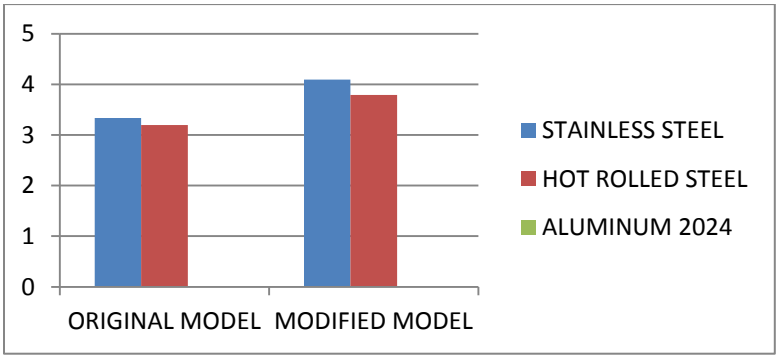


TEMPERATURE AT TIME 3 SEC



HEAT FLUX AT TIME 3 SEC



CONCLUSION

Investigation in CFD was performed on four parameters comprises manifold temperature, manifold pressure, exhaust piping system temperature and atmosphere pressure. Results of CFD simulation was showed in the form of pressure and velocity contours and streamline. This study found the modification of exhaust piping design of the 4-stroke marine diesel generator increased the backpressure. By verifying the results obtained here we could observe that the modified model with stainless steel has obtained the better results output when compared with the original

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model and the other materials selected for the analysis. As if we verify the CFD results here also the mass flow rate and the heat transfer rate has satisfied for the modified model when compared with the original model

REFERENCES

1. http://www.cliffordpower.com/stuff/contentmgr/files/0/bf657520fa44f1f763f8a6d84ca8fa43/misc/is_58_sound_attenuation_material.pdf

2. Balakrishna, B., & Mamidala, S. (2014). Design Optimization of Catalytic Converter to reduce Particulate Matter and Achieve Limited Backpressure in Diesel Engine by CFD. International Journal of Current Engineering and Technology, 2, 651-658.

3. Burnete, N., Moldovanu, D., Baldean, D. L., & Kocsis, L. (2016). Studies Regarding the Influence of Exhaust Backpressure on the Performances of a Compression Ignited Engine, in Proc. of the European Automotive Congress EAEC-ESFA 2015, November 2015, 141-149.

4. Chaudhari, U. B., Pate, S. M., Jani, D. S., & Bambhania, M. P. (2015), Catalytic converter analysis. Int. Journal of Fluid and Thermal Engineering (IJFTE), 1(01), 1-5.

5. Dixit, M., Sundaram, V., & Kumar, S. S. (2016). A Novel Approach for Flow Simulation and Backpressure Prediction of Cold End Exhaust System. SAE Technical Paper: 2016-28-0235.

6. Gopan, M. B, & Annamalai, K. (2015). Optimising the Backpressure of 4 Stroke Engine by using Baffle Plates in Tail Pipe. Indian Journal of Sci. & Technol, 8(31), 1-6.

7. Hield, P. (2011). The Effect of Backpressure on the Operation of Diesel Engines. Maritime Platform Division, Defense Science and Technology Organization, Australian Government (Unclassified): DSTO-TR-2531.

8. Joardder, M. U. H., Uddin, M. S., & Roy, M. M. (2011). Effect of Engine Backpressure on the Performance and Emissions of a CI Engine. In Proceedings of the International Conference On Mechanical Engineering 2011 (ICME 2011), Dhaka, Bangladesh, Dec 2011, 1-5.

9. Karuppusamy, P., & Senthil, R. (2013). Design Analysis of Flow Characteristics of Catalytic Converter and Effects of Backpressure on Engine Performance. International Journal of Research in Engineering & Advanced Technology (IJREAT), 1(1), 1-6.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
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10. Kesgin, U. (2005). Study on the Design of Inlet and Exhaust System of a Stationary Internal Combustion Engine. Energy Conversion and Management 46(13), 2258-2287.

11. Khalid, A., Nursal, R. S., Tajuddin, A. S. A. & Hadi, S. A. (2016). Performance and Emissions Characteristics of Alternative Biodiesel Fuel on Small Diesel Engine. Journal of Engineering and Applied Sciences, 11(12), 7424 – 7430.

12. Kocsis, L. B., Moldovanu, D., & Baldean, D. L. (2016). The Influence of Exhaust Backpressure Upon the Turbocharger's Boost Pressure, in Proceedings of the European Automotive Congress EAEC-ESFA 2015, November 2015, 367-374.

13. Kore, S., Aman, A., & Direbsa, E. (2011). Performance Evaluation of a Reactive Muffler Using CFD. Zede Journal, 28(1), 83-89.

14. Lee, J. W., & Jang, G. W. (2012). Topology design of reactive mufflers for enhancing their acoustic attenuation performance and flow characteristics simultaneously. International Journal for Numerical Methods in Engineering, 91(5), 552-570.