Design and Analysis of Automotive Silencer for Effective Corrosion Control

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Abstract - *Automobile silencers have the problem of corrosion since its existence. So new corrosion resistant materials are emerging day by day. Here, we use different corrosion resistant materials (Composites) for silencers and then they are analyzed and compared for different stresses and strains produced in the silencer both pressure and thermal loads. Then the materials are rated for their best usage. The existing material is Mild steel which is compared with our selected materials which are as follows Stainless steel, Carbon fiber and Glass fiber. We have selected these materials because of their high strength and their high resistant to corrosion. These materials are analyzed in Ansys where there Stress, Strain and Deformation were analyzed and the best material is selected accordingly and rated for their best usage.*

Key Words: **Corrosion resistant material, fiber, Ansys**

1. INTRODUCTION

Silencer is a device which is used to carry the exhaust gases from the combustion chamber to the atmosphere. Since it carries the exhaust gases it should be resistant to heat and should withstand pressure and resist corrosion. Mostly, Silencer failure happens due to the effect of corrosion. It is due to the atmospheric conditions of our world and the acidic condensate deposit on silencer. These condensates erode the silencer material and causes corrosion. So, corrosion resistant material should be used to avoid such circumstances. For that we're selecting the best corrosive materials like Carbon fiber, glass fiber, stainless steel and the presently used material Mild steel and compare them with thermal and pressure load conditions and select best material which resists corrosion.

2. METHADOLOGY

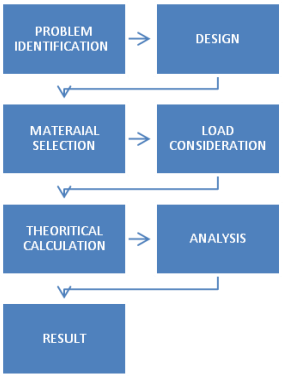

Fig 1 Flow diagram representing Methodology

2.1 .PROBLEM IDENTIFICATION

The main problem behind the silencer failure is because of the silencer corrosion. Corrosion in the silencer is caused due to the Environmental or atmospheric conditions and the deposit of acidic condensate in silencer.

Fig 2.1 Corroded silencer

2.2 .DESIGN

We have designed the silencer in Creo Parametric 2.0 and have Analysed in Ansys software. We took the dimens1ions of Splender Pro bike silencer since it is mostly used one. The cross sectional and modelled views of the silencer are shown below.

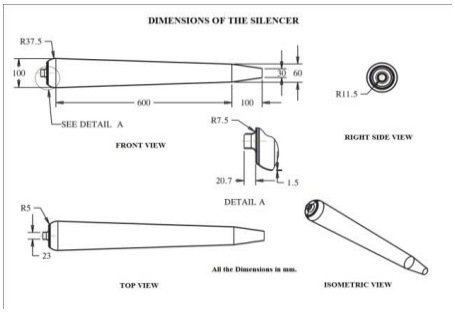

Fig 2.2 Layout of silencer

The 3d Modelled and cross sectional views are as follows,

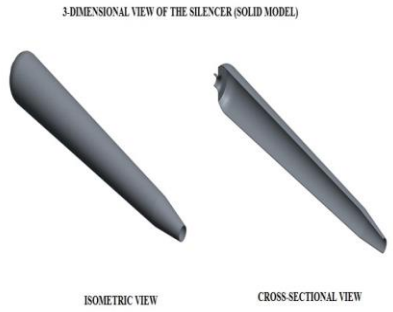

Fig 2.4 3D Modelled view of silencer

2.3. MATERIAL SELECTION

The present material used in automobile silencer is Mild steel in which we're going to analyze the load and thermal stresses.The materials that we're going to analyze and compare with mild steel are Carbonfiber,Glass fiber, Stainless steel.We have selected carbon fiber because it have high corrosion resistance and it is 70% lighter than steel and it has low mass. We have selected glass fiber because it is resistant to corrosion and have high strength. We have selected stainless steel because it is the material which shows high resistant to corrosion.

2.4. LOAD CONSIDERATION

In silencer we have considered the fixed load on the top side of the silencer. This is because in Splender pro vehicle a clamp fixes the top side of the silencer as fixed to make the position of the silencer. so, Fixed load is considered here on the top side of the silencer.

2.5. THEORITICAL CALCULATION

For the Splendor pro engine specifications, The theoretically Calculated temperature, Pressure and mass flow rate are as follows

Inlet Temperature of silencer,

T_1=803.90k

Inlet pressure of silencer,

P_1 =2.687 bar

Mass flow Rate,

M_i= 0.036 kg/s

Inlet Velocity of Silencer,

V_i=45 m/s

3. ANALYSIS

We have analysed the materials that we have selected for manufacturing Silencer in Ansys Software and we have found the Various Stresses and Strains Acting on them and the deformation occurring on them.

MILD STEEL

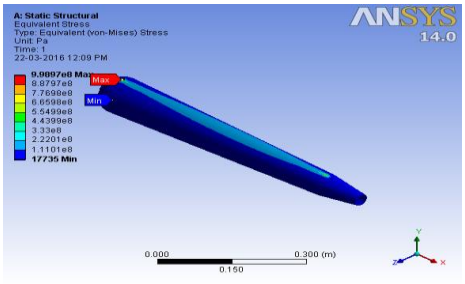

Fig 3.1 Stress in Mild steel

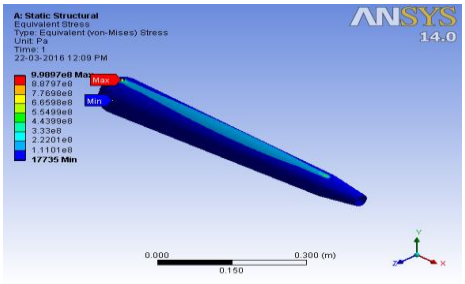

Fig 3.2 Strain in Mild steel

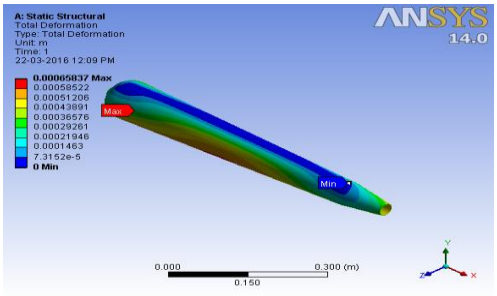

Fig 3.3 Deformation in Mild Steel

CARBON FIBER

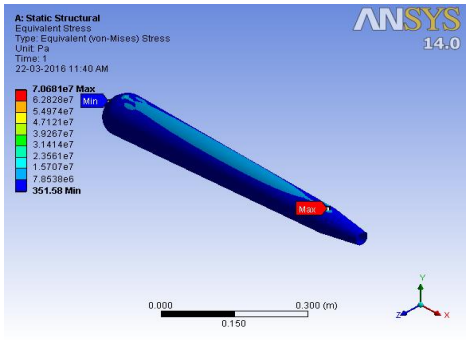

Fig 3.4 Stress in carbon fiber

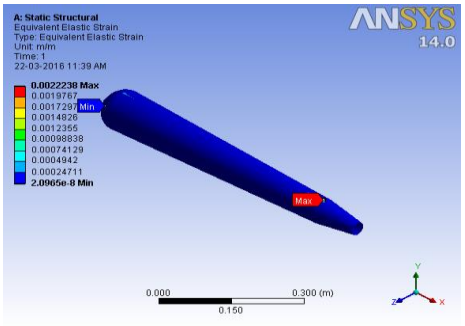

Fig 3.5 Strain in Carbon fiber

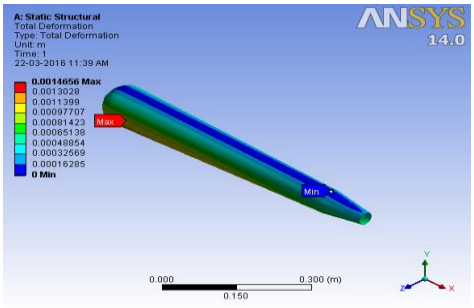

Fig 3.6 Deformation in Carbon fiber

STAINLESS STEEL

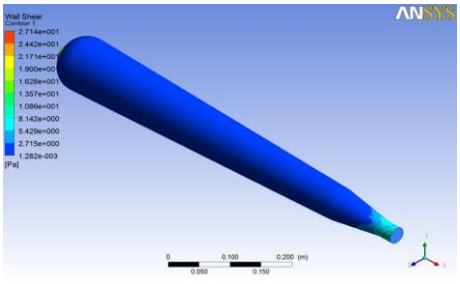

Fig 3.7 Stress in Stainless Steel

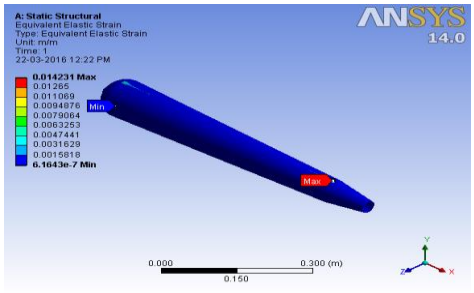

Fig 3.8 Strain in Stainless steel

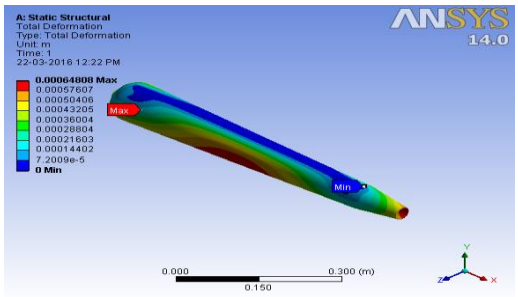

Fig 3.9 Deformation of stainless steel

GLASS FIBER

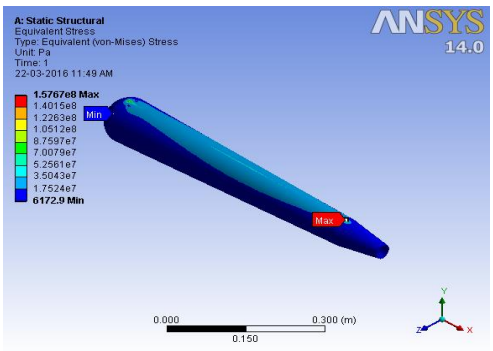

Fig 3.10 Stress in Glass fiber

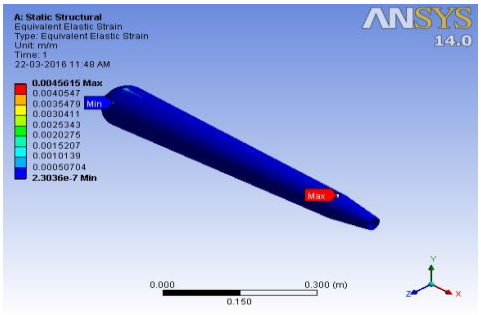

Fig 3.11: Strain in Glass fiber

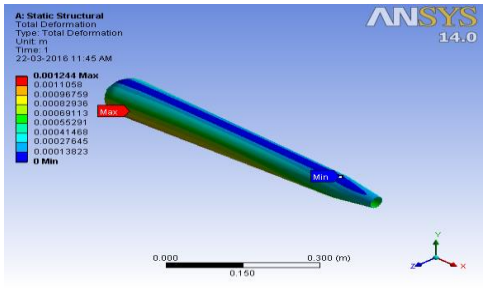

Fig 3.12 Deformation in Glass fiber

4. RESULTS

From the Analysed figures the Stress Strain and Deformation value for those materials are as follows,

TABLE-1 STAINLESS STEEL VALUES FROM ANSYS

Object Name	Total Deformation	Equivalent Elastic Strain	Equivalent Stress
Results			
Minimum	0. m	6.1643e-007 m/m	15747 Pa
Maximum	6.4808e-004 m	1.4231e-002 m/m	1.3544e+009 Pa

STAINLESS STEEL

TABLE- 2 MILD STEEL VALUES FROM ANSYS

Object Name	Total Deformation	Equivalent Elastic Strain	Equivalent Stress
Results			
Minimum	0. m	5.395e-007 m/m	17735 Pa
Maximum	6.5837e-004 m	9.8467e-003 m/m	9.9897e+008 Pa

MILD STEEL

TABLE- 3 GLASS FIBER VALUES FROM ANSYS

Object Name	Total Deformation	Equivalent Elastic Strain	Equivalent Stress
Results			
Minimum	0. m	2.0965e-008 m/m	351.58 Pa
Maximum	1.4656e-003 m	2.2238e-003 m/m	7.0681e+007 Pa

GLASS FIBRE E-GRADE

TABLE- 4 CARBON FIBER VALUES FROM ANSYS

Object Name	Total Deformation	Equivalent Elastic Strain	Equivalent Stress
Results			
Minimum	0. m	2.3036e-007 m/m	6172.9 Pa
Maximum	1.244e-003 m	4.5615e-003 m/m	1.5767e+008 Pa

CARBON FIBRE

5.CONCLUSION

Analysis results from testing the silencer under static load containing the stresses and deflection are listed in the Table. The materials we have analyze are mild steel, stainless steel, glass fiber E-grade and carbon fiber.

In the analysis of silencer we have found that the carbon fiber silencer have a good strength and it have a less stress under the fixed support and force, than the other three material which are used for silencer. So the existing mild steel material can be replaced with optimized carbon fiber material because of its low deformation and elastic strain values. Compared to other optimized materials like glass fiber E-grade and stainless steel the carbon fiber has low stress value. So the suitable material for silencer is carbon fiber.

Even though Carbon fiber is costlier it should be used in manufacturing silencer since it shows the resistant to corrosion among the given materials.

6. REFERENCES

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