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Analysis of Car Tyre Using Fabric Coating

K. Karthiga[1*], Dr.R.Balamurugan[2], R. Chandru[3], K. Deepak Raja[4], N. Naheshwaran[5]

[1*]Faculty, M.Kumarasamy College of Engineering, Karur, Tamil Nadu, India. E-mail: karthigak.snh@mkce.ac.in

[2]Faculty, M. Kumarasamy College of Engineering, Karur, Tamil Nadu, India.

[3]UG Student, M.Kumarasamy College of Engineering, Karur, Tamil Nadu, India.

[4]UG Student, M.Kumarasamy College of Engineering, Karur, Tamil Nadu, India.

[5]UG Student, M.Kumarasamy College of Engineering, Karur, Tamil Nadu, India.

ABSTRACT

Producing analysis results of tyre on fabric coating, which gives a good result and a good choice when compared with ordinary rubber-based tyres. These analysis results show that the coating makes the lifetime of the tyre higher and the life time is higher than normal rubber-based tyres. This makes the same cost with high durability and quality. There are various structures of fabric-related resins and coating available in the world of materials. Based on the cost and structure, the value of the product may change.

KEYWORDS

Fabric Coating, Nano-fabric Materials, RIM Structure.

Introduction

A wheel consists of two types of structures, namely a tyre and rim. Travelling of the wheel to the ground for traction is caused by the vehicle's load from the axle. The primary purpose for the designation of the tyre is to support the weight of the vehicle and absorb road shocks. And it also helps to transmit traction, braking forces. Stability to the lower sidewall is provided by bead filler, and it is also responsible for bead area. The bead filler's density increases stability and the stiffness increases performance for the designation. Basically, most of the tyre manufacturers produce air fillable tyres or pneumatic type tyres to make the process easier and convenient.The tyre materials might be synthetic or natural rubber, fabric and wire with various chemical components. The tyre consists of the tread and body where tread provides traction and body provides containment for the present quantity of the tyre. The tyre material can be fabric to withstand with high pressure of the vehicle and the support provided by the designation of the tyre. In this one, the modified tyre designation produces good results compared with rubber basedtyres, the deformation that occurs on the tyre is lesser than the ordinary rubber based tyres. So, when the complete analysis takes place, better results will be identified other than the rubber-based one.

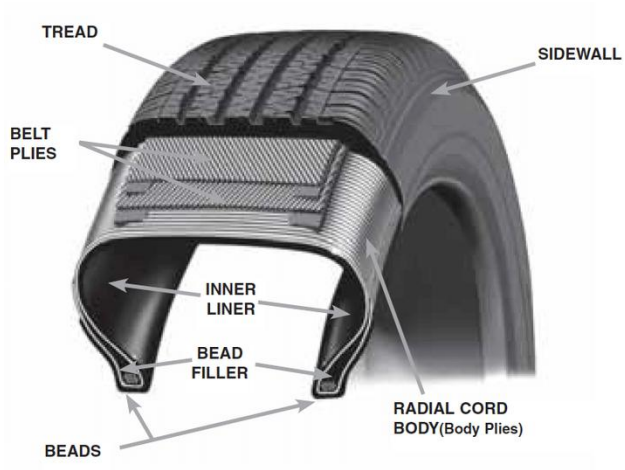

Figure 1. Analysis of tyre structure diagram

We collected various information about materials suitable for tyre and rim structure and obtained material's

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mechanical properties and the tyre designation completed with approximate dimensions. Analysis of tyre with suitable material will be taken and the results will be obtained successfully.

Literature Review

With reference to the various papers that we conclude the dispersion of material is important while selecting the tyre material to withstand with high loads and stability, and a good tyre material possesses high tensile yield strength and wear resistance. Based on that, we selected various materials for rubber tyre alternative, finally we concluded that fabric is a good choice to achieve better results. By referring to various notes, the dispersion of particles in fabric is good was obtained. The fabric is a good choice, but selection of fabric material is not easier because many types of fabric materials are available today, but we prefer nano fabric materials to achieve greater results, and here we used a some kind of resin polyester which used to make fabric materials, based on our research the selected material gives good results when compared with normal rubber tyres. So, we used the resin polyester and our analysis with respect to normal rubber tyre analysis methods. Based on our research, we can also use various nano-technology-related fabric materials for further achievements in analysis because the nano fabrics play a major role nowadays, they have good strength and lifetime. And also, nano-cure technology plays a major role in automobile industries, it is easier to achieve using nano-fabric materials.

Modelling

The wheel is taken with approximate dimensions for modelling and study. The tyre and rim structure is modelled and assembled in 3D using SolidWorks 2018. The 3D model used for analysis is depicted below.

Figure 2. 3d model of tyre and rim structure

Analysis of Normal Tyre Structure

Density	**2770 kg m^-3**
Coefficient of Thermal Expansion	**2.3e-005 C^-1**
Specific Heat	**875 J kg^-1 C^-1**
Compressive Ultimate Strength	**0 Pa**
Compressive Yield Strength	**2.8e+008 Pa**
Tensile Yield Strength	**2.8e+008 Pa**
Tensile Ultimate Strength	**3.1e+008 Pa**
Young's Modulus	**7.1e+010 Pa**
Poisson's Ratio	**0.33**
Bulk Modulus	**6.9608e+010 Pa**

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Shear Modulus	**2.6692e+010 Pa**
Reference Temperature	**22 C**
Relative Permeability	**1**

Figure 3.1. Properties of aluminium alloy

Density	**1950 kg m^-3**
Coefficient of Thermal Expansion	**2.3e-004 C^-1**
Specific Heat	**296 J kg^-1 C^-1**
Thermal Conductivity	**0.28 W m^-1 C^-1**
Compressive Ultimate Strength	**0 Pa**
Compressive Yield Strength	**0 Pa**
Tensile Yield Strength	**2.5e+007 Pa**
Tensile Ultimate Strength	**3.3e+007 Pa**
Reference Temperature	**22 C**
Young's Modulus	**1.1e+009 Pa**
Poisson's Ratio	**0.42**
Bulk Modulus	**2.2917e+009 Pa**
Shear Modulus	**3.8732e+008 Pa**

Figure 3.2. Properties of polyethylene

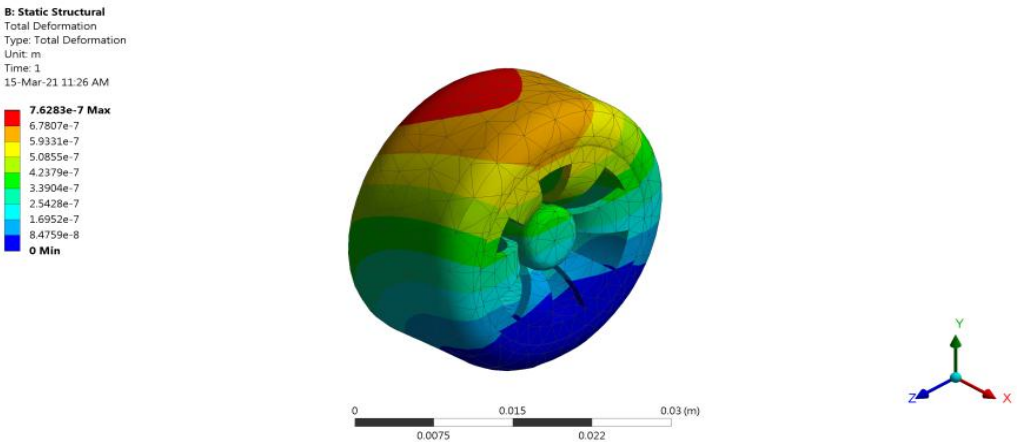

Figure 3.3. Total deformation

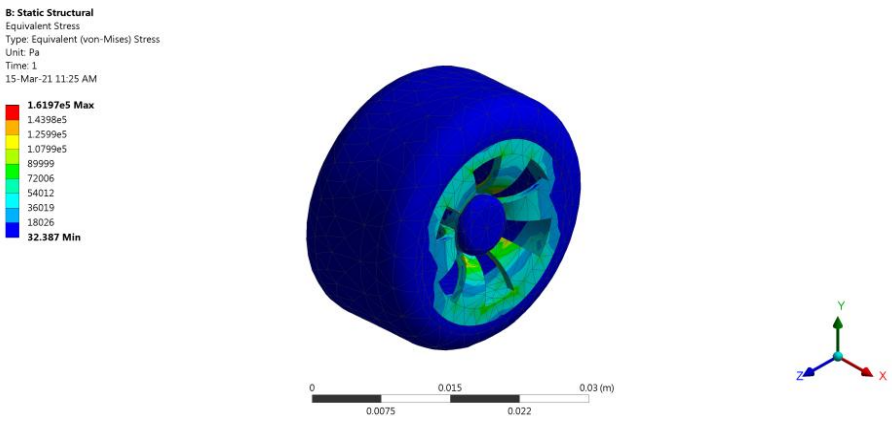

Figure 3.4. Stress distribution

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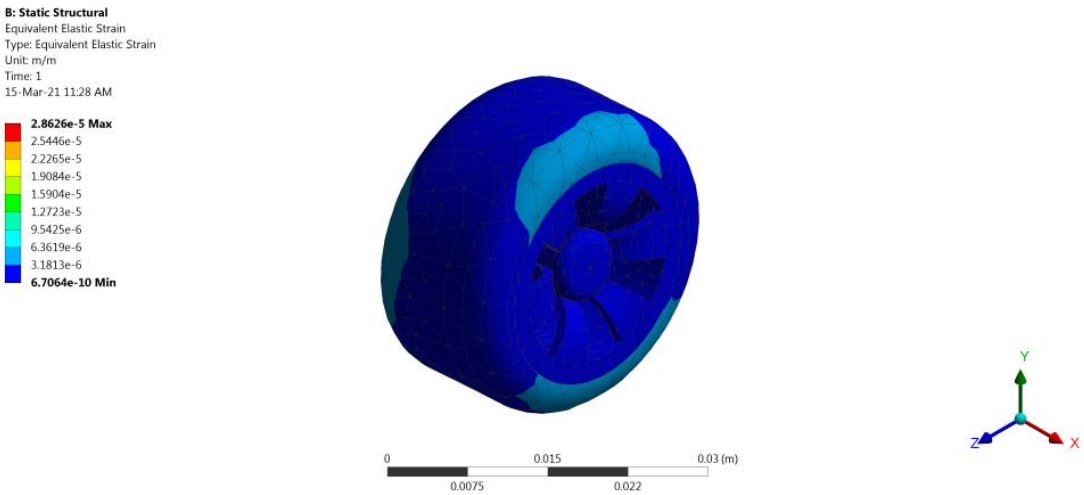

Figure 3.5. Strain distribution

Analysis of Modified Tyre Structure

Density	**2770 kg m^-3**
Coefficient of Thermal Expansion	**2.3e-005 C^-1**
Specific Heat	**875 J kg^-1 C^-1**
Compressive Ultimate Strength	**0 Pa**
Compressive Yield Strength	**2.8e+008 Pa**
Tensile Yield Strength	**2.8e+008 Pa**
Tensile Ultimate Strength	**3.1e+008 Pa**
Young's Modulus	**7.1e+010 Pa**
Poisson's Ratio	**0.33**
Bulk Modulus	**6.9608e+010 Pa**
Shear Modulus	**2.6692e+010 Pa**
Reference Temperature	**22 C**
Relative Permeability	**1**

Figure 4.1. Properties of aluminium alloy

Density	**1.95e+015 kg m^-3**
Compressive Ultimate Strength	**0 Pa**
Compressive Yield Strength	**0 Pa**
Young's Modulus	**3.e+009 Pa**
Poisson's Ratio	**0.316**
Bulk Modulus	**2.7174e+009 Pa**
Shear Modulus	**1.1398e+009 Pa**

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Figure 4.2. Properties of resin polyester

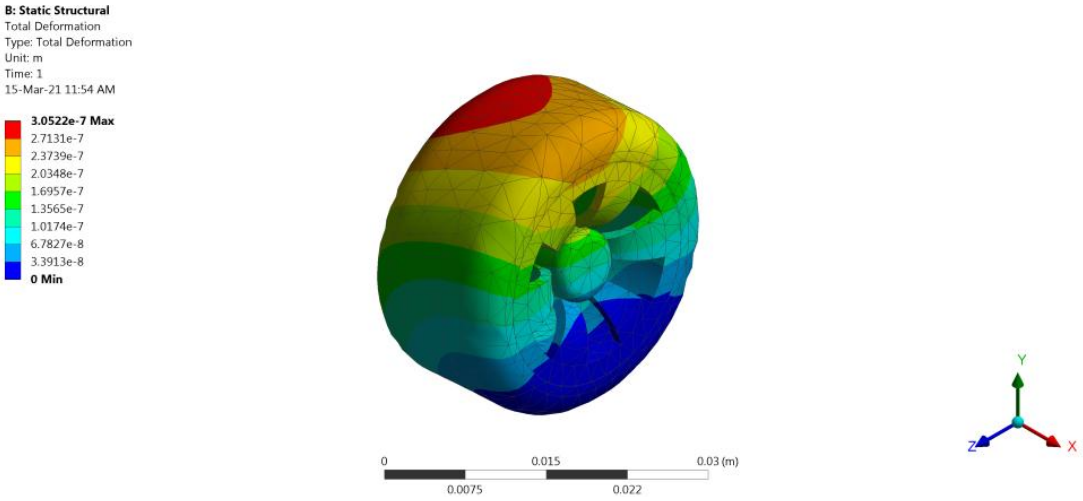

Figure 4.3. Total deformation

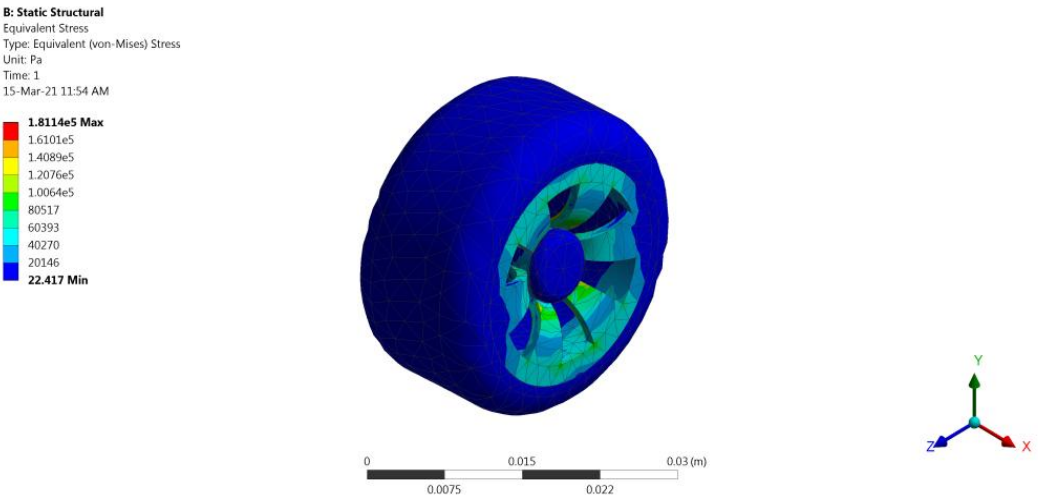

Figure 4.4. Stress distribution

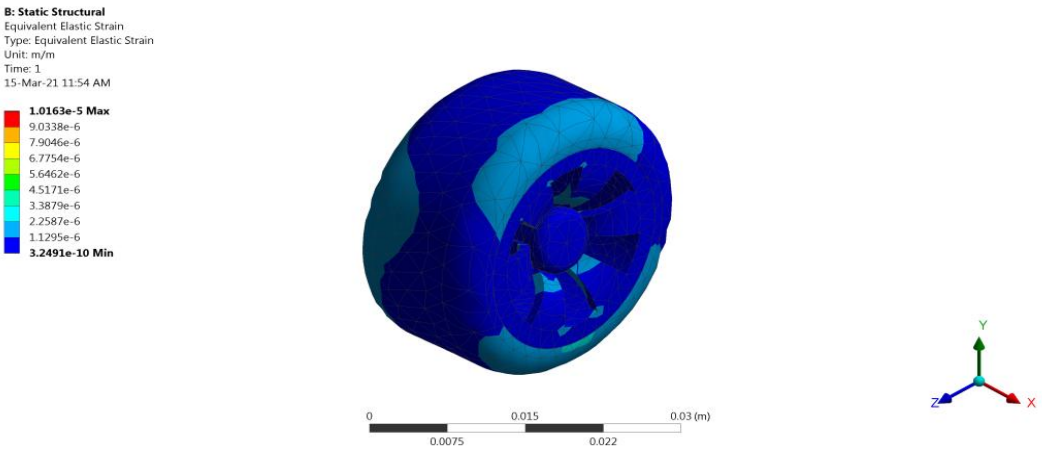

Figure 4.5. Strain distribution

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Results

Object Name	*Equivalent Elastic Strain*	*Total Deformation*	*Equivalent Stress*
State	**Solved**		
Scope			
Scoping Method	**Geometry Selection**		
Geometry	**All Bodies**		
Definition			
Type	**Equivalent Elastic Strain**	**Total Deformation**	**Equivalent (von-Mises) Stress**
By	**Time**		
Display Time	**Last**		
Calculate Time History	**Yes**		
Identifier			
Suppressed	**No**		
Integration Point Results			
Display Option	**Averaged**		**Averaged**
Average Across Bodies	**No**		**No**
Results			
Minimum	**6.7064e-010 m/m**	**0. m**	**32.387 Pa**
Maximum	**2.8626e-005 m/m**	**7.6283e-007 m**	**1.6197e+005 Pa**
Minimum Occurs On	**RIM-1**	**TYRE-1**	**RIM-1**
Maximum Occurs On	**TYRE-1**		**RIM-1**

Figure 5.1. Analysis result of normal rubber based tyre

The results obtained through the analysis of a normal rubber-based tyre are mentioned above. The above results were obtained through keeping some appropriate data for both normal and modified structure. The minimum and maximum value difference can be identified through the analysis results produced.

Object Name	*Total Deformation*	*Equivalent Elastic Strain*	*Equivalent Stress*
State	**Solved**		
Scope			
Scoping Method	**Geometry Selection**		
Geometry	**All Bodies**		
Definition			
Type	**Total Deformation**	**Equivalent Elastic Strain**	**Equivalent (von-Mises) Stress**
By	**Time**		
Display Time	**Last**		
Calculate Time History	**Yes**		
Identifier			
Suppressed	**No**		
Results			
Minimum	**0. m**	**3.2491e-010 m/m**	**22.417 Pa**
Maximum	**3.0522e-007 m**	**1.0163e-005 m/m**	**1.8114e+005 Pa**

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Minimum Occurs On	**TYRE-1**	**RIM-1**	
Maximum Occurs On	**RIM-1**	**TYRE-1**	**RIM-1**

Figure 5.1. Analysis result of modified rubber based tyre

Result Discussion

The results obtained through the analysis of modified rubber basedtyre are mentioned above. The above results obtained that deformation occurs in the modified one is less than in the normal rubber-based tyres. The stress distribution on the rim structure is vary, but this can be compensated by using various light-weight alloys like magnesium alloy, nickel based alloys, chromium alloys, vanadium based alloys etc. There are various nano-fabric material also available to get many more good results regarding the selection of various materials to tyre structure. Based on our results, the resin polyester gives good results by decrease in deformation of the tyre structure, and it shows that the modified one has good stability property.

Conclusion

The rubber-based tyre and modified tyre with rim structure were designed and the underlying investigation was done. For the normal and modified rubber-based tyre, the total deformation, stress distribution and strain distribution were measured using ANSYS. By static analysis, the displacement value of the modified tyre is 3.0522e-007 m, which is lesser than the normal rubber-based tyres of value 2.8626e-005 m/m. As compared to the normal rubber-based tyre, the modified one produces good results and is also suitable for replacements. To obtain many more better results, the rim structure material can also be modified.

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