Design of Customized Pneumatic Wheel

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Abstract

The modern wheel of a car is defined as a circular section intended to rotate the axle bear. To meet market demand, original equipment manufacturers use the latest technology to design and manufacture wheels. Advanced technology that assists in the production of wheel rims is computer aided design (CAD) software and software analysis. In this paper we have used CAD and analytics software to the best of their ability. Wheel modeling was done using SOLIDWORKS and was submitted to ANSYS for analysis work. The ANSYS system is used to reproduce various strengths, component weight tracking and to validate and review results. The solution mode in the ANSYS system calculates bending times, pressures, and shifts in their relationships without manual intervention, reducing the relative time and scientific calculation strategy by the person. The dry analysis work of the ANSYS was performed by considering the Polyamide Imide material with different geometry (suggestions 1, 2, 3, 4, 5, 6) and their related functionality have been observed respectively. In this outcome paper Proposition 6 met the requirement and suggested prototyping.

Keywords: ***ANSYS, SOLIDWORKS, Stress Analysis, Wheel***

INTRODUCTION

Wheels have been part of human civilization since 3500 BC. The creation of the wheel started from the late Neolithic and was found related to some major innovative advances that offered ascend to the early Bronze Age. Since then, wheels have revolutionized and brought a boom in the transport industry. They play a very integral part in the vehicle which propels with the help of the power developed by the engine. A wheel is a roundabout part which is to be pivoted on a hub bearing. Wheels, related to axles, enable overwhelming articles to be moved effectively encouraging development or transportation while supporting a heap, or performing work in machines.

Compound wheels are the wheels that are produced using the mixture of Aluminum and Magnesium. Combinations are generally known as blends which are generally produced. They usually provide more prominent quality over unadulterated metals, which are generally considerably as more ductile. Alloys of Aluminum and Magnesium are typically lighter for the same strength, provide better heat conduction, and often produce improved cosmetic appearance over steel wheels.

Most compound wheels are fabricated by the method of throwing, yet some are produced by different methods. Produced wheels are normally lighter, more grounded, yet substantially more costly than cast wheels. In recent times there were various designing and analyzing software which were made the manufacturing of wheel rims as a very easy process. The analytical results were in accordance with the experimental results of fatigue wheel life.

DESIGN OF WHEEL

The purpose of selecting the proper wheel material and designing wheel is to make it as light weight as possible and to provide proper handling, adherence, control, and brake efficiency

There are usually problems while using the conventional wheels, they are as follows

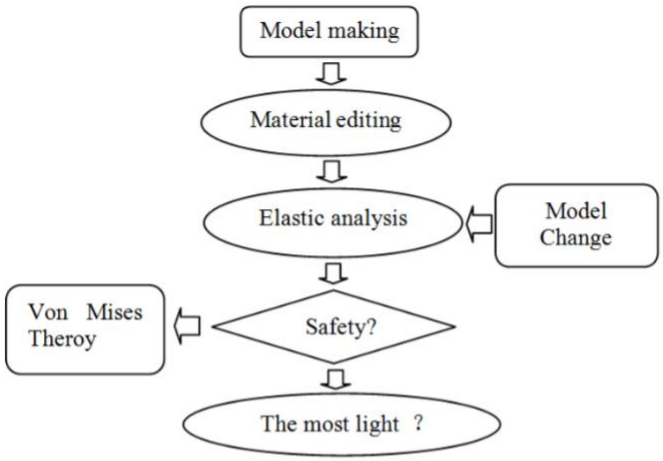
- Buckling of wheel
- Flattening of tires
- Less traction
- Narrow contact patch

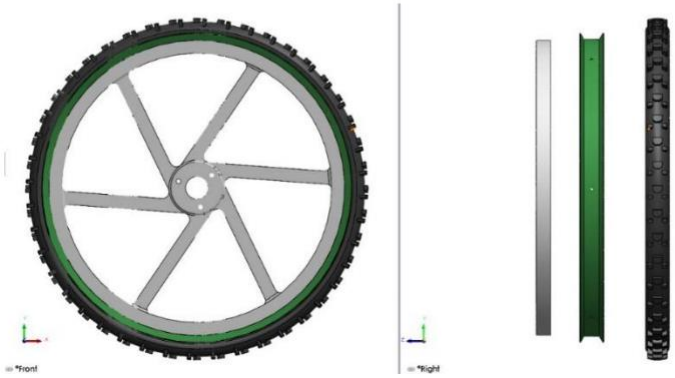
To overcome the above-mentioned problems, we are using self-customized wheels to achieve broader contact patch, higher traction, and most importantly higher strength. In this regard composites are being used which is **Polyamide-imides**.

The rim size has been finalized based on the requirement and target specifications along with inputs from powertrain departments.

FEA has been done to reduce the weight of the rim by providing pockets without affecting the required strength. While finalizing the rims it has also been considered to reduce the machining cost i.e., without affecting the thickness of the rim the pockets will be removed.

The wheel optimization flowchart is shown in figure below. Using optimization, we can achieve our target





Final Wheel Design

Mechanical Properties of Polyamide-imide and Mild steel

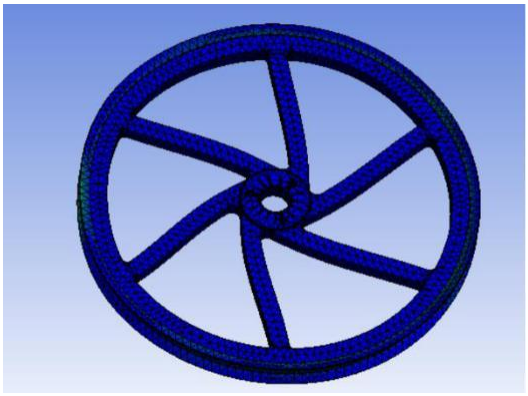
	POLYAMIDE-IMIDE	MILD STEEL
DENSITY	1.4 g/cm^3	7.85 g/cm^3
MODULUS OF ELASTICITY	3.03 GPa	200 GPa
POISSON RATIO	0.34	0.3
YIELD STRENGTH	3.8x10^7 N/m^2	210x10^9 N/m^2

ANALYSIS

The analysis is carried out on the motor bike wheel rim using FEA method. The motor bike wheel rim 3D model was created by the SOLIDWORKS software. The created 3d model was saved in the step format. The maximum numbers of engineering problems are solved by the numerical analysis technique of the FEM. In this paper ANSYS workbench 15.0 is used for static structural analysis on the motor bike wheel rim with various boundary conditions. The import design from Solidworks is shown in the figure.

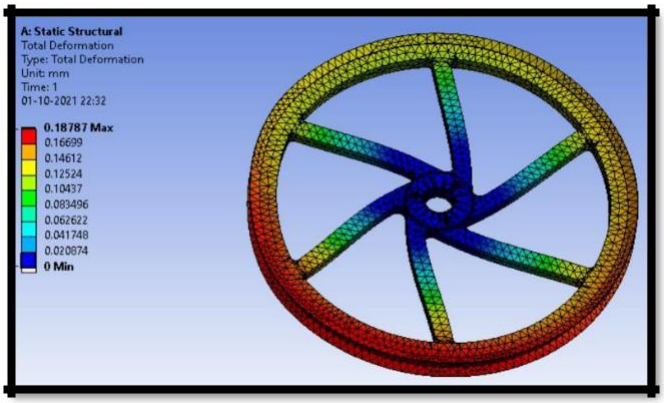
MESHING

All the changes in the model are based on the meshing in the workbench. It is a common technique for all the parts in computer simulation. The nodes and elements are generated while meshing. In the analysis, different methods and tools are used for meshing the model. The fine meshing of the wheel rim is shown in the figure.



RESULTS AND DISCUSSION

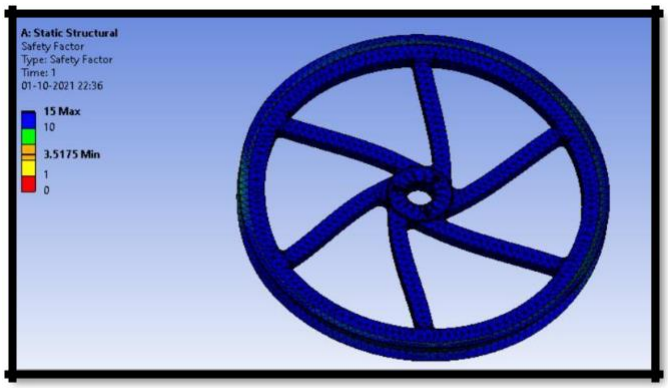
The total deformation of the steel and polyamide imide alloy rim are shown in the above figure no 5. Both mater 100i0als are analyzed in the same boundary conditions. The pressure and load are applied in the wheel rim.



Total deformation= 0.18 mm

FACTOR OF SAFTEY

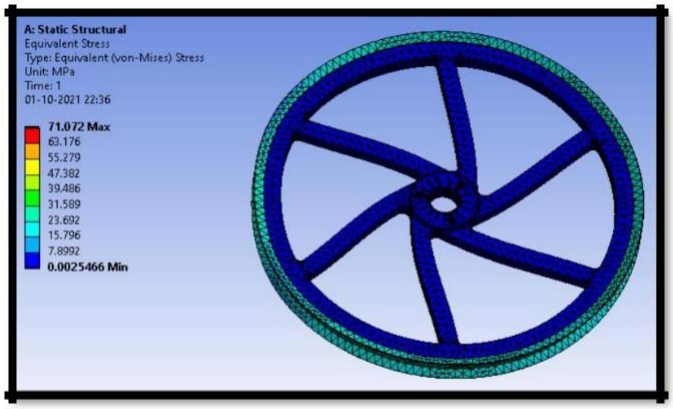
Factor of safety is an important aspect to determine the strength of every component. The figure no 6 shows the factor of safety for the steel and polyamide imde rim. The overall factor of safety is 3.5,which is significantly a good value.



FOS =3.51

EQUIVALENT STRESS

Equivalent stress is generally used to determine a material's status for ductile material. The value of equivalent stress should always be less than the yield stress for a part not to fail. In our case its value is represented in fig



Equivalent Stress = 71.072 MPa

Conclusions

To enhance the performance of wheel for light electric vehicle, demand for a lightweight wheel has dramatically increased. To satisfy both the performance and safety, a wheel made of polyamide imide and mild steel is efficient due to its mechanical properties.

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