

Technical Review on Manufacture Tyre by using Additive Manufacturing

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DOI:- <https://doi.org/10.47531/SIC.2022.20>

Abstract

The major issue whilst implementing manoeuvres are acceleration, braking and guidance for the protection control, which in the long run depends on the street and tyre floor friction. To withstand the vertical hundreds and hold accurate traction with the touch floor, pneumatic tyres with a high extent of pressurised air are required. To enhance the consolation, coping with, and grip with low unsprung mass, non-pneumatic tyres are wanted, which are not bolstered with air pressure. The decreased impact of rolling resistance added cushioning effect, and better cell shear band design multiplied the performance degree than pneumatic tyres. Here, the air is replaced via poly-composite spokes that eliminate the possibility of the tyre going flat. This paper specifically discusses the environmental impact and stability troubles of conventional pneumatic tyres and makes a speciality of an airless tyre's diverse, viable layout and additives. This paper additionally gives the modelling and analysis of non-pneumatic tyres followed via three-D published sealed version using ABS (Acrylonitrile Butadiene Styrene) and TPU (Thermoplastic Polyurethane). Honeycomb based mobile shear band products of polyurethane are tested with unique shear band angles and loading conditions. The simulation results show that a shear perspective of 120o for non-pneumatic tyres is maximum promising and provides higher rides and luxury.

Keywords: - Additive Manufacturing, Analysis, Design, DMLS, SLS.

INTRODUCTION

Additive manufacturing, commonly known as 3D printing, allows the direct conversion of design construction files into fully functional objects. It is joining materials to make objects from 3D model data, usually layer upon layer. In this, the material is joined or solidified under computer control to create a three-dimensional object. The material is

added together (liquid molecules or powder grains being fused layer typically by layer.

Vehicle manufacturers have been at the forefront of implementing additive manufacturing technology. One of the most prolific additive manufacturing applications in the automotive world is rapid prototyping. This is also among the

oldest uses of the technology, with some large auto manufacturers having prototyped parts with 3D printers for more than 20 years. Beyond prototyping, automotive manufacturers are now increasingly bringing it into use for actual production. In recent years, additive manufacturing (AM) technologies have radically changed our way to design, develop and manufacture new products. In the automotive industry, additive manufacturing technologies have done wonders to bring new shapes to life, allowing for lighter and more intricate structures at the best possible cost.

AIM AND OBJECTIVES:

Innovative and without making use of tools, manufacturing intricate shapes and lightweight components is possible.

- Maximum freedom for design, allowing the creation of complex yet lightweight components with a high level of rigidity.
- Additive manufacturing can significantly reduce material waste, reduce the number of production steps, inventory being held and reduce the number of distinct parts needed for assembly work.
- Reducing the need for manual assembly
- Additive makes it possible to create internal complexities and precisely control microstructure.
- Enables production of components with integrated functionality without the need for tools, thereby cutting development and production costs.
- Time and cost reduction (shorter lead time).
- Leads to more market opportunities.

Firstly we'll explain the procedure, i.e., how the additive manufacturing is carried out and then

requirements in the automotive industry, AM in the automotive industry, common automotive applications, current and future uses of AM in the automotive industry, challenges for the automotive industry. But before that, you should know different AM processes.

REQUIREMENTS IN AUTOMOTIVE INDUSTRY

- **Weight - final parts:** One of the most critical aspects of the automotive industry is the weight reduction of components. Automotive applications make use of advanced engineering materials and complex geometries in an attempt to reduce weight and improve performance. AM can produce parts from many of the lightweight polymers and metals that are common in the automotive industry.
- **Complex geometries - prototypes and final parts:** Affecting weight and aerodynamics (and therefore vehicle performance) is the geometry of a part. Automotive parts often require internal channels for conformal cooling, hidden features, thin walls, fine meshes and complex curved surfaces. AM allows for the manufacture of highly complex structures which can still be extremely light and stable. It provides a high degree of design freedom, the optimisation and integration of functional features, the manufactures of small batch sizes at reasonable unit costs and a high degree of product customisation even in serial production.
- **Temperature - testing and final parts:** Many automotive applications require significant heat deflection minimums. Several AM processes offer materials that withstand temperatures well above the average 105°C

sustained engine compartment temperatures. SLS nylon, as well as some photo-cured polymers, are suitable for high-temperature applications.

- **Moisture** - testing and final parts: Most components that go into the production of automobiles must be moisture resistant, if not moisture-proof, entirely. One major benefit of additive manufacturing is that all printed parts can be post-processed to create a watertight and moisture resistant barrier. Additionally, many materials, by their very nature, are suited for humidity and moisture plagued environments.
- **Part consolidation** - prototyping and final parts: The number of items in an assembly can be reduced by redesigning a single complex component. Part consolidation is a significant factor when considering how AM can reduce material usage, thereby reducing weight and, in the long run, cost. Part consolidation also reduces inventory and means that assemblies can be replaced with a single part should repairs or maintenance occur, another critical consideration for the automotive industry.

REVIEW ON WHEEL MANUFACTURING

The wheels were produced on a customized Rep Rap Pro Ormerod 2, an Ultimaker 2+ and an Original Prusa i3 MK2 all three relatively inexpensive consumer-grade Fused Deposition Modeling (FDM) 3D-printers. The Rep Rap Pro had to be customized in order to print with flexible filaments, the Ultimaker only managed to print the SemiFlex material (stiffest of the test materials) while the Prusa supported all materials without any changes. The ease of prototyping with

3D-printing also allowed for testing of wheels with different designs.

Five different tyre designs were produced and given names for easy distinction. A hub was designed for simple swapping of tyres. The hub was also 3d-printed, but in a stiffer material than the tyres, namely

The perforated wheel was designed this way to be softer than its massive counterpart. The different spikes and fins were designed to bend, or even be pressed flat against the rail to give a higher surface area if the material used was soft enough. One spike design and two fin designs of various fin thickness were tested. A total of five different designs was considered to provide a reasonable variation compared to the number of tests necessary.

ANALYSIS OF TIME SERIES

The maximum pull force for each repetition was found by analysing the time series. The preload force and motor effect

at the time of maximum pull, and the value of forces were also found. The mean and standard deviation of these values for all five repetitions in each test was calculated. Table.1 present these values for the 40N test with constant motor voltage. The table also includes pull force divided by tensioning force to give a comparable number for each wheel. This provides an

estimated friction coefficient between each wheel and the surface of the aluminium rail when considering the preload the same as the actual normal force between wheel and rail. A higher friction coefficient shows the higher friction wheel, indicating the “better” wheel for pulling the car in this test.

Table 3. Average max pull force during the five constant voltage tests with 40N preload for the different wheel specimens. Standard deviations in parenthesis.

Specimen	Max Pull Force (N)	Actual Preload Force (N)	μ^*	Actual Effect (W)
Ninja Original	31.88 (1.20)	46.04 (0.84)	0.69	8.25 (0.41)
Ninja Holes	30.84 (0.46)	47.12 (4.00)	0.65	10.18 (1.17)
Ninja Thick fins	20.36 (0.54)	34.20 (1.72)	0.60	7.00 (0.47)
Ninja Spikes	22.68 (0.48)	39.68 (3.73)	0.57	5.97 (0.43)
Ninja Thin fins	31.92 (1.23)	57.16 (2.41)	0.56	9.74 (0.63)
Reference	28.36 (0.38)	57.28 (6.19)	0.50	7.59 (0.67)
TPE90A Spikes	20.40 (1.24)	45.28 (1.82)	0.45	6.10 (0.34)
Semi Holes	15.96 (0.17)	41.64 (2.22)	0.38	4.98 (0.69)
TPE90A Original	15.24 (0.17)	44.68 (0.76)	0.34	4.32 (0.41)
Semi Thin fins	15.24 (0.22)	51.40 (2.52)	0.30	5.38 (1.00)
Semi Spikes	11.64 (0.26)	44.08 (1.62)	0.26	5.00 (0.35)
TPE90A Thin fins	11.64 (0.74)	50.32 (4.37)	0.23	3.40 (0.57)

CONCLUSION

Consumer grade FDM 3D-printing makes it easy to produce plastic parts in almost any shape and desired colour. Even different "material properties" can be obtained by adjusting the amount of fill material used between the outer walls of a part, thus making the "macro density" higher or lower. However the actual materials available has mostly been ABS and PLA, thus nevertheless limiting the possibilities. In this paper we have investigated how 3D-printed thermoplastic elastomer materials behaves. Such materials expand the possibilities for creating functional parts with inexpensive FDM 3D-printers. The produced components can bend and twist without breaking or getting permanently deformed.

Their material properties include "softer" surfaces with a more interesting friction properties than those of the standard rigid plastics like ABS and PLA. The experiments presented in this paper show that 3D-printed wheels of such soft materials can indeed be used as driving wheels on a smooth surface such as an aluminium rail.

The trend when comparing the two test procedures at 20N preload is that higher pull forces were generated with the constant voltage test. This is true for all specimens except NinjaFlex - Spikes

and TPE90A - Spikes. At 40N preload this trend is more diluted, as three specimens shows the opposite, one seems to have equal results, and the ones still following the trend show less difference between the two tests.

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