

Using the DLC as the Tyre Material for the synthesis of Rubber & Ply; Increasing Tyre's Life

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Abstract— Review on using DLC in making tyres. DLC films have been used as protective coatings for various applications. We can use DLC to improve the tyre's life especially for sports cars and supercars like Lamborghini and Bugatti Chiron. And also in military vehicles for making the tyres bulletproof. DLC is a class of amorphous carbon material that displays some of the typical properties of diamond. DLC is usually applied as coatings to other materials that could benefit from some of those properties but we can use DLC in the synthesis of tyre's rubber (for making threads) and ply thus improving the overall quality of the tyres.

Index Terms— Amorphous carbon, DLC (Diamond Like Carbon), military vehicles, sports cars & supercars, tyre's life,, tyre's rubber and ply.

1 INTRODUCTION

Tyres are the most important part of the vehicle, it is the only component of the automobile which is in contact with the road surface. It holds and bears the road bumps and roughness over the time, tyres get to wear but the tyre life of cars like Lamborghini and Bugatti and race cars is very less. They need better tyres with the improved life span.

Tyres are made using Elastomer, Vulcanizing agents, Accelerator activators, Accelerator, Retarder, Antidegradant, Fillers, Processing oils, Extending oil, Plasticiser, Special purpose ingredient. These are basically PLC, polymer like carbon example carbon black, they provide tyres flexibility, rigidity and tyre-road adhesion but with the advancement of an automobile, and engines, we require tyres which can hold the maximum speed of the vehicle. Tyres which can withstand for more than a lap. For this purpose, I have introduced a new material for tyres synthesis called DLC (Diamond Like Carbon) which will add with carbon black and silica with other compounds like natural and synthetic rubber for the basic material and anti-oxidants (which prevents tyres for premature aging) for the vulcanized rubber. In addition to this, we can also use DLC in the Ply of the carcass.

F1 race car tyres gets wear out easily due to the; vertical load above 1,000 kilograms, lateral accelerations of 4.5G upto 5G, one tread surface temperature due to high friction (or road resistance) above 150°C, and impact on curving 260 km/h. [2] With the help to DLC in the rubber, the tyres quality will enhance and can withstand for the longer time.

2 WHY WE SHOULD USE DLC FOR SYNTHESIS OF TYRE'S RUBBER AND PLY.

DLC films have the average linear thermal expansion coefficient of DLC in the temperature region between 25 and 150 °C was found to be 2.3 ppm/°C while the biaxial elastic modulus is Pa. [1] Therefore DLC is the achievable additive compound for tyre's rubber and ply synthesis. DLC in tyre's rubber and ply can provide higher thermal coefficient of expansion, this will prevent the tyres from getting worn out too soon even when the vehicle is running at maximum speed as in case of F1 cars. DLC used in synthesis of ply will prevent the core of the tyre from the extreme G forces (lateral and longitudinal). It will also help to prevent the shape of the tyre under stress due to various factors like low air pressure in tyres, poor suspension, poor wheel alignment. During emergency braking at high speed tyres will not get burst from heat which will arise due to the rolling to static friction transformation between road and tyre surface. Protecting tyres at its core by using DLC ply and the outer surface by using DLC with carbon black and silica will increase the tyre's life for more miles.

3 DIAMOND-LIKE CARBON (DLC)

Diamond-like carbon (DLC) is a class of amorphous carbon material that displays some of the typical properties of diamond. DLC exists in seven different forms. All seven contain significant amounts of sp³ hybridized carbon atoms. The reason that there are different types is that even diamond can be found in two crystalline polytypes. The more common one has its carbon atoms arranged in a cubic lattice, while the less common one, lonsdaleite, has a hexagonal lattice. By mixing these polytypes in various ways at the nanoscale level of structure, DLC coatings can be made that at the same time are amorphous, flexible, and yet purely sp³ bonded "diamond". The hardest, strongest, and slickest is such a mixture, known as tetrahedral amorphous carbon (ta-C). For example a coating of only 2 µm thickness of ta-C increases the resistance of common (e.g., type 304) stainless steel against abrasive wear,

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changing its lifetime in such service from one week to 85 years. Such ta-C can be considered to be the "pure" form of DLC since it consists only of sp³ bonded carbon atoms. Fillers such as hydrogen, graphitic sp² carbon, and metals are used in the other 6 forms to reduce production expenses or to impart other desirable properties.

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4 AVERAGE COMPARISON BETWEEN P ZERO SERIES AND PROPOSED TYRE WITH ADVANCE TYRE MATERIAL.

4.1 P zero series

- More wear hence short Life Span.
- More deformation; more rolling resistance (and hysteresis loss).
- Lower thermal stress coefficient.
- More wear due to G force (4.5 to 5 G) on tyres.

4.2 Proposed Tyre

- Less wear hence longer life span.
- Less deformation; less rolling resistance (and hysteresis loss).
- Higher thermal stress coefficient.
- Less wear due to G force on tyres. (can hold up to 8-9G)

5 CONCLUSION

- We will be having the better tyre of racing and super cars.
- In F1; they will be able to get enhance their performance in finals and therefore, they'll be able to use less numbers tyres for practice, and qualifying sessions.
- Therefore, less tyre wear in final race.
- Cars would be able to attain more closer to it theoritcal speed on practical parameters.

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REFERENCES

- [1] Linear thermal expansion coefficient and biaxial elastic modulus of diamondlike carbon films Ilan A. Blech and Peter Wood Citation: Journal of Vacuum Science & Technology A 11, 728 (1993); doi: 10.1116/1.578800 View online: <http://dx.doi.org/10.1116/1.578800> ViewTableofContents: <http://scitation.aip.org/content/avs/journal/jvsta/11/3?ver=pdfcov> Published by the AVS: Science & Technology of Materials, Interfaces, and Processing.
- [2] EVO Tyre Test 2017; Pirelli. Publication: EVO. Date: 01/09/2017.Type: Consumer Magazine Monthly. Circulation: 43119. Readership: 129357. Display Rate (£/cm²): 9.09. Size (cm²): 4830. AVE: 43904.70
- [3] A Review of Polymer Interfaces in Tyre Technology" A.