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ROAD ACCIDENTS DUE TO TYRE FAILURES

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ABSTRACT

The ability of tyres to withstand significant impact loads is a critical consideration in their design. Hence, tests for radial deflection, bounce, and blast loading were conducted in order to build a solid experimental data base. Findings from are crucial because they can be used to compare numerical models. A very specialized way of analysis is required for the highly demanding procedure of failure analysis construction in automobile tyres. A multistage testing process for truck tyres is presented by the authors. Comparing experiments with finite element analyses of quasi-static, dynamic, and severely dynamic testing, they demonstrated adequate accuracy in terms of deformation (first and second tests), and failure (third test). The results that follow speak to the occurrence of unwanted phenomena such various artefacts resulting from their construction, but they also attest to the applicability of the method for failure analysis research on vehicle tyres.

KEYWORDS: *Tyre failures, dynamic testing, road accidents, deformation.*

I. INTRODUCTION

While designing a vehicle model, a number of variables should be taken into account, with safety being possibly the most crucial. A vehicle's passive safety can be increased through a variety of design strategies, such as the efficient management of crash energy through the plastic collapse of specific structural components. One of the main classes of commercial metals is made up of copper and copper alloys. Its exceptional electrical and thermal conductivities, outstanding resistance to corrosion, ease of production, and good strength and fatigue resistance make them extremely popular. Copper can be harmed by typical environmental factors and agents, in contrast to gold and other precious metals. Under the majority of corrosive situations, pure copper resists assault fairly well. however, some copper alloys are occasionally only partially usable in specific situations due to hydrogen embrittlement or stress-corrosion cracking (SCC) Wang and Wang studied the estimate of tyre cornering stiffness and tyre-road friction coefficient based on longitudinal tyre force differential production. Wang et al. addressed the identification of road surface condition based on road characteristic value. They provided information on the use of the Burckhardt model, which divides roadways into six categories. An off-road instrumented tire's soft soil experimental testing was provided by Naranjo et al. The study of tyre contact length on dry and wet road surfaces recorded by a three-axial accelerometer was the focus of Matilainen and Tuononen.

II. MATERIALS AND METHODS

The automobile tyre is a closed ring-toroid in terms of geometry, and from a mechanical perspective, this can be thought of as a pressure vessel. The vessel's wall is a flexible membrane whose structure is made up of a sophisticated composite system that significantly affects the vessel's behavior and operational parameters. The rubber that encircles the outside of a car tyre and is patterned is called tread. It is made up of a collection of irregularly spaced rubber grooves that contact the road. The resultant pattern establishes the tread's pattern and decides how long it will last. The road surface is directly in contact with this area of the car tyre. the three-axial accelerometer in the inner liner. . The researchers Dubois et al. provide yet another intriguing study. They utilized a multi-asperity approach to deal with the numerical evaluation of tyre and road contact pressure. The article Mechanical characterization of a Tyre Derived Material: Experiments, Hyper Elastic Modeling, and Numerical Validation was published by Montella et al. They presented their findings regarding the tensile, compression, simple shear, and volumetric tests for vehicle tyres in this paper. Computer simulations are also frequently utilized in the investigation of material and operational characteristics in addition to experiments. The forces and moments produced in the tyre-road contact area have to be described in their simulations using tyre models.

Baranowski et alpaper .'s ."Modeling and testing of logistic trucks supporting military operations tyre under strongly dynamic loading conditions" They evaluated and in simulated Analyze the pressure distribution and a tyre structural deterioration characteristic. Measurement and uncertainty assessment frequently use Monte Carlo simulations. Cramer, Palencar, and others discussed their use of it. Ostertag and Fabian dealt with the theoretical model of the integrated drive unit wheel mechanism. Their research's objectives were to lower operational expenses and boost security. A novel measurement apparatus for tyre-road contact forces was designed and tested by Cheli et al. They talked about the wheel mechanism with built-in driving unit model. Their study proposed a novel method for measuring the forces between tyres and roads with the intention of lowering actual operating expenses and enhancing measurement security. Gonzalez et al. looked into the impact of rotation on tyre dynamic behavior and researched the impacts of rotation on tyre dynamic behavior. A multi-laminated non-linear model of a tractor tyre was created by Mohsen Manish and colleagues. The stress analysis of a finite element tyre model pressure vessel provided the 3D pressure fields used in the modelling process. tyre-road contact forces measurement devices and offered a novel method for measuring these forces. Gonzalez et al. looked into the impact of rotation on tyre dynamic behavior and researched the impacts of rotation on tyre dynamic behavior. A multi-laminated non-linear model of a tractor tyre was created by Mohsen Manish and colleagues. The stress analysis of a pressure vessel made out of a finite element tyre model served as the foundation for the modelling procedure.

III. EXPERIMENTAL PROCEDURES:

A typical setup for the impact testing included a tyre and rim combination purchased from the market that was firmly fastened in a large support and clamped to a 2.8 tonne anvil. The impact region was limited to the tyre/rim set since it was 30 degrees angled towards the impact mass. A typical setup for the impact testing included a tyre and rim combination purchased from the market that was firmly fastened in a large support and clamped to a 2.8 tonne anvil. The impact region was contained within the test because the tyre/rim set was angled by 30 degrees towards the impact mass.

IV. DISCUSSION

After taking into account the findings of the aforementioned research, the failure of the brass air valve was attributable to supplied SCC. The simultaneous fulfilment of three conditions—the sensitive material, the environment that produces SCC for that material, and the necessary tensile stress to create SCC—determines whether SCC will occur.

V. SUSCEPTIBLE MATERIAL

Most metals can create SCC under certain circumstances. High-purity metals are typically thought to be far less prone to SCC than the majority of commercial grades of metals and alloys.

On the basis of experience and a number of ideas on the mechanism underlying this failure process, pure metals were actually thought to be resistant to SCC. It was claimed that brasses with more than 15% Zn are more vulnerable, and that the susceptibility increases with Zn content.

VI. CORROSIVE ENVIRONMENTS

In conditions with ammonia or amines, whether in aqueous solutions or moist atmospheres, SCC in copper alloys occurs most commonly. Yet, there are other SCC instances of copper alloys in non-ammonia conditions, such as in industrial settings with citrate, tartrate, wet SO_2, nitrites, and even pure water. The ammonia concentration of specimen D in this case study was measured, and it was quite low (0.19 ppm). According to a research, the practical ammonia concentrations at which SCC can be generated for brass taps are between 15 and 30 ppm.

VII. STRESS CONDITION

The air valves were found to be fractured in the elbow's circumferential direction by macroscopic examinations. As a result, the axial tension was what caused the crack to spread. The axial stress was then calculated using a straightforward formula (r = p R/2t; p=inner pressure, R=inner radius, and t=air valve wall thickness). The inner pressure of the tyre was around 7–10 as stated by the clients. The computed outcome showed that the axial stress that was applied and caused by inner pressure was minimal (r 1 MPa). As a result, it's possible that the axial stress caused by interior pressure won't be enough to cause SCC.

It is important to think about residual stress. In this case study, the elbow's root-bend was the cracking position. It goes without saying that the residual stress must exist and that it must be tensile tension upon cold bending. We measured the valve tube's Vickers hardness in both its bent and straight positions. At the root-bent position, the Vickers hardness average was 180 kgf/mm2.

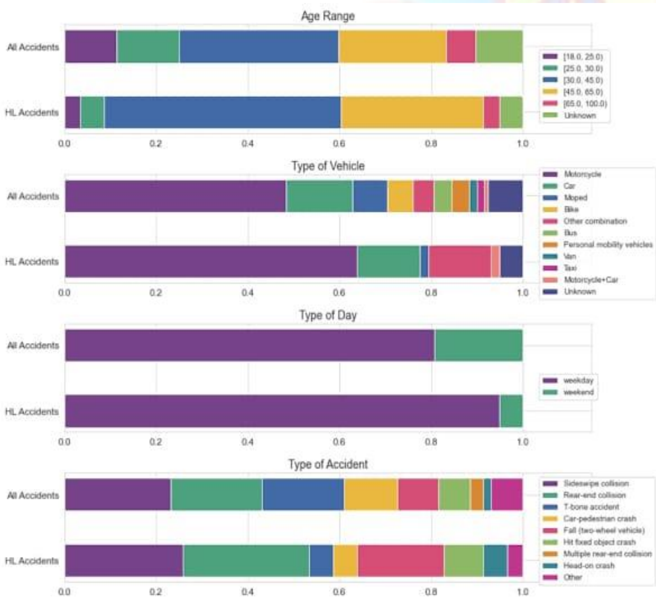
VIII. CRASH CHARACTERISTIC ANALYSIS

So, it is illegal to use tyres with thread depths of less than 1.6 millimetres since they may fail in an emergency. The majority of respondents (88%) in the Metropolis were aware that tyres have expiration dates, but 90% did not know where to look for a tire's expiration date, making it impossible for them to tell whether the tyre they were using was still in good condition. This supports the findings of a study conducted by Ghana's National Road Safety Commission (NRSC, Report, 2013), which discovered that more than 50% of the country's drivers were unaware of the tyre information that consumers may find on the sidewall of a tyre.

The total number of the one hundred fifty-six (156) 35 percent of the respondents thought that worn tyres were to blame for tyre failure. (Fig. 4) A total of 150 respondents, or 33% of the sample, ascribed tyre failure to under-inflation; another 99 respondents, or 22% of the sample, believed that over-inflation was to blame; and 45 respondents, or 10% of the sample, thought that over-loading the vehicles was to blame.

IX. Conclusion

This study used Takoradi Metropolis as a case study to investigate the causes and effects of tyre failure on traffic accidents. It concluded that commercial drivers are aware of the four main causes of tyre failures, which are overloading, under inflation, over inflation, and excessive tyre wear. These failures are the result of human error on the part of drivers who, although being aware of the issues, do not look up tyre information. This study supports previous research by Wheat (2005) that found human error to be to blame for 93 percent of all traffic accidents. Ninety percent of Metropolis drivers are unaware of the tyre information written on the sidewalls of the tyres. Also, many drivers (60 percent) did not even know that tyres which have a thread depth of less than 1.6 millimetres should be discarded and not used according to Ghana's laws (LI 2180). Accordingly, when tread depths are below 1.6millimeters road traffic accidents rate are trebled and even increases seven fold when the tread depths go below 0.5mm.(Bulls, 2004).Tread depths below 0.5millmeters could also result in a fault known as aquaplaning, a situation where the tyre fails to clear the water on the road when the tyre contacts the ground. Mudd (2009).



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