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Performance Evaluation of A Run-Flat Tyre

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ABSTRACT:- Continuous research and development efforts by tyre manufacturers show that tyres can be improved by adding a special supporting sidewall structure that allows the tyre to make it to the nearest service station completely devoid of an air pressure. This work evaluates the performance of a run-flat tyre that combines unique wheels and tyres used for original equipment vehicle applications. It involves the analysis of maximum tangential force at the instant of tyre burst, reaction at the supports and run- flat tyre vibration. It has been shown experimentally that the vibration of a run flat tyre in the region near the contact patch can be represented by a set of decaying waves thus; a run flat tyre was modeled as a lossy wave guide in which decaying waves propagate in the circumferential direction. The gliding times obtained before inserting run flat tyre for gliding distances of 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100 and 1200m are 150, 180, 205, 230, 255, 270, 295, 315, 335, 360 and 400s. Similarly, the gliding times obtained after inserting run flat tyre for the same distances mentioned above are as follows: 100, 120, 150, 170, 190, 225, 255, 275, 290, 320 and 340 respectively. It can be concluded that the vehicle maintained its linear driving at maximum left and right turns.

***Index Terms*—Continuous research, development, gliding times, gliding distance**

I. INTRODUCTION

Studies show that tyres have played an important role in determining a vehicle's overall comfort and safety. However, tyres are being exposed to harmful conditions such as extreme temperature, exposure to the elements and attacks by debris on the road during their life (Dongpin, 2012). Rum-flat tyre improves on standard tyres by adding a special supporting side wall structure that allows the tyre to make it to the nearest service station completely devoid of an air pressure

It places most of the mechanical task of providing run-flat capability on the wheel which typically does not wear out or need to be replaced. It also minimizes the responsibility of the tyre which does periodically wear out and requires replacement. (Jogdarnd, et al, 2012).

Run Flat is custom built to meet the specific load rating criteria and distance requirements of the application. Composite Run-Flat products are specified on numerous government and security vehicles

where flat tyre mobility is critical. In addition, the Composite Run-Flat is used on emergency vehicles, prisoner transport trucks and surveillance vehicles and in similar applications where continued mobility is essential. It is very easy to install using only two bolts, and can drive a minimum of 30 km at 30 km/hr with all four of tyres flat. The device is inserted into a tubeless tyre, which is in turn fitted around the wheel, thus becoming an "assembly" of complimentary components all designed to work together to provide optimum mobility. Two types of wheels are satisfactory for use in this "assembly" either a "2-piece bolt together" or a "3-piece lock ring style" which utilizes a lock ring and side ring to secure all the parts together. However, the design of the run flat has to allow for the tyres to be re-fitted and therefore no bead lock is possible and so the tyre will effectively "float" on the wheel causing lack of control when running flat

Run-flat tyres possess the following advantages (i) it cannot move on the wheel during emergency braking and therefore the balance is not affected (ii) tyre cannot slip on the wheel enabling the vehicle to negotiate steep holls with one or all four tyres deflated, sand, dirt and mud cannot get into the tyre when flat, tyre beads are locked to the wheel flanges giving superior corner ring and steering control. However, rum-flat tyre has the some limitations. It has to allow for the tyres to be re-fitted and therefore no bead lock is possible, the tyre will effectively float on the wheel causing lack of control when running flat. The installation is also very hazardous for the fitter - as he has to work with his hands inside the tyre. This is extremely dangerous and he can easily damage the tyre in the process. But run flat tyre cannot move on the wheel during emergency braking, and therefore the balance is not affected. The tyre cannot also slip on the wheel, enabling the vehicle to negotiate steep hills with one or all four tyres deflated. Sand, dirt and mud cannot get into the tyre when flat which would seriously reduce the performance of a run flat. The tyre beads are also locked to the wheels flanges giving superior cornering and steering control.

This work evaluates the performance of a rim-flat tyre.(Dongpon, 2012) .(Luca, et al, 2011), Jogdarnd, et al, 2012, Boada, et al, 2005).

II. METHODOLOGY

In this research, performance of a run flat tyre was evaluated. Device performance is an indication of the degree of success with which the device does the job assigned to it. The run-flat device was fitted on the vehicle and the following tests were carried out.

- Gliding test
- Test for maximum tangential force at the instant before and after inserting run-flat tyre.
- Test for maximum tangential force on cyclonical curve driving

These tests were based on the following:

(1) Rule of automobile road test method
(2) Technical condition of motor car operation

The self-supporting run flat tyre insert used is as shown below.

Plate 1: Run-Flat Tyre

Plate 2: Experimental Set up

III. RESULTS

Table 1: Test condition: the following test conditions were also recorded

Date	14-11-2017
Place	Yaba College of Technology
Weather	Sunny
Load on vehicle (kg)	350
Vehicle Type	Mazda, V6 Engine

Table 2: Gliding test

Gliding Distance (m)	**Gliding Time (s) Before inserting run flat tyre**	**Gliding Time (s) After inserting run flat tyre**
200	**150**	**100**
300	**180**	**120**
400	**205**	**150**

500	**230**	**175**
600	**255**	**190**
700	**270**	**225**
800	**295**	**255**
900	**315**	**275**
1000	**335**	**290**
1100	**360**	**320**
1200	**400**	**340**

Table 3: Test for maximum tangential force at the instant of tyre inserting run-flat

Vehicle tyre : R15		
Item	At the instant of run-flat tyre	Keep linear driving after inserting run-flat tyre
Left turn	Maximum	Maximum
Right turn	Maximum	Maximum

Table 4: Test for maximum tangential force on cyclonical curve driving

Vehicle type	Mazda, V6	
Item	Before inserting run-flat tyre	After inserting run-flat tyre
Left turn (N)	Maximum	Maximum
Right turn (N)	Maximum	Maximum

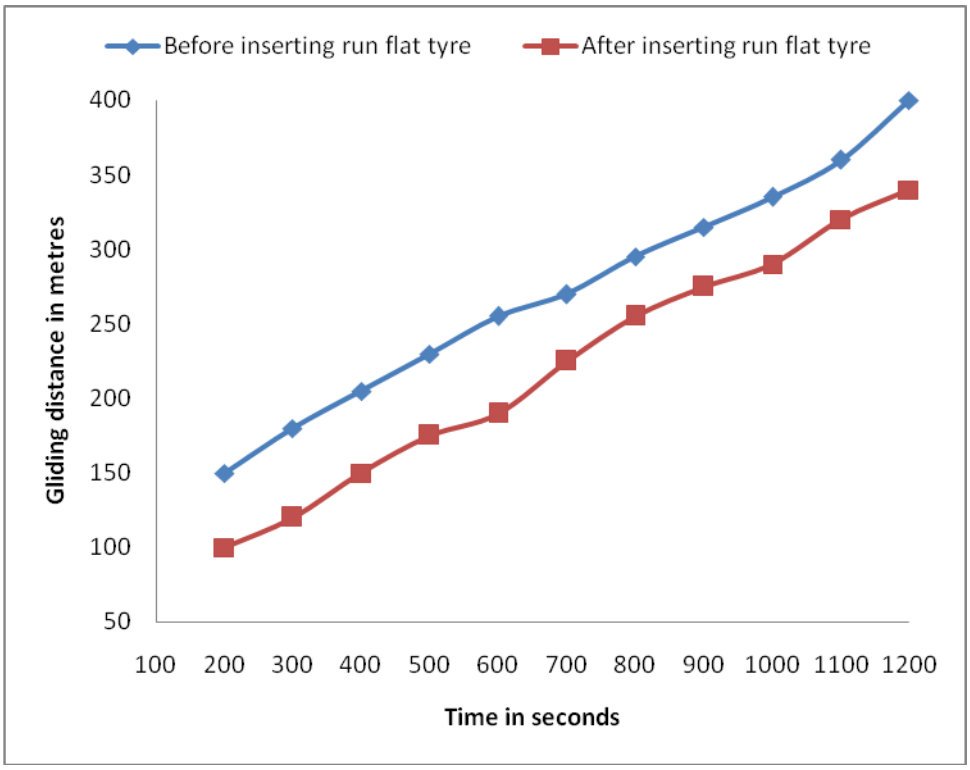

Figure: 2

IV. DISCUSSION

Table 2 above depicts the results obtained before and after inserting run flat tyre, the result showed that there was sharp reduction in gliding times after inserting run flat tyre.

V. CONCLUSION

This work evaluated a run- flat tyre that combines unique wheels and tyres used for vehicle applications. In these systems, the flat tyre's tread rests on a support ring attached to the wheel when the tyre loses pressure.

REFERENCES

[1] Day, T.D and Roberts, S.G. 2002. A simulation model for vehicle braking system fitted with ABS. SAE paper 2002-01-0559.

[2] Dongpin X. and Guang D. 2012. Tyre burst detecting and anti-deviation system and method. United States Patent Application Publication. Pub. No: us 2012/0053792 AL.

[3] DSTI 2016. Dynamic Sealing Technologies Incorporated. Design and Manufacturing of Rotary Unions and Swivel Joints. United States of America.

[4] Duff, N. 2011. Design and manufacturing of rotary unions. Published by Columbus Mckinnon Corporation, 205, Crosspoint Parkway, Gertzville, New-York, United States of America.

[5] Eaton, W.P and Smith, J. H., 1997. Micromachined Pressure Sensors: Review and Recent Development. Smart Electronics and Mems-Smart Structures and Materials. 3046 Pp 30-41.

[6] Eren, Y., Erdinc, O., Gorgun, H, Uzunogln M and Vural, B. 2009. 'A fuzzy logic based supervisory controller for an FC/UC hybrid vehicular power system', *International journal of Hydrogen Energy* 34(20):8681-8694.
[7] Federal Road Safety Commission reports 2008. Annual Reports of the Federal Republic of Nigeria road safety agency. .
[8] Firestone 2011.Two-tube safety device for large tyres. Commercial motor transport, Truck and Driver Magazines.5, The Courtyard, Timothy's Bridge road, Stratford Upon Avon, Warwickshire, England.
[9] Flemming W. J 2001. Overview of automotive sensors. *IEEsensorsjournal*1:296-308