ASSESSING THE KNOWLEDGE OF VEHICLE USERS AND VULCANIZERS OF TYRE PROFILE ON VEHICLE PERFORMANCE

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Abstract- Motor vehicle tyres are costly and plays an important role in the motor vehicle handling, hence it is important they are handled by well- trained people. A survey of one hundred and eighty (180) drivers and twenty (20) vulcanizers at Sekondi -Takoradi metropolis, Ghana were conducted to assess their knowledge of tyre profile on vehicle performance. The objectives of the study were to identify the knowledge of vehicle users and vulcanizers on tyre mixing on vehicle performance, to determine the knowledge of vehicle users and vulcanizers on the life cycle of tyre on vehicle performance and also to find out whether vehicle users and vulcanizers have knowledge on tyre inflation/loading as an effect on vehicle performance. The survey adapted a descriptive study design. Both simple random and snow ball techniques were used to select the sample for the study. Questionnaire design on a likert scale was employed for the primary data collection. The deviation around the mode of their knowledge on tyre mixing, tyre life cycle indicated that, the respondents had low knowledge in tyre mixing and tyre life cycle as a way of affecting vehicle performance. On the tyre inflation/loading, the respondents had excellent knowledge in inflation pressures of tyre but had fair knowledge in tyre loading as a way of affecting vehicle performance. The responses to the survey on tyre rating showed that, the respondents had excellent knowledge in rim size, but had low knowledge in the areas of speed of tyres and aspect ratio. The survey draws a conclusion that, most licensed drivers and vulcanizers within the study area had low knowledge in tyre profile and it's usage as a way of affecting vehicle performance.

Index Terms- Tyre profile, Expiring date, Aspect ratio, Inflation pressure

I. INTRODUCTION

The vehicle handling is directly related to the tyre-road contact. The tyres absorbs and transfer the horizontal and vertical forces acting on the vehicle as a result of steering, braking and driving in combination with possible road disturbances or external disturbances. The tyre is a rubber construction, significantly re-enforced by metal and composite materials. The tyre is the sole point of interaction between ground and vehicle. While a rubber compound acts as the final interface towards the texture of the track, its performance is also affected by various mechanical re-enforcements and chemical additives, working to offer good maneuverability to the driver [7]. The tyre is a complex technical component of today's motor cars and must perform a variety of functions. It must cushion, dampen, assure good directional stability, and provide long-term service [2].

The role of tyres is crucial in vehicle performance and hence, it is important that vehicle users must be knowledgeable in its handling. The vehicle users and vulcanizers require special knowledge, skills and training. It is also important that tyres are handled by well-trained people (vulcanizers) due to the role the tyre plays in vehicle performance. Having the requisite background of tyre profile is a key to an efficient and effective tyre handling. Therefore, there is a need to assess the knowledge of vehicle users and vulcanizers on tyre profile as an effect on vehicle performance. Results from the study could be used for making policy decisions on acquisition of driver's license and also training of tyre mechanics. The objectives of the study were to identify the knowledge of vehicle users and vulcanizers on tyre mixing on vehicle performance, to determine the knowledge of vehicle users and vulcanizers on the life cycle of tyre on vehicle performance and also to find out whether vehicle users and vulcanizers have knowledge on tyre inflation and vehicle loading as an effect on vehicle performance.

II. TYRE PROFILE

There are a large number of tyres for passenger cars and light trucks intended to meet the needs of a wide variety of consumers, vehicles and operating conditions. Selecting and utilizing the proper tyre starts with an understanding of the basics of tyre size, type and load capacity (or load range), [8]. The tyre profile also includes, tyre mixing and life cycle.

A. Loading and tyre inflation

The load carrying capacity of a tyre depends on the tyre size, construction, inflation pressure, operating speed and the duration of loading. Inflation pressure is governed by the load carried by a given tyre, all though manufactures vary the pressure to modify the steering characteristics. Large section tyres uses lower pressure for a given load and greater comfort is achieved, but the resistance to rolling is increased. The pressure recommended by the manufacturer is applicable to a cold tyre i.e. it is the pressure before the tyre is used, and takes into account the average pressure rise ($28kN/m^2$) which is caused by the temperature during use [4]. Tyres should be inflated to ensure their suitability for the purpose they are being used, usually this means in line with the vehicle manufacturer's recommendation. Tyres are designed to accept a maximum load as indicated by their Load Index and then only when correctly inflated. If the maximum load is exceeded or the inflation pressure used is inadequate for the load being carried, it will result in reduced service life, increased fuel consumption and in severe cases premature failure of the tyre [9]. Also inadequate tyre pressure and over loading will results in difficult steering.

B. Tyre rating or specification

The sidewall of tyre provides the information about the tyre including the specifications, the brand, etc. All the codes on tyres are standardized and recognized by all tyre manufacturers worldwide. Figure 1 shows a side wall of tyre specification and rating.

Fig.1 Tyre side wall specification and rating
[5]

Meaning of codes marked on tyre in fig.1:
1. Tyre width (in mm)
2. Aspect Ratio
3. Rim Diameter (in inches)
4. Load Index
5. Speed rating

Specifications of tyre marked on sidewall on above image as 235/45R17 97W
The '235' indicates the section width of the tyre in millimeters.
The '45' tells the 'profile' of the tyre, or the width of the tyre compared to its height. It is expressed in percentage. (45%, in this case).
The 'R17′ indicates the size (in inches) of the wheel rim to which the tyre is designed to be fitted.
The '97' indicates the tyre's load index, and
The 'W' denotes the speed rating [5; 6]**.**

C. Tyre mixing

To achieve optimum performance, vehicle should be fitted with a matching set of tyres. For certain high performance cars, matching sets of vehicle manufacturer approved tyres are recommended to maintain the handling characteristics of the vehicle. It is not proper to mix tyre sizes and to mix tyre constructions e.g. radial, cross-ply etc., across an axle. It is also improper to fit radial tyres to the front axle and cross-plies to the rear. It is inadvisable to mix tyres of different categories on a vehicle, e.g. summer tyres, winter tyres, and "run flat" tyres, on/off road tyres, etc. and never across an axle. It is also not recommended that tyres with significantly different states of wear be mixed across an axle. Special care should also be taken with 4x4 vehicles where some vehicle manufacturers specify a maximum tread depth difference between axles, [9].

D. Life cycle of tyre

Consumers also need to be aware that the age of a tyre can influence service performance and should seek advice in order to establish if a tyre needs replacement. Conditions of storage and use will influence the rate at which a tyre ages. Typical symptoms of tyre ageing are cracked/crazed sidewalls and/or distorted tread. There is nothing in the current legislation that requires a tyre over a certain age to be replaced.
However some tyre and vehicle manufacturers do specify a recommended maximum age at which tyres should be replaced, [9]. Figure 2 shows an example of tyre expiring date code

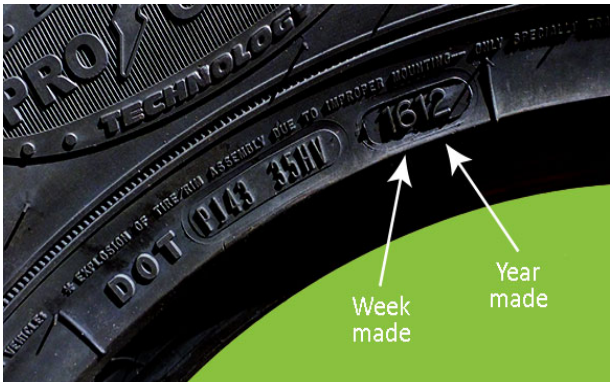

Fig.2 Tyre date expiring date code
[1]

Tyres have expiring date. To start with, vehicle tyre has a 6-year validity period from their date of manufacture (DOM). To find out whether your tyre has expired, a stamp like this (*1612*) in fig.2, is indicated on the tyre. There is an asterisk at the beginning and at the end of this serial number (some tyres don't have asterisk). The first two digits (16) indicates the week and the second two digits (12) indicates the year of manufacturing. Therefore, *1612* shows that, the said tyre is manufactured in the sixteenth (16^{th}) week of the year 2012.Tyre aging is a “hidden hazard” because most consumers do not know that tyres expire in six years and it is difficult for most consumers to tell how old a tire is without deciphering an 11-digit code that is imprinted on the side of the tyre. Federal rules mandate that the tyres with Department of Transport (D.O.T.) code be clearly branded or etched on the side of each tyre. For most tyres, the D.O.T. number is typically 11 digits. If the tyre has only 10 digits, the tyre was manufactured before the year 2000. Figure 3 below shows a current D.O.T. number for a tyre made in the fifth week of 2011, [1].

Fig.3 Current D.O.T number for a tyre
[1]

A survey conducted by [5] showed that, only 4% of consumers are aware that tyres become more dangerous as they age. A large body of scientific evidence supports that most tyres should be replaced six years from the date they are manufactured. This six-year expiration date begins from the day the tyre was manufactured at the plant not the date it was sold to a consumer or the date that it was installed on a vehicle. Most consumers either do not know that this code exists or do not understand its significance.

III. RESEARCH METHODOLOGY

A. Research Design

The design used for this study was that of survey which relied on questionnaire to generate data for the analysis. The study was to find out the knowledge of tyre profile on vehicle performance among vehicle users and vulcanizers in the Sekondi-Takoradi Metropolis.

B. Study Area

Sekondi-Takoradi Metropolis is located at the south-eastern part of the Western Region. The Metropolis is bordered to the west by Ahanta West District and to the east by Shama District. At the south of the Metropolis is the Atlantic Ocean and at the northern part is Wassa East District. The Metropolis covers land size of 191.7 km^2 and Sekondi-Takoradi is the regional administrative capital. Though the smallest district in terms of land size, the Sekondi-Takoradi Metropolis is the most urbanized among the 22 districts in the region.

The population of Sekondi-Takoradi Metropolis, according to the 2010 Population and Housing Census, is 559,548 representing 23.5 percent of the region's total population. Males constitute 48.9 percent and females represent 51.1 percent. Ninety six percent of the population is urban. The Metropolis has a sex ratio of 95.6, [3].

C. Study Population and Sample

The study populations were: (a) vulcanizers (b) saloon car users (c) commercial cars (trotro) drivers and

(d) Heavy duty truck vehicle drivers. The populations included people with valid driving license, vulcanizers and have at least two (2) years' experience as field experience. A simple random sampling technique was used for the vehicle users and snow ball for the vulcanizers.

D. Instrument and Data Collection

The data used in this study were collected during a survey mounted by the researcher between July and October 2017. By means of structured questionnaires, data were obtained from a total of 200 respondents. The 200 respondents which includes, 20 vulcanizers, 80 saloon car users,60 commercial car users (trotro) ,40 heavy duty vehicle drivers. For the purposes of the study, the respondents were selected within Sekondi-Takoradi metropolis.

The questionnaires were personally administered by the researcher that gave the opportunity to interact with the respondents, explained in details the rationale for the research and gave explanation where necessary. Enough time was giving to the respondents to answer the questionnaire of which the questionnaires were collected on the same day. A likert scaling questionnaires were used and was rated as 1. Excellent, 2. Very good, 3. Good, 4. Fair, 5. Poor

IV. RESULTS AND DISCUSSIONS

A. Tyre mixing

The respondents were asked to state their knowledge of tyre mixing on vehicle performance in relation to tyre plier, tyre arrangement and the thread pattern. Fig. 4 presents the summary of the responses on tyre mixing.

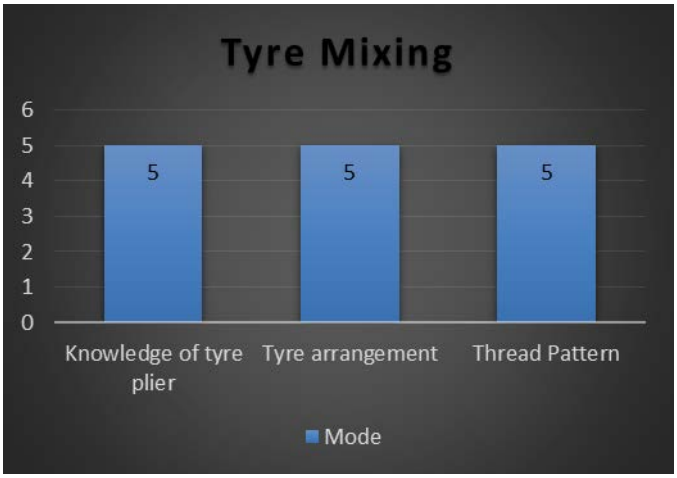

Fig. 4: Tyre mixing

The results indicate that, out of the 200 responses, the deviation around the mode indicates that, the knowledge of tyre mixing which is a subset of tyre profile on vehicle performance is poor. This means, the respondents do not have keen knowledge of tyre mixing as a way of affecting vehicle performance.

B. Tyre life cycle

The summary of respondents' responses on life cycle as a subset of tyre profile is shown in fig.5

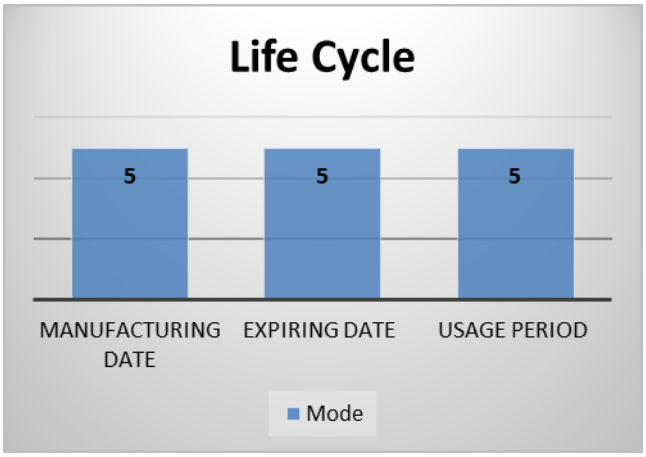

Fig. 5: Life cycle of tyre

On tyre life cycle, the results indicated the deviation around the mode to be 5, which means that, all the respondents have poor knowledge of life cycle of tyre in relation to manufacturing date, expiring date and usage period on vehicle performance.

C. Tyre inflation/loading

The respondents were asked to indicate whether inflation/loading of the tyre have impact on vehicle performance. Fig 6. Shows the summary of results.

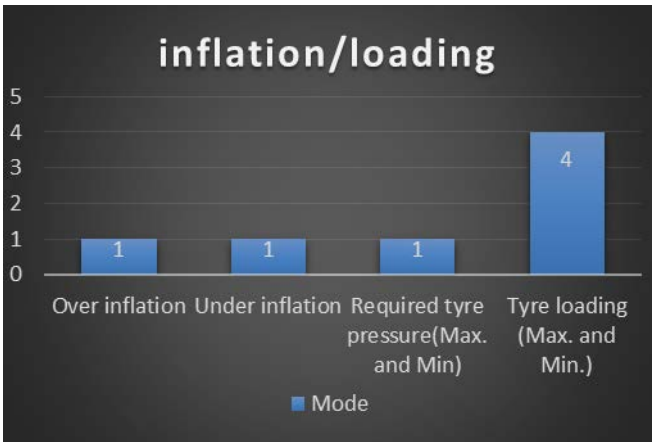

Fig. 6 Tyre inflation/loading

Invariably, the respondents indicated deviation around the mode of 4, which shows fair knowledge of tyre loading as a way having impact on vehicle performance but in relation to over inflation, under inflation and the normal required tyre pressure for vehicle operation, the results indicated deviation of the mode around 1, which implies that, the respondents have excellent knowledge of over inflation, under inflation and required tyre pressures.

D. Tyre rating

The respondents were asked to indicate their knowledge of tyre rating in relation to speed rating of tyres, aspect ratio and rim size. Fig. 7 shows the summary of the results.

Fig. 7: Tyre rating

The results indicates that, the deviation around the mode was 5 on the knowledge of speed of tyres and aspect ratio, this implies that, the knowledge is poor, again the knowledge of rim size is 1 around the mode, which shows that, the respondents have excellent knowledge of rim size.

V. CONCLUSION AND RECOMMENDATION

The survey draws a conclusion that, most licensed drivers and vulcanizers within the study area have low knowledge in tyre profile and it's usage as a way of affecting vehicle performance.
The study recommends that law enforcing agencies should ensure vehicle tyre users adhere to manufacturers recommended tyre operating conditions, since it plays a role in vehicle handling. The study recommends that, tyre technicians, vehicle examiners and tyre sales staff need the ability to read and interpret a range of data and related specifications as found in vehicle manuals, tyre catalogues and tyre markings. This not only requires the ability to read and extract the information but also the knowledge to understand what it means and the skills to communicate this orally (for example, to a customer, supervisor or driver). Additionally, the vehicle examiners should educate tyre users on tyre profile thus; tyre mixing, rating/specification, inflation/loading and tyre rating as a way of affecting vehicle performance.

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