

# COMPARATIVE ANALYSIS OF CHARACTERISTICS OF PASSENGER CAR TIRES IN SERBIA

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*The paper presents the results of the condition and characteristics of tires that are in use in Serbia. Data on wear patterns, sizes, ages, brand, type, more than 700 tire and vehicle information to which they are mounted. Data about tread depth, dimensions, tire age, brand and type of more than 700 tested tires were gathered, as well as information about vehicles to which they are mounted on.*

*Primary conclusion on tire condition is positive, notably better than the Serbian vehicle fleet condition. Average age of tires was around three years and measured tread depth about 5 mm.*

*A significant part of the examined vehicles was equipped with winter tires. First survey (Belgrade, November 2009) for winter tire usage had good showings with around 25% cars equipped with such tires. During the second survey (Belgrade, July 2010) decline of about 5% was found. In Užice, where survey was conducted in November of 2010 it was found that the percentage of winter tires increased up to 50%. Structure and age of the passenger cars fleet in Serbia have been assessed as unsatisfactory. With the current level of fleet renewal such a situation will be very slowly changing for the better and that will affect both the structure and characteristics of tires that will be bought in Serbia in the coming years.*

*With the current level of renewal of the fleet, such situation will be very slowly changed for the better that will affect the structure and characteristics of tires that that will be purchased in the coming years in Serbia.*

*Keywords: Tires, Winter tires, Tread depth, Tire age, Car age.*

## INTRODUCTION

Tires are very important for safety of transportation, its economy and comfort. They are subject to a diversity of use and operating conditions: depending on the vehicles they are mounted on, way of use and maintenance practice of their consumers, the environment in which they operate, and random events that can cause damage or affect their operation.

The kind of tires used in some countries, the way they are used and their overall condition depends on the level of knowledge, taste and financial situation of its citizens as well as on the charac-

teristics of the vehicles used, road network condition, climate and many other factors.

In order to see a real picture in the field of tires in Serbia the following has to be considered: Serbia has a population of 7.4 million and about 1.5 million passenger cars in use in 2008 (Table 1). As a result, there are about 202 cars per 1,000 inhabitants. These numbers makes Serbia medium motorized country. Average household in Serbia has 3 (2.97) members. With an assumption that 7% of passenger cars [7] are used as a second car in household, it is easy to calculate that about sixty percent of the households in Serbia have at least one car.

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Table 1. Registered passenger cars in Serbia between 2004 and 2008

Registered cars in Serbia	Year					
	2004	2005	2006	2007	2008	2009
Total registered cars	1,422,578	1,481,497	1,511,837	1,476,642	1,486,174	1,637,002
First registered cars	85,430	42,286	67,044	77,303	87,284	126,382
First registered new cars	21,197	21,523	25,530	32,684	36,085	44,682
Imported used cars first registered in Serbia	64,233	20,763	41,514	44,619	51,199	81,700

Sources: Republic of Serbia Ministry of Interior and Association for Motor Vehicles Manufactures of Serbia

Table 1 shows that the number of the first registered cars increased slightly, but on the other hand the total number of registered cars in Serbia stagnated up to 2009. A possible reason was that the number of written off cars in the monitored years was only slightly smaller than the number of first registered ones. According to the preliminary data in disposal (the data had certain illogicality) number of cars in use has risen by 10%.

Simultaneously the number of the first time registered cars was also on the rise. Direct comparison between 2004 and 2009 statistics is 21,197 to 44,682 respectively. The number of used cars (imported from abroad) also grew in this period.

The first oscillation in the number of first time registered used cars happened between 2004 and 2005. The application of the new regulations regarding vehicles import started in 2005. The second change was caused by the Government decision to allow unconditional three-month import of used cars in 2009. Interestingly, it did not hinder the rise in number of new cars. This happened primarily due to the Government subsidies for the purchase of Fiat Punto models.

The average age of registered vehicles in Serbia in 2008 was about 16 years. More than 55% of vehicles were older then 15 years (Figure 1).

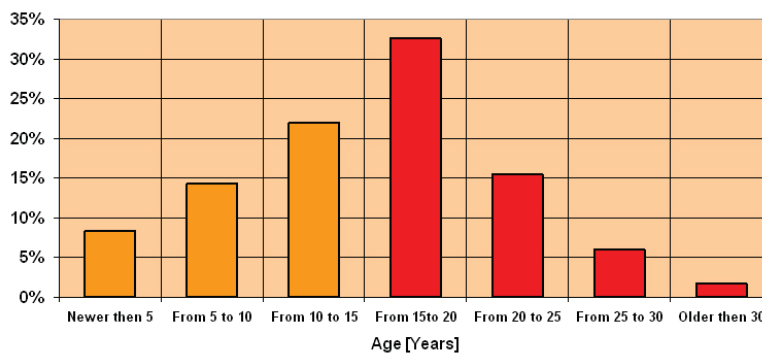


Figure 1. Cars in Serbia – Age Distribution in 2008 [2]

The average age of vehicles has not changed significantly regardless of new purchases in the last five years [3]. A possible reason was that purchases of new cars were still insignificant (only 3% of registered vehicles). This situation was also affected by the large import of used cars, which were from four to seven years old.

Based on the research that the “Synovat” Company and the Serbian magazine “Vrele gume” [10] carried out in 2008, the structure of the Serbian fleet with respect to manufacturers and brands presented Zastava and Fiat models as one third of all registered cars, followed by Opel

and Volkswagen. All these cars had up to 1.4 litre engines and belonged to the group of small cars. Cars sale in 2010 confirms this. Figure 2 gives an insight to sales in year 2010, made class-wise [5].

As shown in diagram, class B cars represent 50% of the total sales, with models like Punto (30.31%), Dacia (8.83%) and Škoda (8.34%) which dominate the market [5].

Currently, there are three tire plants operating in Serbia. These are: Tigar Tires from Pirot, Trayal Corporation from Kruševac and Rumaguma from

Ruma. However, there is a fourth tractor tire factory in Belgrade, named Rekord whose production has been stalled for a long time.

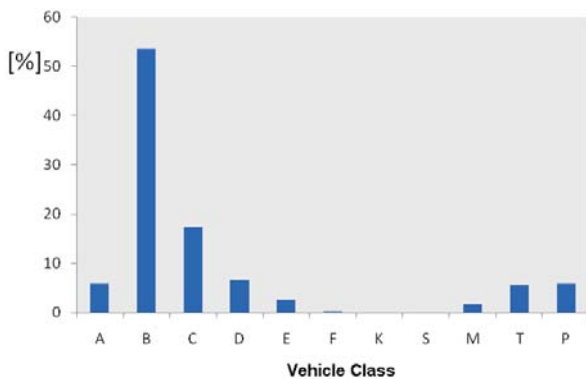


Figure 2. Passenger cars sold in Serbia by for 2010 – Distribution by vehicle class [5]

Tigar was founded in the year 1935. The first radial passenger tire produced in Serbia was made in Pirot in 1972. Two years later, Tigar started the cooperation with BF Goodrich from the USA. When Michelin took over Goodrich in 1997, Tigar signed the Joint Venture Agreement with Michelin North America. Presently, the tire factory is a part of the Michelin group with the new name “Tigar Tyres” and the production of 6 million car and light truck tires per year.

Trayal Corporation was founded in the 19th century. Factory’s name and its modern production of road vehicle tires date back to 1974 as the result of the joint venture and technology adopted from French factory Kleber. The current owner of the company is the Bulgarian company Brikel. Trayal’s average production over the past five years has been 1.8 million tires, 1.8 million tubes, plus another 700,000 two-wheeler tires.

Rumaguma has been operating in the rubber industry since 1981. In 2003 the plant was bought by company Galaxy from USA. In 2008 Czech company Mitas has taken over the factory from Galaxy. Rumaguma produces the tires for heavy vehicles, agricultural machines and building machines. Factory has a production capacity of 15,000 tonnes of tyres per year.

The production of car and commercial vehicle tires in Serbia in 2008 was about 8 million pieces. In 2008 approximately 1,500,000 tires for passenger cars have been sold. It amounts to one tire per registered vehicle in Serbia in 2008. The market share of domestic manufacturers was slightly higher.

## MATERIALS AND METHODS

This paper is about characteristics and condition of tires used in Serbia, as well as about vehicles utilising them. Majority of research (3 out of 4) were conducted by University of Belgrade - Faculty of Mechanical Engineers. It took place in period of two years: October and November 2009 [6] and June and July 2010 in Belgrade [8], and in December 2010 in Užice [10]. These researches have been part of student’s diploma works [5, 6, 8]. Total number of cars surveyed was 842 with 592 (244+348) cars in Belgrade and 250 cars in Užice.

Cars included in Belgrade survey were found on parking spots near faculties, public buildings and shopping centres. For the purpose of this research, measurement of tread depth was taken by “Mitutoyo 571-100” depth gage.



Figure 3. Depth Gage “Mitutoyo 571-100”

In addition, for the observed tires and vehicles the following data were recorded:

- Vehicles: brand, type, model, year of a model launch (estimated), year of production (estimated);
- Tires: tire size, tire width, tire design (winter or no winter use).

There was an intention to engage measuring tire pressure in the research. From this we gave up, regardless of its importance for the tires reliability and lifetime [4, 1]. We gave up because it was impossible to obtain the approval of the absent car owners for such operation.

Form used for gathering data for further analyzes is shown on Figure 4.

Survey in Užice was concentrated on gathering information from vehicles brought to technical inspection, and was further expanded to cars on public parking lots.

Similar survey organized by “SAT Plus” automo-

bile magazine took place in November 2010 [9]. The journalists interviewed, with the help of traffic police, about 20 passenger vehicles (120 tires) on the main road Belgrade – Užice.

Location: _____						Date: _____					
<b>Car</b>						<b>Tires</b>					
No.	Brand of the car	Model of the car	Year of production	Year of the launch of the car model	Producer	Type	Sort	Dimensions	Tread depth [mm]	Production date	Tires are same
1.											

Figure 4. The form that was used to record data

**THE RESULTS AND ANALYSIS OF THE RESULTS**

A part of the research results is presented in this paper. The first part of the results is related to the characteristics of cars that are observed. Analysis showed, as expected, that the largest number of the observed vehicles were Fiat and Zastava models, mostly small cars, such as Yugo, Punto and Panda. In Belgrade these were followed by the Opel models i.e. Kadett, Corsa and Astra.

VW Polo and Golf models, and Felicia and Fabia “Škoda” models (Figure 5) succeeded. In Užice the situation is similar except that the Opel and VW brands swap their places.

The age distribution of the observed vehicles during the survey is shown in the Figure 6. The age of model of vehicles was estimated based on the data obtained from the drivers or from a catalogues or Internet.

The average age of cars included in the re-

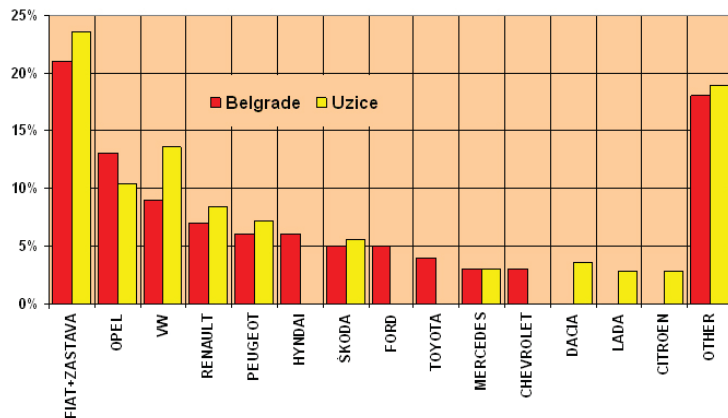


Figure 5. Structure of the Observed Vehicles – Manufacturer distribution [5, 6, 8]

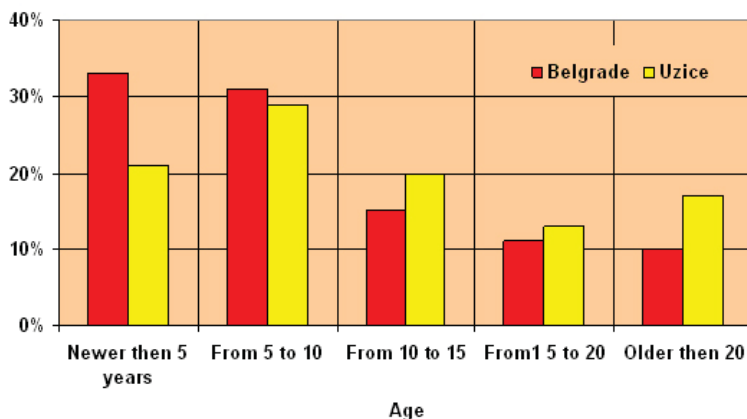


Figure 6. Observed vehicle Characteristics - Age Distribution [3, 5, 6, 8]

search was lower than the average age of Serbian passenger car fleet. Note that the average car age was lower in Belgrade surveys opposing to Užice.

Also interesting is the analysis of year when the models of observed cars were launched. The results conducted in Užice are presented below (see Figure 7).

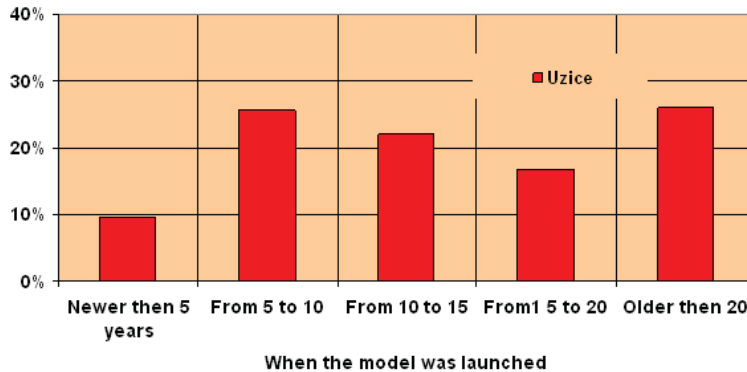


Figure 7. Observed vehicle Characteristics – Model Age Distribution [5], location Užice

The figures 5, 6 and 7 clearly suggest that customers choose older (and cheaper) vehicle models. In Užice, 20% of vehicles in the control group were younger than 5 years, but only 5% of that number is models younger than 5 years. A good example is the best-selling car in Serbia Punto

which is last time redesigned by FIAT in 2003.

The second part includes the results for observed tires including the type and brand of tires. Diagram on the Figure 8 shows tire brand distribution on surveyed vehicles with a notation that the only tire measured was the front left tire.

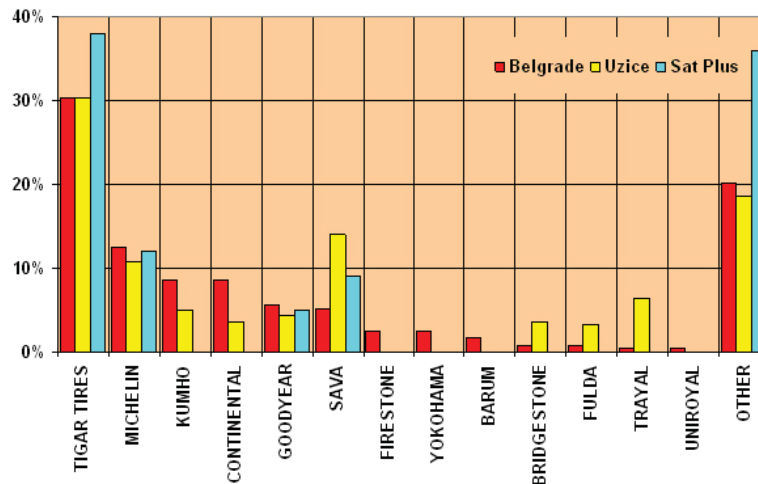


Figure 8. Tires on Observed Cars - Tire brands distribution [5, 6, 8, 9]

Most reviewed cars have Tigar Tyre tires as it is shown in the Figure 8. Michelin, Sava, Kumho, Continental, Goodyear tires follow. There are some differences between surveys conducted in Belgrade and those in Užice where Sava (14%) and Trayal (6.4%) tires have a considerable share. Research on “Ibarska magistrala” conducted by “Sat plus” have shown bigger share of Tiger tires (38%).

Furthermore, the research also included the analysis of a tread depth on the observed tires. The first conclusion was that the observed tires

were in a satisfying condition (Figure 9). Average measured tread depth was about 5 mm. This turned out to be far better than expected in the onset of the study. Only two percent of observed tires were below the legal limit (1.6 mm).

It is important to mention that more than 70% of the observed tires in Belgrade have more than 4 mm of tread depth, which should guarantee a good grip in wet and winter conditions. Situation in Užice is even better with 84% of tires with more than 4 mm of tread depth. This is logical if one takes into account where the survey was conducted (vehicle technical inspection).

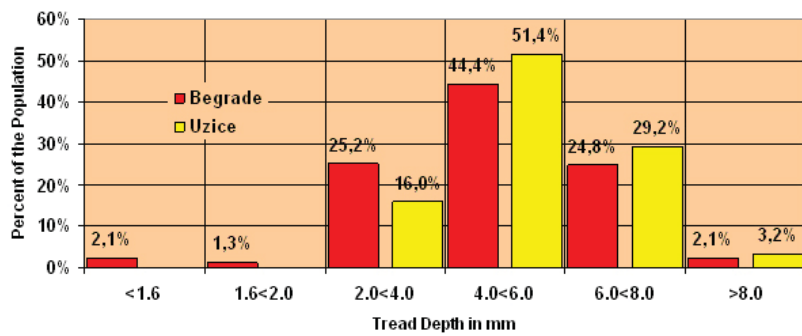


Figure 9. Tires on Observed Cars – Tread depth distribution [5, 6, 8]

Results of measured tread depth in “Sat-Plus” survey (Figure 10).

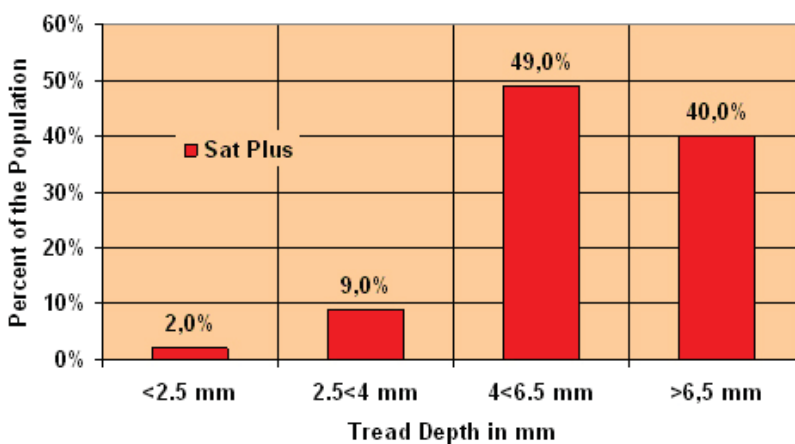


Figure 10. Tires on Observed Cars – Tread depth distribution [9]

Results are even better with 89% of vehicles with tires with tread depth deeper than 4 mm. However, a number of vehicles (2%) had worn tires. According to [9] the lowest value was 1.27 mm.

A considerable number of vehicles were equipped with winter tires, which is understandable if we

take into account that the research was conducted at the end of autumn 2009 in Belgrade, and nearly in same time in Uzice in 2010 (Figure 11).

The average tread depth on winter tires (Belgrade) was slightly higher than the overall average and amounted to 5.87 mm [3, 6, 2].

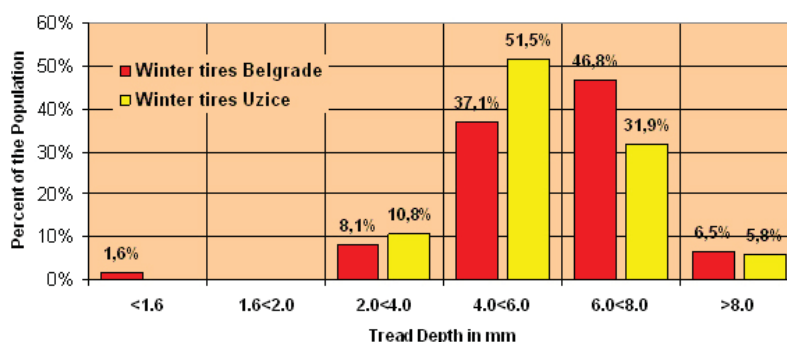


Figure 11. Winter Tires on Observed Cars – Tread Depth Distribution [2, 4, 5, 10]

Winter tires were found on every fourth vehicle (at least at the front wheels). In Uzice situation was even better [5]. Winter set of tires were found on half of observed vehicles (51.2%) with the average tread depth nearly same as in [6].

The results of research of tire sort published in

[9] are shown in Table 2.

From the presented data it is clearly concluded that the 76% vehicles from all those observed, had at least one winter tire. Rest had summer tires (20%), and (4%) so called “all season tires”.

Table 2. Sort of tires on observed vehicles [9]

All winter tires	46%
All summer tires	20%
Winter tires on drive axle	20%
Winter tires on no drive axle	10%
Universal – All season tires	4%
<b>Total</b>	<b>100%</b>

It is important to say that the all season tires despite its undoubted quality cannot compare with winter tires. All season tires didn't pass winter condition tests so it can not be part of winter equipment proposed by the Law.

Positive thing is that the most of the vehicles have winter tires despite the fact that the law on obligatory use of winter tires is not up till 2011-2012. In November 2009 this percentage was 25%, in November 2010 even 50% and, to our pleasure, passenger cars checked on the road had winter tires in 76% cases. This may be caused by increased awareness of the drivers regarding changed regulations announced by new Law. Shown numbers go down after taking

into account July and August research done in Belgrade in 2010. In July share was 20 %, slightly lower then the November 2009 reading. However, as seen before, not many of them decided to store tires for next winter season and used them during summertime period.

For survey period July and November 2010 [5, 8, 2] age of tires was concluded from the research. Special code written on the side of the tire that can trace to the exact date of production of the tire was taken. Figure12 shows placement of production years among control sample.

Almost 70% of control tires in Belgrade are manufactured after 2006, and the average age is less the 3 years (2.86). Only 6% is older then 6 years. Survey in Užice, once again, had different results governing the fact that was already discussed, with 20.8% brand new tires used. Further, this reflected on average age of 2.77% and on the fact that no tire older then 8 years was found. However, the number of old tires which have to be replaced is greater (8.4%).

Survey conducted by the Sat-Plus gives slightly, but not much, different results (Figure 13).

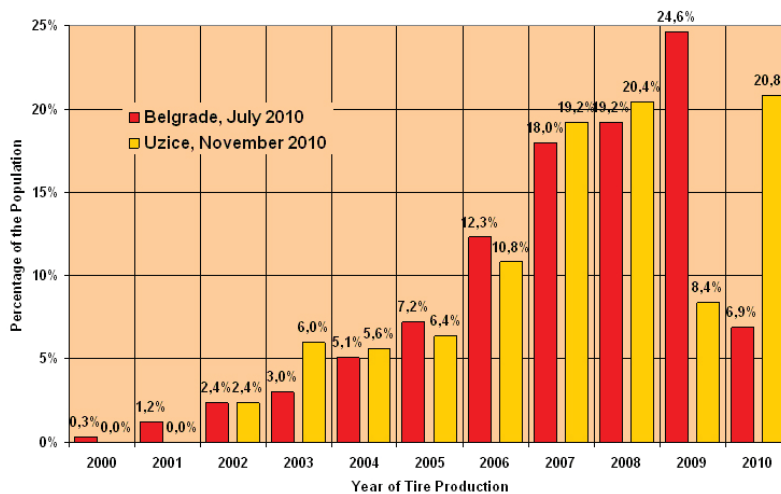


Figure 12. Tires on observed cars - Age distribution [5, 8]

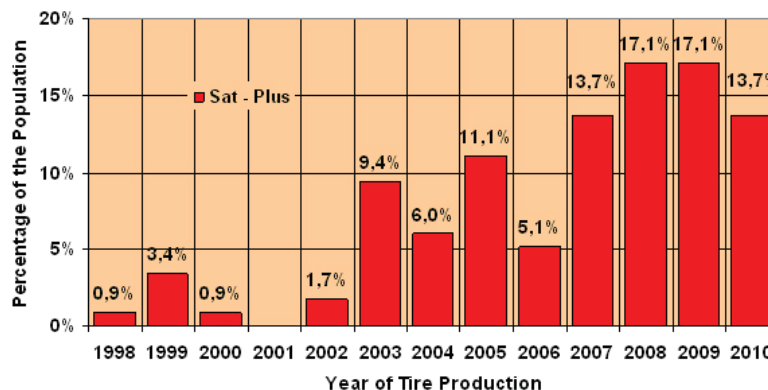


Figure 13. Tires on observed cars - Age of controlled tires distribution "Sat - Plus" [9]

Survey done on Ibarska Magistrala showed higher average age than the one done by the Faculty of Mechanical engineering [5, 8]. Around 16% of tested tires were older than 8 years and no matter their preserved condition, they had to be replaced.

## CONCLUSIONS

Before giving any conclusions, it must be taken into account that this was not an extensive study. Survey included only around 1,000 vehicles. The surveys were carried out in Belgrade, Užice and on the road Belgrade - Užice. For the purpose of this research, the tread depths were measured only on left front wheel. Regardless of possible remarks, certain conclusions are unquestionable.

The situation in Serbia in regard to tires may be defined as satisfying. The results from the research showed that tread depths are in most cases deeper than it is legally required (1.6 mm). Only small part of the observed tires (less than 1%) was below this limit. It is worth mentioning that more than 70% of observed tires have more than 4 mm of tread wear depth, which should guarantee a good grip for both wet and winter conditions. Such positive results may stem from the recently enacted Law on road safety which imposes more rigorous penalties, among others, for driving with improper tires. This is particularly relevant for the increase in purchasing of winter tires.

Observed average tire age was satisfying. 8% of tires is older than 6 years and according to the criteria established by Mechanical Faculty in Belgrade, those tires are considered to be old and fall into expired category [5, 8, 2]. During road surveys [9] situation were much worse. There was found that 16% of tires were older than 8 years.

The Serbian tire market is widely open. Also, drivers have a wide range of products to choose from. Owing to the strong domestic industry, more than 30% of tires purchased in this country were manufactured in Serbia. The remaining 70% were mostly imported from Europe, though they have lately been imported also from the Far East. Number found in Belgrade was around 30%, while Užice had 37% which was similar to the finding of the SAT plus journalists.

Finally, as the Serbian car fleet continues to change, slowly though, the choice of buyers will simultaneously modify. The owners of newer, bigger and more expensive cars would prefer to buy premium tires with modern design which will eventually affect the traffic safety and environmental protection.

## REFERENCES

- 1) Danon G., Mitrović, Č.: Possible Beneficial of Application of TPMS on city buses. Istraživanja i projektovanja za privredu Vol 6 (21), 2008: pp 35-44
- 2) Danon, G., Vasić, B., Simović, Ž.: Kakve pneumatike vozimo, VI naučno stručni skup "Pneumatici 2010", Zbornik radova, Zlatibor, 2010: pp 1 – 7
- 3) Danon, G., Vasić, B.: Serbia's Evolving Tire Market: Wider Choice, and a Strong Domestic Industry, Tire Technology International 2010 – The Annual Review of Tire Materials and Tire Manufacturing Technology, 2010: pp. 108 – 111
- 4) Gavrić P, Danon G., Momčilović V., Bunčić S.: Exploitation and maintenance of commercial vehicle tires. Istraživanja i projektovanja za privredu, Vol 7 (25), 2009: pp 1-10
- 5) Jokić, B.: Analiza stanja i karakteristika pneumatika na vozilima u Srbiji, Diplomski rad, Univerzitet u Beogradu – Mašinski fakultet, Beograd, 2011: pp 32
- 6) Marjanović, M.: Analiza vrsta, tipova i karakteristika pneumatika koji se koriste na vozilima u Srbiji, Diplomski rad, Univerzitet u Beogradu – Mašinski fakultet, Beograd, 2009: pp 54
- 7) Pucci, A. et al: General Master Plan for the Transport in Serbia, Anex 1 – Road Transport, 2009: pp 135
- 8) Simović, Ž.: Analiza pneumatika koji se koriste na vozilima u Srbiji, Diplomski rad, Univerzitet u Beogradu – Mašinski fakultet, Beograd, 2010: pp 46
- 9) Vujanović, T.: Na kakvim gumama se vozimo, Sat-plus, Broj 251, god X, 2010: pp 50 – 55
- 10) www.vrelegume.rs

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