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TYRE RECYCLING

RECIKLAŽA GUMA

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Abstract: *The article deals with problem of tyres reusing and recycling. The first part of article is centred on characteristic and composition of tyres and the second part analyses concrete methods of balds tyres processing.*

Key words: *carwreck, recycling, tyre*

Apstrakt: *Ovaj rad se bavi problemom ponovnog korišćenja i reciklažom guma. Prvi deo rada je usmeren na karakteristike i sastav guma a drugi deo analizira konkretne metode za obradu "ćelavih" guma.*

Ključne reči: *oštećenje automobila, reciklaža, guma.*

1 INTRODUCTION

Approximately 15 million cars and trucks reach the end of their useful life in the world each year. More than 75% of the materials from end-of-life vehicles are profitably recovered and recycled by the private sector. Automotive materials recycling is a success story. Tyres represents one of the most „popular" recycling materials.

1 TYRES

Tyres are the eminent parts and the spotted problem of life of our modern society. They serve to transport, from air transport to safety bicycles. Automobile tyres are responsible in terms of wastes disposal. Weare – out of tyres comes after 30 000 and 70 000 km driving. Speed of wear (so as life – cycle) depends on types and material composition, after on regular service, style of application and on technical condition of the vehicles, too. Figure 1 represents life – cycle of tyres.

1 UVOD

Svake godine približno 15 miliona automobila i kamiona dođu do kraja svog veka upotrebe. Više od 75% materijala iz istrošenih vozila se obnovi i reciklira od strane privatnog sektora. Reciklaža automobilskih materijala je veoma uspešan posao. Gume su među «najpopularnijim» materijalima koji se recikliraju.

1 GUME

Gume su najznačajniji delovi i predstavljaju poznati problem jednog modernog društva. Služe za transport, od vazdušnog transporta do bicikala. Automobilske gume su odgovorne u smislu odlaganja otpada. Pohabanost guma se javlja nakon 30000 i 70000 km vožnje. Brzina habanja (tokom veka upotrebe) zavisi od vrste i sastava materijala, a takođe nakon redovnog servisiranja, načina upotrebe i tehničkog stanja vozila. Slika 1 predstavlja vek trajanja guma.

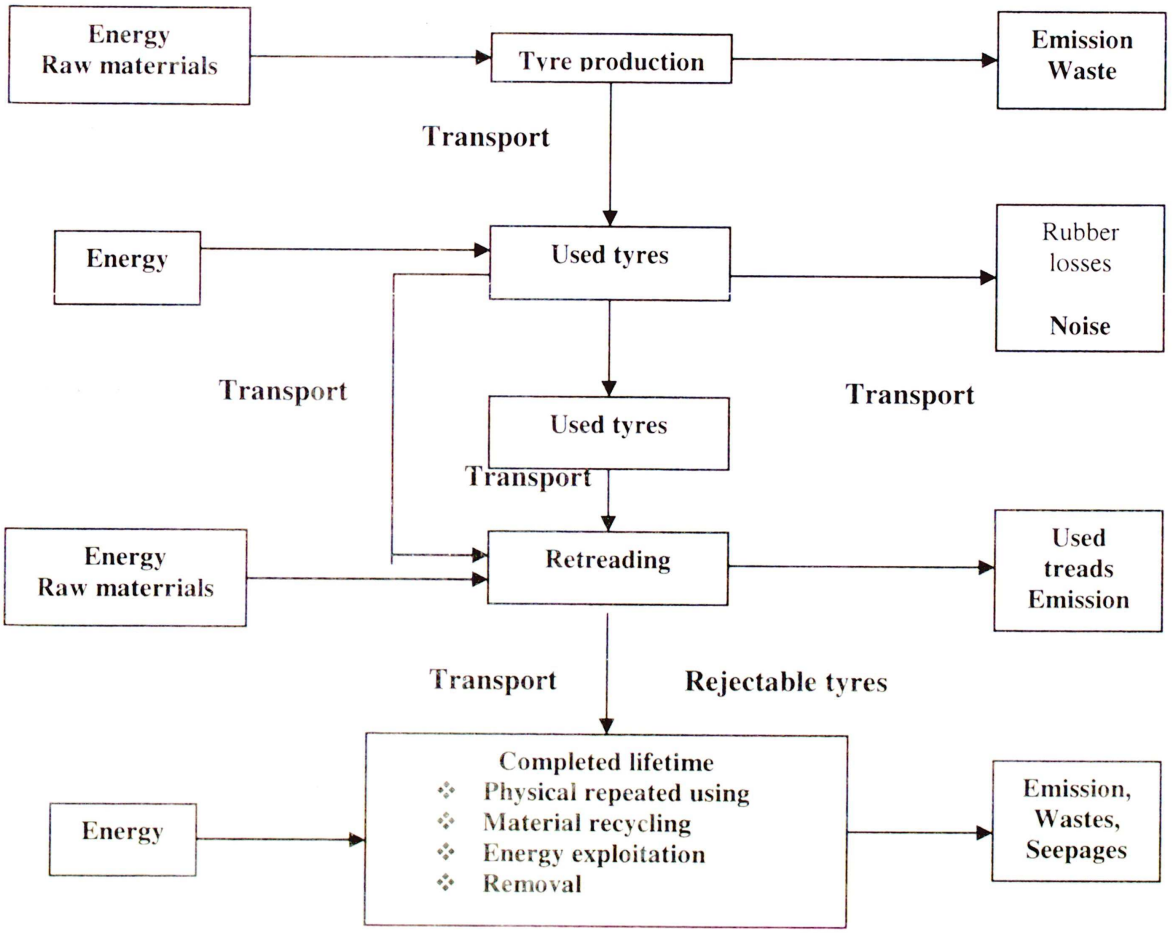

Figure 1 Life – cycle of tyres
slika 1Vek upotrebe guma

Used up tyres separate to 3 categories:

a) partially used up tyre - for original purpose,
b) worn – out tyre - it isn`t reusable and it is suitable for retreading,
c) worn - out tyre - it isn`t reusable and it isn`t suitable for retreading, too; it is end-of-life tyre.

2 CHARACTERISTIC OF TYRES

Tread, banding, skeleton, internal rubber, sidewall, core of bead and wire bead are the elementary structural parts of pneumatics. Material composition of personal and freight tyres is in the table 1 and the table 2 represents ranges of mass for tyres.

Korišćene gume se mogu podeliti u tri kategorije:

a) delimično pohabane gume - za prvobitnu upotrebu,
b) pohabana guma - ne može se ponovo koristiti i pogodna je za ponovno vulkaniziranje,
c) pohabana guma - ne može se ponovo koristiti a nije ni pogodna je za ponovno vulkaniziranje; to je guma kojoj je istekao vek trajanja.

2 KARAKTERISTIKE GUMA

Površina kretanja, traka (obruč), okvir, unutrašnja guma, bočna strana gume, core of bead and wire bead su osnovni strukturni delovi gume. Sastav materijala u automobilskim i teretnim gumama nalazi se u tabelama 1 i 2 i predstavlja opseg mase za gume.

Table 1 Material composition of tyres of motor and freight cars in European Union
Tabela 1 Sastav materijal u gumama za automobile i teretna vozila u Evropskoj Uniji

Material	Motor car [%]	Freight car [%]
Rubber / elastomer	47	45
Soot	21,5	22
Metal	16,5	25
Textile	5,5	-
Zincic oxide	1	2
Sulphur	1	1
Additives	7,5	5

Table 2 Mass of tyres by means of transport sort
Table 2 Masa guma prema tipu prevoznog sredstva

Tyres groups	Ranges of weight [kg]
private	4,5 - 13,9
delivery	8,1 - 22,4
cargo	20,7 - 96,5
bus	39,8 - 70
others	1 - 430

The mass of tyres depends to sort. Motor cars has a standard mass of tyres cca 7 kg, light trucks cca 11 kg, heavy – duty trucks cca 50 kg, camions cca 70 kg. Top part – tread abrades in the course of tyres using. Progressively their mass decreases about cca 10 – 15 %.

Heating power of tyres is from cca 25 to 32 MJ/kg. This heating power is comparable to current fossil fuel. It is caused by the great share of hydrocarbons (over 75%). From these arguments tyres are alternative of conventional fuels.

Tyre is composite from several materials and structural parts and it conduces to innovation of characteristic. Mix of vulcanized, natural and synthetic rubber, soots and the other short additives makes approximately 80% from general mass of motor car tyres and 75% of freight car tyres mass. Steel and textile are the stabilization materials of tyres – reinforcement. At first it was a textile materials from natural raws and then it was viscose, polyamide and steel, too (all – steel). Table 3 presents the informative summary of reinforcing materials in tyres.

Masa guma zavisi od vrste. Automobili imaju standardnu masu guma od oko 7kg, laki kamioni oko 11kg, kamioni velikog kapaciteta oko 50 kg, teški kamioni oko 70kg. Gornji deo – površina kretanja haba se tokom korišćenja gume. Postepeno se njihova masa smanjuje za oko 10-15%.

Kalorična snaga guma je od oko 25 do 32 MJ/kg. Ovakva kalorična snaga se može uporediti sa sadašnjim fosilnim gorivom. Uzrok za to je veliki procenat ugljovodonika (over 75%). Iz ovih argumenata gume su alternativa za konvencionalna goriva.

Spoljašnja guma se sastoji od nekoliko materijala i strukturalnih delova i teži ka inovativnim karakteristikama. Mešavina navulkanizovanog, prirodnog i sintetičkog kaučuka, čađi i drugih kratkih aditiva čini približno 80% ukupne mase automobilskih guma i 75% mase terenskih guma. Čelik i tekstil su stabilizacioni materijali guma – pojačanje. Najpre je to bio tekstilni materijal iz prirodnih sirovina, zatim viskoza, poliamid i čelik (potpuno čelični). Tabela 3 predstavlja informativni pregled materijala za pojačanje u gumama.

Table 3 Summary of application and distribution of reinforcing materials in tyres
Tabela 3 Pregled primene i distribucije materijala za pojačanje u gumama

Group of tyre casing	Reinforcing materials (% mass of tyre casing)	
	Steel	Textile
motor cars	9,6	7,8
light trucks	7,2	24
heavy duty trucks	11,7	9,5
tractors back	5,5	7,8

3 PROCESSING OF USED UP TYRES

The main methods of used up tyres processing are:

a. reusing of products,
b. reusing of materials,
c. material recycling,
d. energy reappraisement.

Reusing of products – exploitation of partially used tyres for original purpose. This method divides in three parts:

a) immediate reusing – it is the most simple; thickness of tread is deciding in this way (standard is cca 1,6 mm – Europe),
b) slitting – it is the cheapest form; the new sample cuts into rest of tread substance and it is mainly at cargo tyre, because it has a sufficient tread thickness.
c) retreading – it is the other method; there are 2 ways of retreading – hot and cold;

Reusing of materials – it is a using of complete, cut or chopped tyres for the purpose for which it isn`t produced. It is for example application as a constructional materials of stocks, protecting barrier for automobile and motocycle race ground, antinoise screen and so on.

Material recycling

a) recycling – the first step is rubber crushing and after it is separation of individual tyres elements (rubber, steel and textile). Rubber crushed material uses in some possible application, for example as a sports surfaces, roof materials, surfaces and backgrounds of roadways, sound – isolation and thermal – isolation materials and so on.

3 PRERADA POHABANIH GUMA

Glavne metode prerade pohabanih guma su sledeće:

a. ponovno korišćenje proizvoda,
b. ponovno korišćenje materijala,
c. reciklaža materijala,
d. ponovno procenjivanje energetske vrednosti.

Ponovno korišćenje proizvoda – iskorišćenje delimično pohabanih guma za prvobitne svrhe. Ova metoda je podeljena na tri faze:

a) neposredno ponovno korišćenje – to je najjednostavnije; debljina površine kretanja je odlučujuća u ovom načinu (standard je oko cca 1,6 mm – Evropa),
b) prosecanje – ovo je najjeftiniji oblik; novi uzorak se useca u ostatak površine kretanja i to uglavnom kod teretnih guma, jer je debljina površine dovoljna.
c) navulkanizovanje – to je drugi način; postoji dva načina navulkanizovanja – toplo i hladno;

Ponovno korišćenje materijala – je korišćenje celih, razrezanih ili isečenih guma u svrhe u koje nisu proizvedeni. To je, na primer, primena guma kao konstrukcionih materijala za štokove, zaštitne barijere za trkački teren za automobile i motocikle, zvučnih zaklona i tako dalje.

Reciklaža materijala

a) reciklaža – prvi korak je gnječenje kaučuka a zatim separacija pojedinačnih elemenata gume (kaučuk, čelik i tekstil). Izgnječeni gumeni materijal može imati i drugu primenu, na primer, može se koristiti kao podloga za neke sportove, krovni materijal, površine i podloge za železnicu, materijali za zvučnu i toplotnu izolaciju i tako dalje.

b) regeneration – it is mixing of rubber granulation product with additional materials and its exploitation as a raw material by rubber products production.
c) pyrolysis – it is based on thermal splitting of macromolecules at the bind conservation between carbon and hydrogen. Processes realize by higher temperature in the reactor (by oxygen absence). Quality (quantity, too) of each products rests at applied technology and pyrolysis condition.

Energy reappraisement – great alternative of this method is combustion at cement factories. It provides excepted energy exploitation also a complete using of inorganic elements (iron, sulphur) to the products of cement furnace – sinter.

b) regeneracija – to je mešanje gumenog granuliranog proizvoda sa dodatnim materijalima i njegovo iskorišćenje kao sirovine za proizvodnju gumenih proizvoda.
c) pirliza – zasnovana je na termičkom cepanju makromolekula na očuvanju veze između ugljenika i vodonika. Procesi se vrše putem visokih temperatura u reaktoru (odsustvom kiseonika). Kvalitet (kao i kvalitet) svakog proizvoda počiva na primenjenoj tehnologiji i pirlitskim uslovima.

Ponovno procenjivanje energetske vrednosti – velika alternativa ove metode je sagorevanje u cementarama. Omogućava iskorišćenje izuzete energije kao i potpuno korišćenje neorganskih elemenata (gvožđe, sumpor) za proizvode cementnih visokih peći – sige.

SUMMARY

Tyres are the great source of materials and it is caused by material composition and energy properties. There are several possibilities of tyres exploitation and it is real also after the end of the first life-cycle. In the next year accumulation of tyres consumption will be bigger and so tyres reusing is our first-rate priority, mainly with consideration to emission and unrestored sources which are used by production.

ZAKLJUČAK

Gume su veliki izvor materijala zbog sastava materijala i energetskih osobina. Ima nekoliko mogućnosti za iskorišćenje guma i ostvarive su i nakon kraja njihovog veka trajanja. Sledeće godine potrošnja guma će biti veća tako da će ponovno korišćenje guma biti naš glavni prioritet, posebno zbog emisije neobnovljenih izvora koji se koriste u proizvodnji.

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