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ECONOMICAL AND ENVIRONMENTAL ADVANTAGES OF MATERIALS MANUFACTURED FROM WASTE TIRES

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Abstract: Presently, there are known various technologies for processing of waste tires and their components. Rubber materials are by separating devices processed into small pieces or granules, which are added to asphalt, concrete products and in railway sleepers. One disadvantage of these technology solutions is inefficient rubber materials evaluation and potential environmental hazards at their disposal. The paper is focused on therefore reducing the economic and environmental impact on the environment using fabrics components from waste tires. Recycling by itself plays an important role in meeting the objectives of the EU as regards the use of secondary raw materials, namely the reduction of energy consumption and their applications to the new material. Currently, processors of waste recycling systems are motivated to recovery for environmental solutions. There are research companies seeking to develop new more appropriate methods of processing waste tires, and the use of known methods of recovery and their constant innovation.
Keywords: Saving cost, waste tires, secondary raw materials, environment

INTRODUCTION

The current situation in Europe point out highlights the increased activity in the field of waste management of used tires. According to the Slovak Law about "Waste", the waste holder is required to dispose of waste as far as possible be recovered, priority must be given to energy assessment material utilization (combustion). [1] Currently, processors of waste recycling systems are motivated to recovery for environmental solutions. There are research companies seeking to develop new more appropriate methods of processing waste tires, and the use of known methods of recovery and their constant innovation. [2] Slovakia is currently implementing projects with investment aid Recycling Fund to implement environmental objectives. [1] [3] The use of waste tires only for the actual recycling does not make sense. The whole of Europe is engaged in recycling of tires more than 100 independent companies in all Member States. Companies dealing with collection and processing of information on the recovery or disposal of used tires in the world and particularly in Europe, is a lot. One of the main organizations, the company ETRA "European Tire Recycling Association", which gathers information, processes them statistically, evaluate and inform the public about the new possibilities of recovery and subsequent use of the commodity. The individual components of the recovered tires are still defined as a valuable source of raw materials, as well as a viable means to achieve sustainable growth and development. [3] The market for these materials has been shown to be regarded as the most suitable and usable for a wide range of applications. [4] Recent research at the Technical University in Vienna under the guidance of prof. Marini, helped identify a broad range of new products and applications that rely on the chemical and physical properties of recycled tires, especially with regard to cleaning of fabrics components and the use of the separated components. [4], [5], [6]

WASTE TIRES AND THEIR ECONOMICAL AND ENVIRONMENTAL IMPACT

Recycling by itself plays an important role in meeting the objectives of the EU as regards the use of secondary raw materials, namely the reduction of energy consumption and their applications to the new material. [6], [7] Waste tires are a big potential material with saving cost impact on the company. The existing and potential users like to

have the use of secondary materials, compared to traditional, often they find that it is significantly more economical and there is thus a reduced environmental impact. Effective recycling of tires a product recycling tries to copy the properties of natural materials. In 2015 the European Union (Figure 1) has been processed by recycling nearly 5 000 000 tons of passenger and truck tires represents almost one third of annual output in 25 emerging countries.

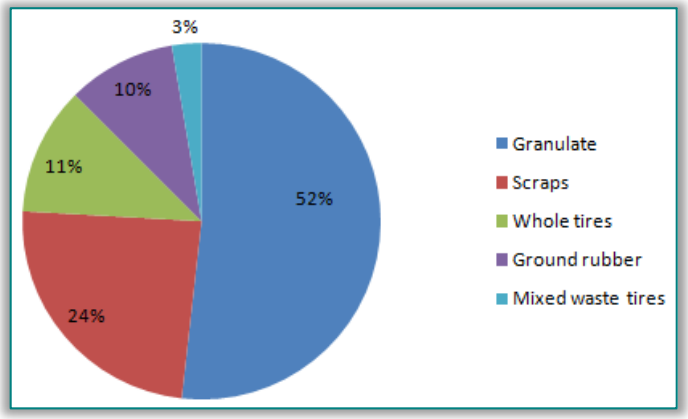


Figure 1. Material production of waste tires in the European Union, year 2015 [5]

Today about 12% of the total quantity of tires is subjected to a treatment such as pressing, removal of wires, the sidewalls, or simple cutting, for use in various applications. [8] About 76% of tires collected for recycling is processed into three broad categories of materials, such as:

- Scraps,
- Granulate,
- Ground rubber (size of 300 mm and ± 500 microns) [5], [9]

Today is very interested in the tire as a valuable source of raw material (Figure 2) is mainly about their final destination. It focuses on the emerging material from amounts collected or processes. [8], [10] For most materials, some percentage of the input material is lost during processing, due to removal of the rubber component, a metal fabric.

It can be says that the indivisible scrap of tires is minimal loss of about 5%. This applies to metals and fabrics. Granulate (about 7–12 mm), may lose approximately 30% of the material, while the loss of a smaller fraction of the rubber granulate or powder may be from 40% to 60%. This depends on the desired size and separation of the impurities. Products and applications using these smaller fractions of materials, generally require that the output product practically free of impurities, a limit of ± 1–5%, with respect to the content of metal or fabrics. Obviously, the greater demand for materials and has specific products which require less treatment before use. This research has led to increased use of whole tires, scrap, gravel, dust and rubber for a variety of engineering applications.

APPLICATION OF WASTE TIRES TO THE INDUSTRY

The paper deals with the production of waste tires component in the composite industry using, secondary raw materials, where the main objective is conservation of raw materials and economical and environmental advantages. Use of this material is mainly in the field of construction, garden and automotive engineering, as finished product or in semi–manufactured forms – granules. Saving the input cost of primary raw material in the production process is currently at the forefront of sustainable development of each country. The effort is used to produce materials with comparable properties and characteristics.

Figure 2. Components after tire recycling (from up to down: steel, granulate, fabrics) [8]

USING WASTE TIRES COMPONENTS IN THE COMPOSITE MANUFACTURE

Fabrics from waste tires are material with high sorption capacity, flexibility and elasticity, excellent sound absorption and thermal insulation properties. At present it is known the use of this raw material in many fields of industry, for example, the production of noise elements in construction, transport (asphalt) and in agriculture (floors in stables). [5] Matrix is a thermoplastic polyvinyl butyral (PVB). Composite materials using two secondary materials–first is fabric from waste tires and second, a matrix is recycled polyvinyl butyral (Figure 3). Company Kurraray (2015) definite a PVB as a thermoplastic, which is typically used for applications requiring strong chemical bonding, optical properties (transparency), and adhesion to the surface of various materials, strength and flexibility. Separation methods there to perfect grinding of windshields using the input line, which is equipped with a highly functional shredder. After reduction comes the conveyors and separators that sorted out metals and other impurities contained in car–glass. Small fragments are further transported to the system of optical sensors, with their help remove debris from the rubble, scrap foils, rubber, etc. displacement. PVB film ensures safety feature in car–glass. PVB film is in the flakes form, which are actually crushed and chopped recycled foil size approx. 20–30 mm. Fibres was obtain from recovery of used tires.

Figure 3. Composite materials
after the homogenization [5]

Authors Knapčíková et al. [8] in their research worked on the entrance commodity for the technological process of recovery used tires into which the passenger tires without the necessary pre–treatment and expensive all steel tires. From these tires must be removed heel rope. Heel ropes are removed to dilute the unbroken and knives input device technology line. Tires also are cut, broken into size of about 250 mm x 250 mm. [3], [7] Slashed tires of the conveyor belt, proceed to the second part of the technological line, which are cut in half, from 18 mm to 20 mm. At the end of the crusher magnetic separator, this captures the metal deposited in collection containers. Force captured metal is approx. 90%. The remaining portion which is separated goes along with rubber and cloth in fine granulator. [8] Material passes through a magnetic separator to remove part of the metal residue. When this unit is plugged exhaust system, whose job is to suck fabric section, which is lighter than granules. Cylindrical magnet captures the remaining metal and fibres exhaust system. The composite contains fibres from used tire and recycled polyvinyl butyral after separation by vibrating screens on fabric (fabric purity is 57, 29%). Separation was performed on a vibrating machine, which are wearing stacked sieves with a mesh diameter of 0,9mm to 0,09mm.

The separation is permanent, conducted in 2 phases after 15 min. In the first stage, coarse fabric cleansed from impurities and the second stage is polishing. [8],[9]

CONCLUSIONS

Components from waste tires have a different applicability as a new material in the automotive industry in the motor section, in wheel arches – noise control, mud flaps – corrosion property, resistance to water, snow, aggressive (in winter – gritted road), insulation hood – control noise, vibration capacity, fire resistance. In part of the passenger esp. in car interior, rubber car mats – extra edge protection against seepage of water into the base fabric, door panels – side bar (stainless material property). Second material application in the construction industry in the indoor use as the backing layer underneath wood, laminate flooring, protection against impact sound, floor anti–vibration ability. Other material application is in the construction industry, in garden engineering as curbs, pots, protection against weeds, protection against undesired growth of roots, pools, as a protection, preventing breakage of the release liner pools. Possibility of material application is in civil engineering too, by rail crossings, cushioning materials under the rails, bumps, noise barriers at busy roads.

References

[1.] CHMIELEWSKA E., KURUC J.: Odpady. EPOS, Bratislava, 199–201,2008, ISBN 978–80–8057771–1

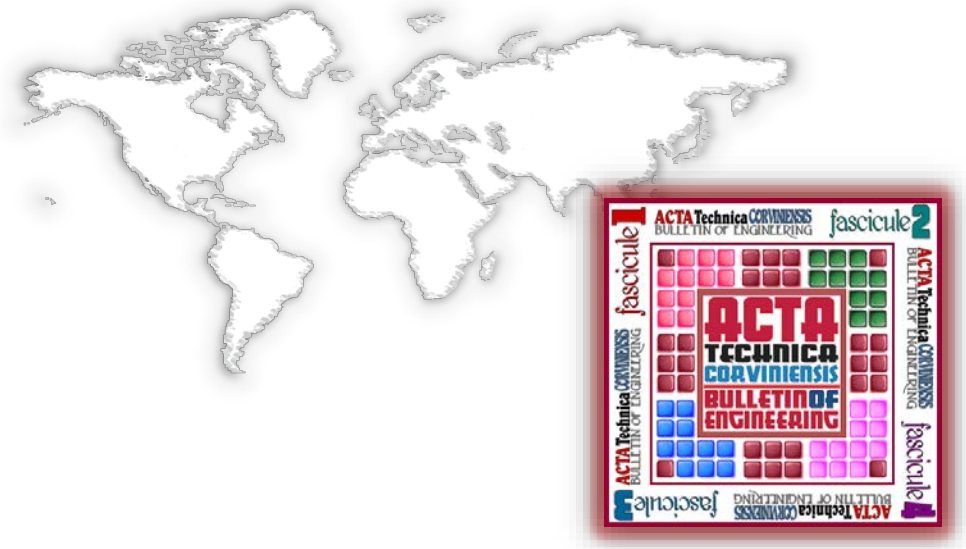
[2.] CRAWFORD R.J. : Plastics Engineering, Pergsmon Press, England. 1987Barry, C.M.F.–Orroth, S.A.:Processing of thermoplastics, In: Harper, CH.A.: Modern Plastics Handbook, USA,2000, ISBN 0–07–026714–6

[3.] ZAJAC, J., SMETANKA, Ľ., PAŠKO, J., HATALA, M., HRIN, M.: Systém dezintegrácie pneumatík In: Doprava a logistika. č. 18 (2010), s. 77–90.ISSN1451–107X

[4.] DIN Taschenbuch 18, Kunststoffe– Mechanische und thermische Eingeschaften, s. 251, ISBN 3–410–13421–2

[5.] KNAPČÍKOVÁ, L. – HUSÁR, J. – FEDÁK, M.: Opotrebovaná pneumatika –materiál budúcnosti,

Tribun EU – 2016. – 90 p.. – ISBN 978–80–263–1068–6.
[6.] LIPTÁKOVÁ T.– ALEXY P. a kol.: Polymérne technické materiály, Vysokoškolská učebnica, 2009
[7.] VASILIEV V.V., MOROZOV E.V.: Mechanics and analysis of composite materials, Elsevier, ISBN 0–08–042702–2, 2001
[8.] KNAPČÍKOVÁ L., HERZOG M., ORAVEC, P.: Material characterization of composite materials from used tires, In: Výrobné inžinierstvo. č. 4 (2010), s. 31–34. – ISSN 1335–7972 <www.tuke.sk/fvtpo/casopis>
[9.] KNAPČÍKOVÁ L, PEŠEK, L.: Kompozitný materiál z recyklovaných textílií, úžitkový vzor č. 6907 : Vestník ÚPV SR č.: 052014 – Banská Bystrica : ÚPV SR – 2014. – 8 s..



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