

MATERIAL AND ECONOMICAL ASPECT OF SOME PLASTICS USING IN AUTOMOTIVE INDUSTRY

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Keywords: plastics, composite, automotive, material, industry

Abstract: Plastics, plastics composites are used for lighter construction vehicles, where they provide support, the corresponding for these progressive approaches constitute the main article for in design-oriented styling, interior car design support according to detailed customer requirements. Using plastics materials in the automotive industry is focused on active and passive safety of vehicles and passengers of course, optimizing aerodynamics, noise reduction, ecology and recycling.

1 Introduction

According to study of "Automotive Plastics Market" [1] It has been estimated that every 10% reduction in vehicle weight results in a decrease fuel economy by 5% to 7%. Currently, the condition to respect the economical and environmental measures in automobile [1].

Among the important advantages of high performance plastics used in vehicles include:

- Minimum corrosion, thereby extending the life of the vehicle
- Significant design freedom in design, allowing for an increase in creativity and innovation
- Flexibility to integrate components
- Safety, comfort and economic side.
- Recycling and recovery of plastic materials [2].

In general, the global market in terms of the use of plastics in the automotive industry increased in 2015 in the 8 kt. This means that the application possibilities of plastics in the automotive industry are currently focused on track to use. In addition to the aforementioned advantages of using, there is a kind of "superiority" of plastic material, into the actual design. Plastics are characterized by improved weathering resistance and versatility in applications.

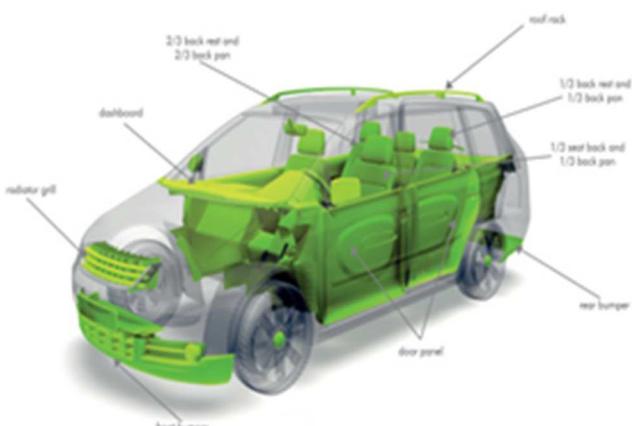


Figure 1 Plastics in the car [3]

2 Plastics in the automotive industry

European Commission adopted already in 2012, strict government regulations on reducing emissions of vehicles [2], [4]. This forces manufacturers to transition the use of lightweight plastics to replace metals such as aluminum and steel (Figure 1), (Table 1). The average car is made of plastic in the range of 5.8% to 10% of its total weight, depending upon the performance requirements and fuel efficiency standards, whether the consumption of vehicle components. In general, the one car account for ca. 105 kg of plastic. Next table presented materials used in the car industry.

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Table 1 Plastics in the car [3]

The materials used in the car industry	
Steel	41%
Non-alloy steel	18%
Aluminium	8%
Iron	6,4%
Zinc,copper, magnesium	2%
Rubber	5,6%
Plastics	9,3%
Other materials	9,7%

A high percentage of the plastic material used (or components) is expected in the future due to the growing demand from consumers, where the important role of weight loss, low power consumption and high performance vehicles on the contrary [4], [5].

In addition to reducing the overall weight of the car, the materials of plastov- of plastic composites used to improve aesthetics, reduce noise and vibration insulation car. The most used types of plastic in the automotive industry make up approximately 66% of all high strength plastic. The characteristics of the most widely used plastic in the automotive industry [2], [4]:

- Polypropylene(PP)

Polypropylene is a thermoplastic polymer used in a wide application range. Saturated addition polymer is made from monomers of propylene, it is resistant to most chemical solvents, and acids. Usage: car bumpers, chemical tanks, cable insulation, gas tanks, carpets.

- Polyurethane(PU)

Polyurethane elastomeric material is of exceptional physical properties, including toughness, flexibility and resistance to abrasion and temperature. Polyurethane has a wide range of hardness (from soft rubbers to the hardness of bowling balls). Polyurethane is characterized by extremely high durability, high lifting capacity and excellent resistance to weathering, ozone, UV, resistance to oil, gasoline and most solvents. Application: flexible foam within the application to the seats, foam insulation panels, automotive hinges, cases, pillows, pads electric cables and hard plastic parts.

- Poly(vinyl) chloride (PVC)

PVC has good flexibility, is flame retardant and has good thermal stability, high gloss. Polyvinyl chloride materials may be extruded, injection molded, pressed and thus allow forming a plethora of products, whether rigid or flexible, depending on the amount and type of plasticizer used. Material application in automotive toolbars, sheathing of electric cables, pipes, doors.

- Acrylonitrilbutadienstyrene (ABS)

Copolymer is prepared by polymerization of styrene and acrylonitrile in the presence of polybutadiene. Styrene gives the plastic a shiny impervious surface. ABS is material with improve impact resistance, toughness and

heat resistance. Application: construction of a car dashboard trims.

- Polyamide (PA, Nylon 6/6, Nylon 6)

Nylon 6/6 is a general purpose nylon, has good mechanical properties and wear resistance. It is often used after the desired low cost, high mechanical strength. Is rigid and stable material. Nylon is water and the high absorbency increased humidity. Applications: gears, cams, bearings, paints weatherproof.

- Polystyrene (PS)

It shows excellent chemical resistance and electrical resistance. Processing technology is simple. Materials made from PS have poor UV resistance. Use: The device covers, buttons, the display on the dashboard.

- Polyethylene (PE)

Polyethylene has high impact strength, low density, and has good toughness. It can be used in a variety of thermoplastic processing techniques, and particularly is useful where the material is desired moisture resistance but a low cost. Application as car body (using glass fiber), electrical insulation.

- Polyoxymethylene (POM)

POM has excellent rigidity, strength and yield stress. These characteristics are constant at low temperatures. POM is also highly resistant to chemical solvents and fuel. Application: interior and exterior moldings, fuel systems.

- Polycarbonate (PC)

Amorphous polycarbonate polymer is characterized by a unique combination of stiffness, hardness and toughness. It exhibits excellent resistance to weathering, creep. It has excellent optical, electrical and thermal properties. Due to its extreme severity of the accident, the material is suitable for automotive bumpers. Using as bumpers, headlights, indoor luminaires

- Polymethylmethacrylate (PMMA)

It is a transparent thermoplastic, often used as an alternative to glass. In view of the price it is less expensive than PC, but is also susceptible to scratching and breakage. Application: windows, display screens [5].

- Polybutylene terephthalate (PBT)

Thermoplastic PBT is used as insulating material. It is highly chemical and heat resistant. Applications: door handles, bumpers, parts carburetor.

- Polyethylene terephthalate (PET)

PET is mostly used for the production of wiper arms and gearboxes, engine cover headlight brackets, connector covers.

- Acrylonitrile styrene acrylate (ASA)

As with ABS and ASA it has great strength and rigidity, good chemical resistance and thermal stability, exceptional resistance to weathering, aging and yellowing and high gloss. Application: profiles, interior and exterior parts obloženie- bar.

- Polyvinyl butyral (PVB)

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Manufacture and usability of this type of thermoplastic has been described in previous chapters. It characterized by use for the production of PVB films. Further, the PVB resin used in the production of coatings, structural adhesives, color dry toners, and as a binder in the manufacture of composite materials. PVB film has a number of excellent characteristics, namely high tensile strength, impact resistance, transparency and flexibility which are especially useful in the manufacture of safety glass windscreens [5], [6].

3 Reasons for the use of plastics in the automotive industry

Modern science and research worldwide is investing in financial resources in the development and production of new materials applicable law in the automotive industry. By continuously improving and developing new technologies and materials are being used car has become the market leader. Automotive industry, it is not just a "production car" is a comprehensive service which affects the engineering, electrical and chemical industries, respectively industry [7]. It is therefore necessary to look at it from several sectors that one complements the other and each other is eliminated [4]. The dynamic development, constantly new requirements from customers and especially the ability to remain on the market, a set of requirements and capabilities of each party. This means constant interaction "research (development)-manufacture-customer". Recently, the requirements of the automotive industry have changed significantly.

The most important factors that influence the development and design of the car include:

- Costs
- The final consumption
- Recyclability and
- Emissions [4], [5].

Just last two factors were 15 years ago in the background. Impact of enlargement European Union's borders be done through strengthening the standards relating to the production of useful materials, their environmental impact and overall impact on the environment [5].

Present in the automobile industry clear, largely the metal parts of the car are replaced by plastic. Research and development of advanced materials, and invest in improving existing materials (and thus increasing the competitiveness of the market) is crucial for the automotive industry, in terms of:

- Design,
- Performance,
- Fuel,
- Corrosion resistance,

- Low operating costs,
- Tightening environmental standards,
- Crash safety (people and cars) and so on [4].

Just above mentioned factors directly and indirectly forcing car manufacturers to use new, advanced materials (Table 2). They are characterized by higher strength relative to their weight, and in particular by better combining of their mechanical properties.

Table 2 The most commonly used types of plastics

Plastics in the car	
PP	32%
ABS	31%
PA6/PA 6.6	31%
PU	17%
PVC	16%
PBT	5%
PVB	2%
PET	1%

Conclusions

Application of plastics and composite materials based on plastics are nowadays of great importance in terms of usability, refund the original materials, reducing the overall weight of the car and especially prices.

References

- [1] KNAPČÍKOVÁ, L., HERZOG, M., ORAVEC, P.: Material characterization of composite materials from used tires, *Výrobné inžinierstvo*, Vol. 2010, No. 4, p. 31-34, 2010. <www.tuke.sk/fvtpo/casopis>.
- [2] KNAPČÍKOVÁ, L.: Skúmanie reologických vlastností kompozitov na báze textílií z opotrebovaných pneumatík, *Plasty a kaučuk*, Vol. XLVIII., No. 1-2(2011), p. 4-5, 2011. (Original in Slovak)
- [3] Automotive plastics, [Online], Available: <https://plastics-car.com> [30.12.2016].
- [4] The use of risk assessment in environmental management, [Online], Available: <http://www.eea.europa.eu/publications/GH-07-97-595-EN-C2/chapter2h.html> [30.11.2016].
- [5] KNAPČÍKOVÁ, L., ORAVEC, P.: Characterization of fabric component from used tires with differential scanning calorimetry, MendelNet 2010, proceedings of International Ph.D. Students Conference, Brno, November 24th, p. 541-545, 2010.
- [6] Progresívne využívané polymérne kompozity v automotive, [Online], Available: <http://www.zapsr.sk/progresivne-vyvijane-polymerne-kompozity-v-automotive/> [01.12.2016]. (Original in Slovak)

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- [7] BALOG, M. et al.: Automation monitoring of railway transit by using RFID technology, *Acta Tecnología*, Vol.1, No.1, p.9-12, 2015.

Review process

Single-blind peer reviewed process by two reviewers.