

Zorica Djordjević¹⁾
Saša Jovanović¹⁾
Sandra Veličković¹⁾
Djordje Jović¹⁾
Jovana Milićević¹⁾

1) University of Kragujevac,
Faculty of Engineering,
Kragujevac, Serbia{zoricadj,
dviks, sandrav}@kg.ac.rs,
djurdje94@hotmail.com,
jovana38.2013@gmail.com

INFLUENCE OF APPLICATION OF NEW MATERIAL IN AUTOMOTIVE INDUSTRY ON IMPROVING QUALITY OF LIFE

Abstract: Due to the increasing need that is imposed by current development of engineering and reducing of the sources of natural materials, metal materials used in the automotive industry are increasingly being replaced, wherever possible, newer, artificially created materials. Parts of the structural elements of the car made of composite materials are parts of the body, full body, steering wheels, bumpers, transmission shaft, chassis, covers, seats, doors, etc. By replacing steel elements with composite elements reduces the weight of the vehicle, which leads to a reduction in fuel consumption and emission of harmful gases which protect the environment. Applying the composite shaft improves the safety of the driver in a collision of the vehicle, and also reduces the noise of the central bearing thereby increasing the comfort during the ride. Composite timing belts affect the increase in capacity, reduce noise and increase service life with significantly lower prices.

Thanks to their good characteristics and impact on the quality of driving and driver safety, increasing the share of composite materials in the automotive industry in the coming years is expected.

Keywords: composite materials, automotive industry, quality of life, driver safety

1. INTRODUCTION

In order to solve the problem of climate change in recent years, the automobile industry also works on the development of new functional materials in order to improve fuel efficiency. It is believed that more than a quarter of greenhouse gas emissions is associated with road transport vehicles. More and more strict regulations on environmental protection have led many automakers to focus on the development of lighter and more efficient vehicles in terms of fuel consumption.

It is assumed that these specific measures in the automotive industry will lead to savings of about one billion tons of greenhouse gas emissions [1]. Selection of new, lighter materials could be a major component to reduce fuel consumption by around 16% to 24%, and thus protect the environment and improve quality of life.

Today 12% of the population owns a car.

By 2020 this number could be 15% [2]. Such a large number of cars has a negative impact on the planet on which we live.

The aim is to reduce the weight of the car by using the material of lower density, or weight, and with better car design. Over the past 30 years the industry has reduced vehicle weight by about 30%. Any reduction in weight of the vehicle of 10% leads to a reduction in fuel consumption by about 6%.

Nowadays a whole range of different materials is developed that would significantly change the nature of the use of the materials in vehicles.

2. REPLACEMENT OF STEEL WITH LIGHTER MATERIALS

From 1920., around three quarters of the vehicles were made of steel. Until 1975., except replacements of some parts with plastic, it has not changed. Since then there is a much greater

use of aluminum, magnesium and high-strength plastic (bonnet, instrument panel, chassis, etc.).

Aluminum alloys have a unique micro-structural characteristics and physical properties which makes them attractive for automobiles [3]:

- They are characterized by high specific stiffness and low weight,
- The ability to impact energy absorption, crash and explosion,
- Vibration damping,
- Good heat-resistant and insulating properties,
- Easy recycling.

Disadvantages of Al-alloys:

- The relatively high price,
- Difficulties in processing,
- Insufficient strength or rigidity for certain applications.

Magnesium alloys have a higher temperature resistance and better damping capability compared with the Al alloy. But, similar to the Al alloy, there are difficulties in processing, application, large deformation in operation, insufficient capacity etc.

Thus, it can be concluded that the advantages of the implementation of these alternative materials are void of their high cost, the performance and environmental impact.

3. COMPOSITE MATERIALS

Progress in the development of new polymeric and composite materials has included these materials in top of the so-called lightweight materials. The fact that these materials are characterized by high strength, contributes to the achievement of the same or a higher degree of security as compared to conventional materials. The primary advantage of using composites in the automotive industry is considerable reduction in weight since the composites are 35% lighter than aluminum and 60% lighter than steel so that the mass of the whole vehicle decreases to 10% [4].

The most commonly used are thermoplastic resins reinforced with glass fibers or a combination of glass and carbon fibers. Carbon fibers have a higher stiffness and are lighter in weight as compared with glass fibers. However, high cost is still a major obstacle to more intensive exploitation of this wonderful material. It still has the largest application in the sports and luxury cars.

Testing found that the transition to the composite drive shaft reinforced with carbon fiber cars wheel strength increased by 5%, primarily due to low rotating mass of the drive shaft. Composite shaft reinforced with carbon fibers can transmit more extensive power than steel shaft of twice the weight. Carbon fiber reduces vibration and therefore there is a reduction of the power loss due to vibration system for transmission force to the wheels.

Use of composite shafts in racing cars has caused a great deal of attention in recent decades. When the high-speed shaft fracture occurs, its components are flying all over the place, which can lead to major accidents. Carbon composite shaft can be broken only by a strong hit from the side. When it comes to such a fracture of the shaft (Figure 1) it splits on fine fibers, gaining the appearance of so-called "broom look" so any consequences for the driver are at a minimum.



Figure 1- Fracture of one-piece composite drive shaft

Japan's company *Hitachi Automotive Systems* last year announced that it will produce a composite carbon/fiber drive shafts for the company *Alfa Romeo*, which will be built into the new *Alfa Romeo Giulia* car. They decided on this move from a well-known reasons, reduce vehicle weight, which leads to reduced fuel consumption and reduce emissions, which is nowadays a very important issue. Drive shafts which will be installed in a vehicle, will have a substantially reduced weight of about 5 kg, which is about 40% less than the weight of conventional steel shafts. It provides excellent contribution to driving safety because it reduces the impact of force, also about 50% more easily leads to fracture of composite than steel shaft in a collision of two vehicles. By using carbon fibers in these shafts is reduced by the noise of the central bearing, which leads to greater comfort during the ride.

Desire for constant improvement of composite materials has led to the development of new materials with minimal environmental impact. This led to the development of nanocomposites with different polymer matrices which will improve passenger safety, while being very light, have a better thermal behavior, long life, positive impact on reducing emissions.

4. BIO-COMPOSITE MATERIALS

Composite fibers can be divided into two main groups: natural and artificial. Using the natural fibers reduces the mass of the car (the density is lower even to 40% in comparison with, for instance, glass fibers) and meet increasingly stringent criteria with regard to protection of the environment, and they are characterized by relatively low operating costs and reproducibility [5]. Fiber jute, coconut etc. are easily accessible, they are characterized by high durability so that they can be an adequate substitute synthetic fibers in the automotive industry. Current research and development of many vehicles are directed to the use of biodegradable plant fibers. How broad the application of natural fibers in the automobile is, as well as in the other industries, it can be seen in Figure 2.

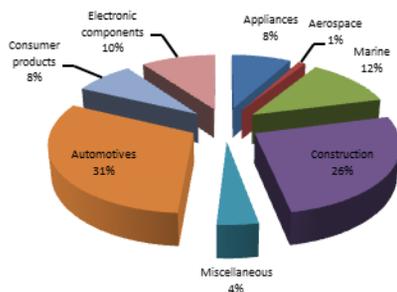


Figure 2- The application of natural fibers in the industry

Compared with synthetic fibers, plant fibers are characterized by many advantages, which are all the more valuable because they can be achieved without significant change or loss of mechanical and acoustic properties. The lower price of the majority of plant fibers (from 25 to 50% compared to, say, the glass) is one of the most important, if not the main reason for the move to composites filled with these fibers.

Fibers dramatically reduce weight while retaining the mechanical properties of the composite. Due to the lower density, which was never higher than 1,5 g/cm³, the components are not only easier but also cars built from them use less fuel. Fibers show increased security in the case of a crash because it does not break. They are good acoustic insulators because of hollow cellular structures. For the same reason, such compositions are also good thermal insulators. Plant fibers are easier to cut and are less abrasive to the equipment for processing than glass fiber. Unlike glass fibers they do not impact negatively on the health of users. Since they are the agricultural products, plant fibers can be easily supplied and are available worldwide. During the production low energy is used, about four times less than the same weight of glass fibers.



Figure 3- The use of natural fibers in cars

Replacement of glass fiber with plant has resulted in the economic, social and environmental benefits. The reasons are numerous: plant fibers such as flax fibers, hemp, agave, jute, curaua (species of the family pineapple) and other are cheaper and lighter than glass fiber and is easy to re-process after use. Application of plant fibers in composites in the automotive sector is growing rapidly, 20% annually (Figure 3). Out of the above mentioned, particularly are interesting fibers of flax and hemp, which are most frequently used in the automotive industry and curaua fibers, whose physical properties almost equivalent to the glass fibers [6]. Their use is about 50% cheaper compared to synthetic.

Examples of their use in practice are numerous. Door panels of the car *Ford Mondeo* are made of a mixture of kenaf fiber and polypropylene resins. In this way, the mass of the door is reduced from 5 to 10%. The ability of fiber to absorb a large amount of moisture

leads to greater comfort, which is not achievable with synthetic materials.

Higher performance applications are achieved with the inside panels of the *Mercedes-Benz E-Class*. Flax fibers were used in combination with epoxy resins. In this way, in addition to weight reduction, a better occupant safety is achieved if there is an accident.

The biggest disadvantage of plant fibers are too large oscillations in quality, which depends on the growth rate, and absorption of moisture, which complicates implementation.

5. CONCLUSION

Reducing the weight of cars, by using the so-called. lightweight materials becomes an important issue for energy efficiency in the

automotive industry, because it affects the reduction of fuel consumption, reduced emissions, improving the environment and quality of life. In addition to the light metal alloy, a lot of attention is paid to the application of the hybrid fibrous composite whose application, besides the protection of the environment, increases the driving quality and improves the safety of drivers and passengers. Recent technological progress in the use of natural fibers (cellulose, jute etc.) has led to a revolution in the design of not only standard but also a luxury cars. These fibers are light, inexpensive, easy to recycle, which makes them one of the top lightweight automotive materials. These are all reasons why their application in the automotive sector in recent years is growing rapidly.

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Acknowledgment: This investigation is a part of the project TR 33015 of Technological Development of the Republic of Serbia and the project III 42006 of Integral and Interdisciplinary investigations of the Republic of Serbia. We would like to thank to the Ministry of Education and Science of Republic of Serbia for the financial support during this investigation.