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DETERMINATION OF MECHANICAL PROPERTIES FOR IMPACT AND BENDING A BUMPER SHOCK ABSORBER MADE OF STEEL COMPARED TO BUMPER SHOCK ABSORBER MADE FROM A NEW COMPOSITE MATERIAL FOR AUTOMOTIVE INDUSTRY - PART 2

A. Calienciug[1], G.N. Radu[2]
[1] "Transilvania" University of Brasov, Brasov, ROMANIA, adrian.calienciug@unitbv.ro
[2] "Transilvania" University of Brasov, Brasov, ROMANIA, rngh@unitbv.ro

Abstract: *A current issue is related to increasing levels of environmental pollution and global warming caused by industrialization especially excessive burning of fossil fuels or liquid. This is due in part to motor vehicle fuel in the combustion process they eliminate environmentally harmful emissions. By reducing the weight of vehicles will be allowed to reduce the amount of energy needed to produce mechanical work. The purpose of this study is to design and create a new lightweight composite material used in the structure of automotive bumper shock absorber. This item is made of composite material and bumper shock absorber type was compared with the current bumper shock absorber made from steel. New laminated composite type must meet the standards of today, have minimized weight and impact absorption capacity at low speed.*
Keywords: *absorption, weight, stratified, bumper car design.*

1. INTRODUCTION

Developing of composite materials is a complex process that requires special attention at all stages of implementation of the final product. Studies theme is very current due to the development of these structures in more and more areas, as a research topic with ample opportunity for optimization in terms of layered structures made from composites. Thus, their development in more and more fields is the subject of this study is a timely and continuous optimization of layered structures made from composite materials.
In Figure 1 is presented a car bumper shock absorber made of polystyrene:

Figure 1: Car bumper shock absorber made from polystyrene [1]

Inspired by this type like in figure 1 of car bumper shock absorber made of polystyrene it was made a new car bumper shock absorber made of a layered structure of fiber glass with cork and polyurethane foam like in figure 5.
A system was designed to form a new matrix car bumper shock absorber and the best choose was the current steel car bumper shock absorber like in figure 4 and the reason for choosing this matrix is complying with the standards of length, height and thickness.

Mechanical test methods for case study namely layered polymeric composite materials consist of car bumper shock absorber made of steel impact test in comparison with car bumper shock absorber made of composites.

2. WORKING METHOD

To obtain auto bumper bar lay up method was used and the current matrix of a motor vehicle bumper is made of steel and polyester resin molding which allowed polylite 440-M880 and reinforcement with 6 layers of fiberglass cloth it like in figure 3. Simultaneously with polyester resin impregnated fabric were stacked sheets of cork and finally added polyurethane foam as can be seen in Figure 2:

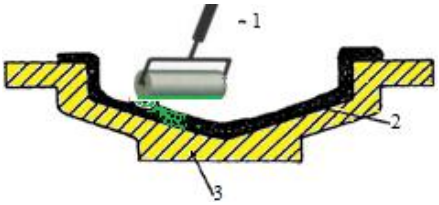

Figure 2: Lay-up method [4]

1. roll; 2. 6 layers(resin-impregnated reinforcement material); 3. mold open

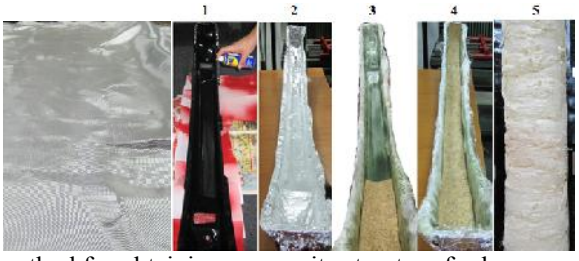

Figure 3: Lay-up method for obtaining composite structure for bumper shock absorber [1]

Temperature is the most important factor in this process because the polymer is plasticizează and pressure die cast him in a certain period of time. After the time-out, the finished product can be removed from the mold as can be seen in figure 4 and figure 5:

Figure 4: Bumper shock absorber made of composite materials removed from the mold [1]

Figure 5: Bumper shock absorber made of composite materials [1]

3. EQUIPMENT USED AT LOW SPEED IMPACT TEST FOR CAR BUMPERS SHOCK ABSORBERS

To do impact testing was used a free-fall impact device slowly as can be seen in Figure 6. which has a power capacity of between 1-50J, obtained by adjusting the height and weight. The device consists of a frame which is fixed to the ends guiding columns in two sheets. Guiding columns are strained by tightening screws fixed to the ends.

Sliding element which is attached to the projectile, in this case steel ball is carried out using Teflon bushings. This device complies with Boeing and Airbus standards [3].

Figure 6: Impact testing device

Figure 7: Device type slide with steel ball projectile

Figure 8: Impactor assembly

The device is shown in Figure 7. as consisting of a set square profiles ball with external thread 17 mm and internal thread 5 mm, joined by a weld that come attached with a screw-type profile barrel with thread M17, which its end is an M8 screw for mounting sliding system. Installing them may be noticed in figure 8 and the impact will be in the center of car bumper shock absorber.
It can be seen in figure 9. Internal thread that is linked to an accelerometer, which is between the ball and sliding device that leads to signal acquisition card with ball acceleration is measured the contact force at the moment of impact.

Figure 9: Cable data aquisition

Figure 10: Accelerometer on board on ball

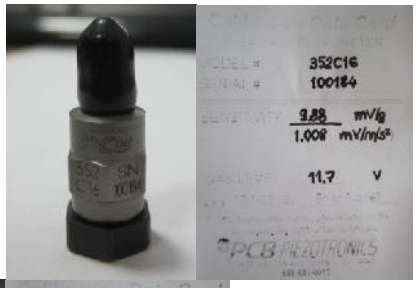

Figure 11: Accelerometer

So when sliding device is released from a distance of fall set initial shock hits the top bar reinforcement or car bumpers. At the bottom is fixed accelerometer to take and pass the wire pulse signal acquisition board. The accelerometer located on impact device can measure voltage, applied load and the accelerometer stuck valve or auto bumper bar are measured deformations.

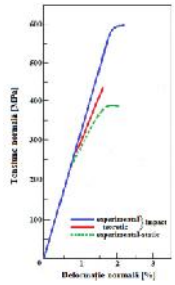

Figure 12: Tensile strain-deformation curves for car bumpers shock absorbers

The figure 13 is composed of a data acquisition system with signal amplifier PCB name F483B07 the role of amplification of signals from vibration impulses as it receives through accelerometers described in Figure 10. and Figure 11., analyzes them and expose them via computer in the form of acceleration-time graphs.

Figure 13: Signal amplifier PCB F483B07

In Figure 14. amplifier scheme is presented for the case study:

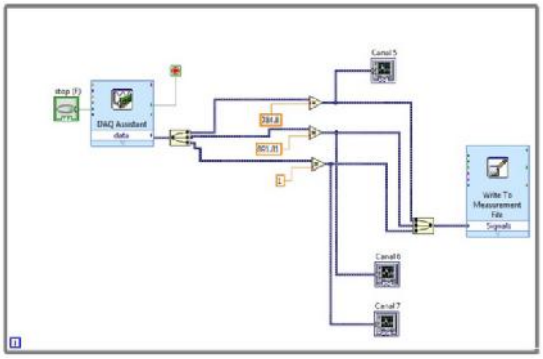

Figure 14: Signal amplifier scheme

4. IMPACT TESTING AT LOW SPEED FOR CAR BUMPERS SHOCK ABSORBERS

Low-speed crash tests conducted on structures such as car bumper shock absorber made of steel and car bumper shock absorber made of composite materials like in figure 15. Were performed from a height of 3m to be respected standards say that the impact speed should be between 5 ± 0.5km / h:

Figure 15: Black car bumper shock absorber made of steel and
yellow car bumper shock absorber made of composite materials before impact testing [1]

The first test was conducted for car bumper shock absorber made of steel, so it was mounted on the removable complying vehicle chassis dimensions, as shown in figure 16., then in Figure 17. is observed that the bumper was hit by the steel ball and in figure 18. it presents a detail of the steel ball hitting the car bumper shock absorber made of steel:

Figure 16: Before hitting
steel element [1]

Figure 17: After hitting
steel element [1]

Figure 18: Impact detail
steel element [1]

A second test was made for car bumper shock absorber made of composite materials, so it was mounted on the removable complying vehicle chassis dimensions, as shown in figure 19., then a steel ball hit at low speed the composite material element like in figure 20. and in figure 21 presents a detail of the ball hitting steel:

Figure 19: Before hitting composite element [1]

Figure 20: After hitting composite element [1]

Figure 21: Impact detail composite element [1]

The impact tests at low speed that is 5.4 km / h, where you can see details about the installation, testing, impact, analysis, standards for car bumper shock absorber respectively in figure 22 using accelerometers will get results in the form of load-displacement graphs for the fitting in figure 23 and composite bumper in figure 24:

Figure 22: Black car bumper shock absorber made of steel and yellow car bumper shock absorber made of composite materials after impact testing[1]

Figure 22. auto bumper was tested at low speed impact from a height of 3m standards to be met.

5. RESULTS

The impact tests where you can see details of test and behavior of car bumper shock absorber made of steel in figure 23 and car bumper shock absorber made of composite material like in figure 24:

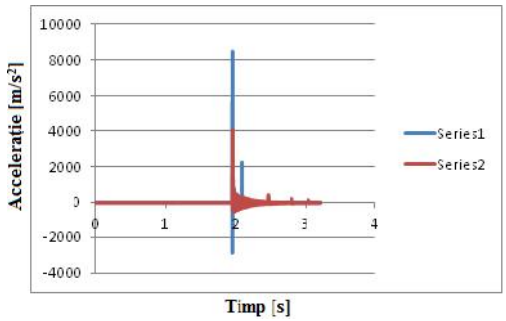

Figure 23: Acceleration versus time graph or car bumper shock absorber made of steel [1]

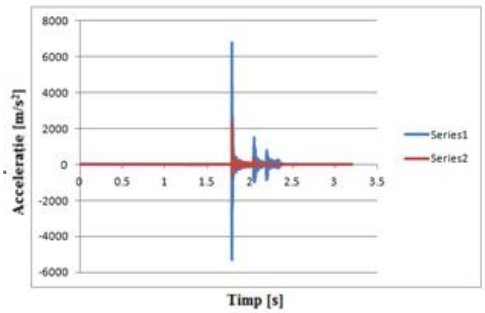

Figure 24: Acceleration versus time graph for car bumper shock absorber made of composite materials [1]

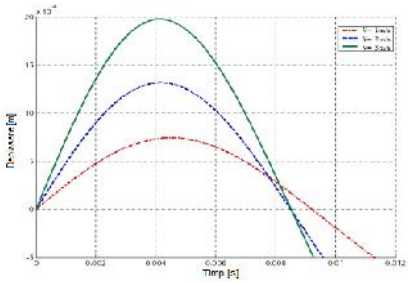

Figure 25: Variation steel ball movement during contact versus time for different speeds of impact of steel ball [3]

In Table 1. results were displayed at maximum values of acceleration versus time graphs on impact car bumper shock absorber made of steel and car bumper shock absorber made of composite materials:

Table 1: Values obtained from both of car bumpers shock absorbers [1]

Values	Car bumper shock absorber made of steel	Car bumper shock absorber made of composite materials
a_{max} [m/s^2]	8149	6311
time [s]	1.72	1.94
v_0 [m/s]	3	3

6. CONCLUSIONS

By reducing the weight of the bumper using biodegradable and recyclable materials such as cork can make the claim that depreciation costs of producing this type of bar can be achieved by reducing the vehicle weight, reducing mechanical work and thus lower consumption.

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