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EXPERIMENTAL INVESTIGATION OF POLYAMIDE, BAMBOO FIBRE AND DEODAR FIBRE MATERIAL USING IMPACT TESTING

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Abstract:

Today, passenger safety is at the heart of all car manufacturers' concerns. New safety standards are set in a variety of crash situations, such as further crashes, corner effects, side effects, rear effects and rollovers. The Fuel economy is also a talk of concern in current scenario. Due to limitations, lighter and stronger composite materials are used in the railroad on the front side of the car than in steel. Car carriers are usually made of heavy structural steel and weigh relatively high. In this project, we can replace the front bumper of the car with good impact resistant or such material, but it can effectively reduce the weight of the car. Strength materials can be best configured with polymer and metal matrix composites. From the polymer matrix, the material is used. Current research explains the damage caused by drop impact tests on composite specimens made from polyamide, bamboo and cedar.

Keywords: Car Front Bumper, Impact Strength, Drop weight test

1. Introduction :

The concept of determining the impact resistance of polymer matrix of polyamide and polyurethane, bamboo fiber and cedar fiber was solved using simulation. The simulation results are based entirely on the theoretical modules implemented in the software. Thus, in order to implement the concept in real time, for example, it is necessary to verify the results obtained in the simulation with the experimental performance of the study. This process is called experimental authentication. Therefore, sample samples for these sections to check the impact resistance of the material

Figure 1. Experimental Flow Process for Impact Strength

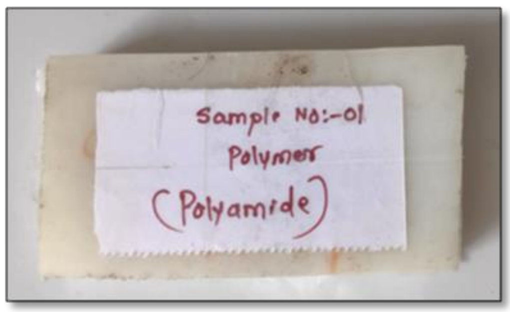

Figure 2. Sample Specimen for Polyamide

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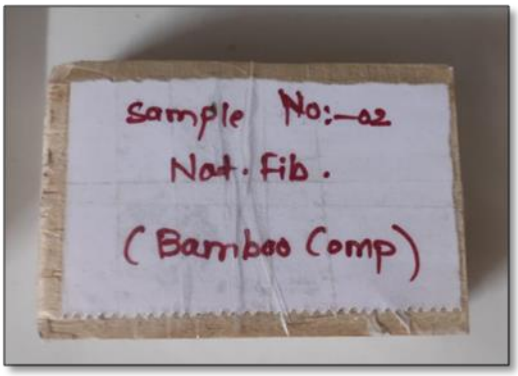

Figure 3. Sample Specimen for Bamboo Fibre

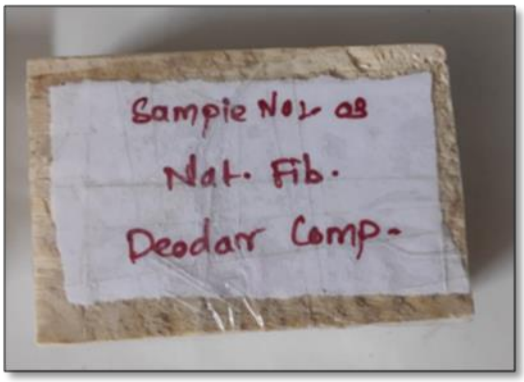

Figure 4. Sample Specimen for Deodar Fibre

Table 1 Dimensional Properties of Specimen

Sample No.	Material	Length (mm)	Width (mm)	Thickness (mm)
Sample 1	Polyamide	65	45	20
Sample 2	Bamboo Fibre	55	45	25
Sample 3	Deodar Fibre	55	45	25

2. Experimental Setup :

The drop weight impact test specifically determines the resistance of the material to sudden external forces. This type of test also applies to pipe tests where the impact resistance of thermoplastic pipes is measured. Applicable standards for this type of test include ASTM D2444 and ISO 3127. The total dimensions of the installation are 550 mm in width and width where its height is 2100 mm. Test sample with variable impact energy from 10 J to 110 J with variable impactor range from 50 g to 20 kg with height 0 to 1.5 m

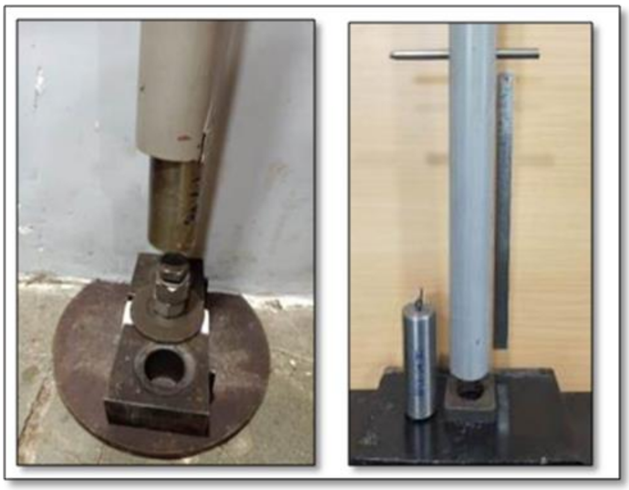

Figure 5. Gardener Weight Impact Test Set Up

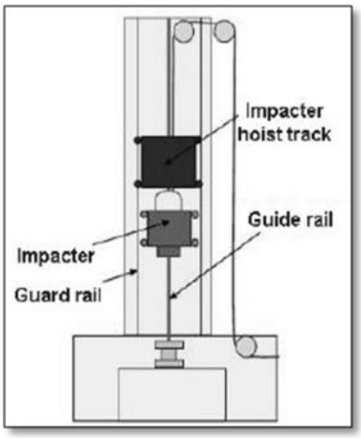

Figure 6. Schematic View of Drop Weight Impact Test Set Up

- The dart is released to fall into the center of the test tube.
- Lose weight and test results (pass / fail) were reported.
- This method of analyzing test data is called "Bruston Staircase" method.
- A series of 20 to 25 effects is performed. If the sample is passed, the weight of the drop is increased by one. If the test sample fails, the drop weight is reduced by one.

- The effects of these effects are used to measure the failure weight - at which point 50% of the samples will fail under the influence.

3. Initial Level parameters :

The principle of placement works on the effect energy which is initially in the form of potential energy due to weight loss from height. The corresponding potential energy is made equivalent to the kinetic energy which is usually determined in an object moving at a certain speed. Thus, using this energy, the velocity and the velocity of an object can be measured.

The potential energy of falling object can be given as,

P.E = m * g * h Eqn (1)

m = mass of falling object in Kg

g = Gravitational forces = 9.81 m/s^2

h = Height of fall = 1m in case of current setup.

And Velocity of free falling object can be calculated as,

$v = \sqrt{[(m * g * h)/t]}$ Eqn (2)

V = Velocity in m/s

t = Time required for falling of object.

Speed in Kmph, S = [v * 18]/5 Eqn (3)

Table 2 Experimental Parameter for Impact Test

Mass, m (Kg)	Impact Energy (J)	Time, t (sec)	Velocity, v (m/s)	Speed, S (kmph)
1	10	0.92	3.30	11.87
2	20	0.92	4.66	16.79
3	30	0.92	5.71	20.56
4	40	0.92	6.59	23.74
5	50	0.91	7.41	26.68
6	60	0.91	8.12	29.23
7	70	0.89	8.87	31.93
8	80	0.89	9.48	34.13
9	90	0.89	10.06	36.20
10	100	0.87	10.72	38.60
11	110	0.86	11.31	40.71
12	120	0.83	12.02	43.29
13	130	0.82	12.59	45.33
14	140	0.79	13.31	47.92
15	150	0.76	14.05	50.58

4. Damage Behaviour :

The theory of placement works on the effect energy that is initially in the form of potential energy due to weight loss due to height. The corresponding potential energy is made equivalent to the kinetic energy which is usually determined

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in an object moving at a certain speed. So the speed and velocity of the object can be measured using this energy.

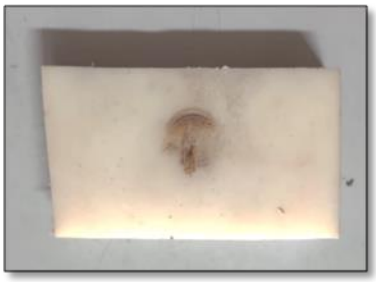

Figure 7. Damage for Polyamide

Figure 8. Damage for Bamboo Fibre

Figure 9. Damage for Deodar Fibre

5. Dye Penetrant Testing :

To determine the deformed area damaged during the test, power spray or non-destructive powder penetrant test is used.

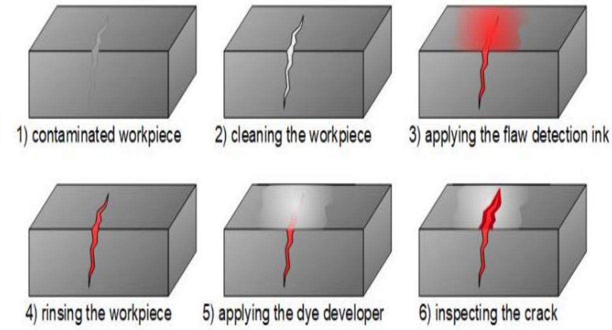

Figure 10. Procedure of Dye Penetrant Testing

Penitent Penetrant (PT) is a widely applied and inexpensive test method used to verify surface fracture defects in all non-porous materials (metal, plastic or ceramics). Penetrant can be applied to all non-ferrous materials and ferrous materials, although magnetic particle probes for ferrous components are used for its ability to detect beneath its surface.

It is used to detect casting, forging and welding surface defects such as hairline cracks, surface porosity, leaks in new products and fatigue cracks on service components.

The main advantages of DPI are speed of testing and low cost. Losses only include surface detection, skin irritation, and the inspection must be performed on a smooth, clean surface where more penetrating material can be removed before it develops. Testing on rough surfaces, such as welded welds, will make it difficult to remove any excess penetration and may lead to incorrect indications. If no other option is available, a water-washable penetrant should be considered. Also, on some surfaces, large enough color contrast may not be achieved or stains will fall on the dye area.

6. Result and Discussions :

a. Impact Damage :

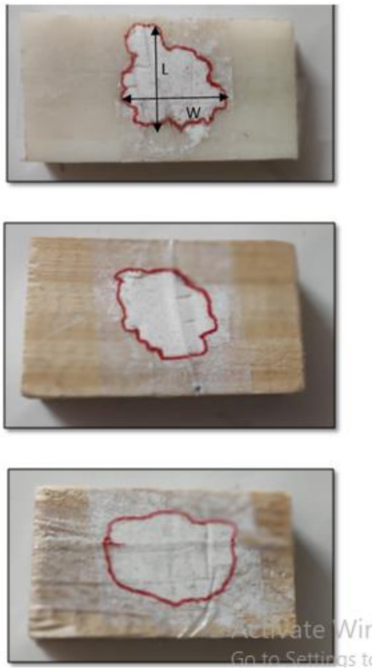

Figure 11. Procedure of Dye Penetrant Testing

Table 3 Results for Impact Damage

Material	Length (mm)	Width (mm)	Deformed area (mm^2)
Polyamide	38	36	1260
Bamboo Fibre	26	25	650
Deodar Fibre	33	28	924

Laminate is dominated by delamination in the plane effect, the fiber breaking occurs only in the upper parts below the impactor. The presence of delamination in compression is expected to be well detected after impact tests. Most of the impact energy during sample production is absorbed by the plastic deformation. Therefore, factors that affect the elasticity behavior and therefore the elasticity of the material, such as temperature and stress rate, affect the impact energy.

The sample for three materials during operation is subjected to a sudden impact load of 32 KN. The sample size is kept constant. The pattern is affected by the impact energy of the vertical height of the pendulum fall. The damaged area of the polyamide is similar to that of bamboo and cedar fibers. Regarding deformation, stress, damage severity, it can be concluded that cedar and bamboo fiber can be used as an alternative to automobile front bumpers.

b. Impact Damage :

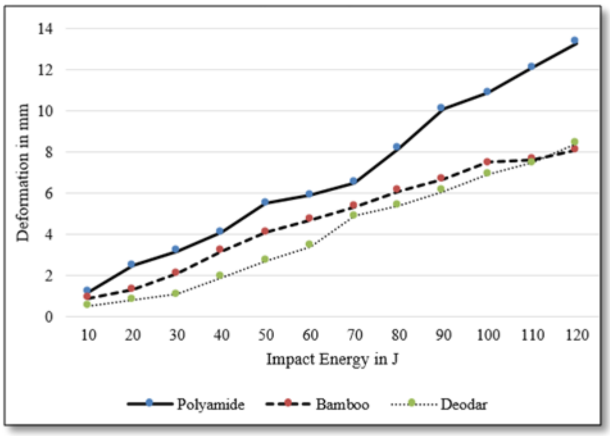

Figure 12. Response analysis for Deformation Produced in Experimentation

The term of deformation produced in the Polyamide Polymer increases from initial period of impact analysis less than 2 Kg. The material goes on deformation with promotion in increase in load. But the deformation is not temporary. As the load is removed, the material regains its original shape and size. If the comparison is done amongst all the three materials, the deformation found in Deodar Fibre is found to be less as that of Polyamide and Bamboo. Hence if the implementation is considered, both the alternative composites of Bamboo and Deodar fibre can be used, but specifically for more assurance Deodar fiber shown better results in consideration with Bamboo fiber.

The deformation term formed in the polyamide polymer increases from the initial period of impact analysis to less than 2 kg. As the load increases, the material continues to deform. But the deformity is not temporary. After the load is removed, the material returns to its original shape and size. Compared to the three substances, the deformation found in cedar fiber is found to be less than that of polyamide and bamboo. Therefore, if implementation is considered, an alternative blend of bamboo and cedar fiber can be used, but especially for the added assurance, bamboo fiber with cedar fiber

7. Conclusions:

Impact resistance was performed in the Gardner configuration. Polyamide content shows more deformation than bamboo and cedar alloys. Car bumpers are usually made of polypropylene and carbon fiber composites. Carbon fiber usually costs more than polypropylene but has more strength. Therefore, in this study, considering the strength of the bumper, an attempt is made to study the impact resistance of polyamide, polyurethane, bamboo and cedar materials. The approach of finding alternative materials for the polymer matrix component is designed to reduce the uneven workmanship of the material and the cost of the material without affecting the strength of the material. Therefore, bamboo fiber and cedar can be used successfully in bumpers. In the research work it is still possible to create a bumper pattern as a beam and validate the beam by bending impact test which can give more clarity to the concept in practical situation.

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