European Journal of Mechanical Engineering Research
Vol.5, No.1, pp.18-26, February 2018
Published by European Centre for Research Training and Development UK (www.eajournals.org)

THE USE OF NATURAL FIBER COMPOSITES FOR BUMPER MATERIALS

Julian

DPK Lecturer Faculty of Mechanical Engineering UNIVA Medan

ABSTRACT: *Bumper is an essential exterior part of passenger cars to protect the cars from the more expensive damage when two cars crash each other since crash is unavoidable things for bumper cars.In addition, the growth of car production recently does not only give rise to the more crowded traffic but also the more crash happened on the road.. Thus, this research is focused on the use of natural fiber composites in order to produce the more resistant bumper to the collision and crash. Three natural fiber composites are used, namely;carbon charcoal, grass and banana stem fiber. In order to achieve the objectives, this research was conducted by using experimental method to test the superiority of polyester resin mixture by testing all natural fibers using, they are;tensile and compressive static test, and impact as well. This research found that carbon charcoal fiber composite is more resistant to the crash, since the impact strength of charcoal carbon is 67.14 kJ/m2 which is higher than the SNI (Standar Nasional Indonesia) Indonesia National Standard impact strentgh which is 50kJ/m2.*

KEYWORDS: Natural fiber composites, Polyester Resin, Bumpe

INTRODUCTION

One of driving point is collision from one car to another car on the road. A good quality bumper could be able to protect more serious and expensive damage when two cars crash. Since bumper is an essential exterior part of passenger cars to protect the cars from the more expensive damage. Generally, bumper is designed to have two major functions, namely; to prevent damages of car exterior structures and to absorb the energy to the bumper system because typically two cars collided would exchange some energy. The use of natural fibers can be used to substitute the metal materials and reinforce the bumper quality so it would be more resistant.

Thus, in relation to the background above the research problems are formulated in the form of question as stated below;

1. Does the natural carbon charcoal fiber composite have higher quality to be more resistant to the crash of bumper?
2. Does the natural carbon charcoal fiber composite have higher quality to be more resistant to the crash of bumper?
3. Does the natural carbon charcoal fiber composite have higher quality to be more resistant to the crash of bumper?
4. Which natural fibers are best to substitute the metal materials of bumper?

Objectives of the Research

Based on the research problems given, the objectives of research are elaborated as follows;

Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)

1. To test whether natural carbon charcoal fiber compositeshavehigher quality to be more resistant to the crash of bumper
2. To test whether natural weed fiber compositeshave higher quality to be more resistant to the crash of bumper
3. To test whether natural banana stem fiber compositeshave higher quality to be more resistant to the crash of bumper
4. To know which natural fiber composite is most appropriate to substitute the metal materials of bumper.

Scopes of the Research

In accordance with the research problems, this research has some limitations of study as described as follows;

1. This research will focus on three natural fiber composites, namely; natural carbon charcoal, weed and banana stem fibers which use to substitute the manufature material for bumper
2. This research will test each of three natural fibers to test the tensile, compressive, and impact strength test.

Bumper

According to Oksman [2] bumper is one of an essential exterior structure for passenger cars which designed to have three major functions; receiving the impact, protecting againts the crash that may cause the more serious damage and absorbing the sufficient energy to meet the Original Equipment Manufacture (OEMs). The illustration of standard regulation of bumper is visually shown in Picture 1

Picture 1. Standard Regulation of UNECE Iso 9002, WP 42

While, the illustration of bumper is visually shown in Picture 2

Picture 2. Bumper

Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)

The Calculation of Bumper Product Design

Moreover, the three kinds of natural fiber composites used for materials of bumper makingprocess would put in impression in order to produce the specimen. The specimen would be calculated by using the following equation;

$$m=pV$$

where:

m=Bumper weight(Kg)

p =Density of material bumper

V =Content of material bumper used(mm2)

Bumper Material

Bumper material used in this research consists of natural carbon charcoal, weed grass and banana stem fiber which mixed with resin and hardness. It results the speciment which has been done with tensile, compressive and impact testing prior to the manufacturer of bumper.

Charcoal Fiber

Charcoal fiber used is kind of powder which is made by drying, then pounded into soft powder with 30-3000 um. After the process has been done, the powder would be tested in this research.

Weed Fiber

Some steps should be taken in order to get the natural weed fiber. Firstly, the weed grass is sliced by knife into approximately 6 to 8 mm. Secondly, it is cleaned from any dirt. Lastly, it is pounded and ready to be used.

Banana Stem Fiber

The natural banana stem fiber is produced through some processes; first, the wet banana stem is cut into approximately 7-9 mm, then it is pounded like porridge, and the last, it is pounded.

Polyester Resin

In this research, the resin ***PolyesteYukalac BQTN 157 ex*** is used as matrix to achieve the objective of the research

RESEARCH METHOD

This research would be conducted by using experiment method which applied Hand Lay Up method. The data of the research were taken from each of natural fibers used in this research by testing the three main stages, namely; tensile, compressive and impact strength. The test is done by using Shimadzu in which the capacity is 100 kN and type is SC-DE of testing rate 0.1 mm/sec. In this research, the number of specimen will be tested based on each of natural fibers used. Staticitic analytic is used to determine the range of measurement that allowed to be data result.

Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)

To get the data explained above, some procedures would be conducted as seen in the following diagram.

Picture 3. The Research Procedure

Specimen Making Process

The sample of composites are made by following some procedures as described as follows;

1. Carbon charcoal fiber is naturally weigthed corresponding to the volume of its mold and density
2. Matrix is also measured corrsesponding to the volume of its mold and density. Then, natural fiber and matrix mix together into a glass container
3. Next, add catalysts and hardenes corresponding to the volume
4. Gently, it is stirred about 4 minutes
5. Pour this mixture intoASTM D638 standard mold prepared
6. Flatten the mixture
7. Wait to dry for 30 hours
8. Release the mixture from mold
9. Smooth the mixture by using sand

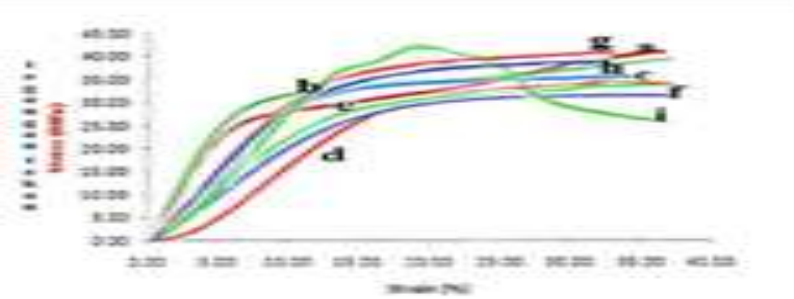
Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)

10. Then, it is measured with correspond to previous geometri and some test would be undertaken such as; tensile, compressive and impact strength test. This mold of test is made from PVC pipe with a diameter 2.5 inch in which there are some stuff inside the pipe, they are; base plate iron and alumunium foil as forming the mold in order to meet ASTM 638 D test method standard.

Furthermore, in order to take some experimental data some required equipment are used, namely; (a) impression made from pipe (b) roller is used to tidy up and compact the composites inside the mold so it would be air-tight (c) brush is used to pick up the mixture of resin and hardner. While, the materials needed are; natural carbon charcoal fiber, natural grass weeds fiber and banana stem fiber, resin, catalyst, and hardner with the comparison resin : hardner is 2 : 1

DISCUSSION

The research findins showed that charoal carbon fiber is the strongest natural fibers to be used as the bumper materials. It can be seen from the averages of charcoal carbon fiber is higher than the other natural fibers used after the results of three different test conducted, namely; tensile, compressive and impact strength result. Based on the result found and tested, it is found that the more increase fibers to compositer, the stronger composite will be. The graph below shows the interaction between the increasing fibers and composite labelled a, b, and c are banana stem fiber, while d, e and f are charcoal carbon fiber, and g, h, i are weed fiber.



Graph 1.

The graph above showed that the increasing of composite always comes along with the mechanical volume. It can be seen from charcoal carbon fiber in graph d would be unbreakable if it is tested on 10/90% by tensile strength average was 22.65 Mpa. Then, graph e showed that the charcoal carbon is tested on 20/80%, the tensile strength average rose up 25.43 Mpa as well. Last, graph f showed that the average of tensile strength varied with 30/70% went up to 27.28.

Furthermore, the highest average of impact strength was charcoal carbon fiber which was 67.14 kJ/m2. As a matter of fact, the SNI (Standar Nasional Indonesia) impact standard or Indonesia National Standard was 50kJ/m2. It extremely showed the use of charcoal carbon fiber as bumper material is much better than manufacture materials. Thus, the use of charcoal carbon as bumper material affects the strenght of bumper itself. Since the function of bumper is protecting the car from the more serious damage when two cars crash.

Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)

RESULTS

The findings of this research are divided into three parts, namely; (a) the result of tensile strength, (b) compressive strength and (c) impact strength.

a. After the experiment has been done, the result of tensile strength to the three natural fibers used through three different tests labelled Test 1, Test 2 and Test 3 are visually shown in Table 1.

Table 1. The Result of Tensile Strength Test To The Three Different Natural Fibers

		Variations	Tensile Strength			
No	Kinds of Fibers	Fiber/Resin (%)	Test 1	Test 2	Test 3	Averages
1	Banana stem	10/90	3.10	2.90	3.05	3.02
2	Banana stem	20/80	3.30	3.60	3.55	3.48
3	Banana stem	30/70	5.20	5.50	5.4	3.37
4	Weeds	10/90	4.12	4.56	4.44	4.37
5	Weeds	20/80	5.66	5.45	5.36	5.49
6	Weeds	30/70	6.17	6.65	6.45	6.42
7	Charcoal carbon	10/90	19.79	14.36	20.76	18.30
8	Charcoal carbon	20/80	24.67	23.11	23.67	23.82
9	Charcoal carbon	30/70	26.55	25.87	25.96	26.13

Through Three Different Test Conducted

Then, test result of tensile strength and elongation break is seen in the following table.

Table 2. Test result of Tensile Strength

No	Fibers	Test Result	
		Tensile Strength (Mpa)	Elongation Break (%)
1	Charcoal	25.98+/-26.13	2.41+/-0.25
2	Banana stem	5.50+/-5.37	1.20+/-0.10
3	Wedd	6.45+/-6.42	2.40+/-0>20

Based on the table above, it clearly shows that tensile strength of resin is higher than all natural fiber used, namely; banana stem, weed and charcoal carbon fibers in which it can be seen from the column of variation by percentage 10/90, 20/80 and 30/70. In addition, from this percentage, it can be seen that the averages of charcoal carbon is higher than other fibers.

b. While, the compressive strength test and variation among natural fibers used has been done for three times as well. The compressive test is visually shown in the table 3.

Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)

Table 3. The Result of Compressive Test To The Three Different Natural Fibers

		Variations	Compressive Strength				
No	Kinds of Fibers	Fiber/Resin (%)	Test 1	Test 2	Test 3	Averages	Captions
1	Banana stem	10/90	9.88	9.76	9.77	9.80	Breakable
2	Banana stem	20/80	10.96	10.95	10.58	10.83	Breakable
3	Banana stem	30/70	12.22	11.97	11.98	12.06	Breakable
4	Weed grass	10/90	10.55	10.68	10.44	10.56	Breakable
5	Weed grass	20/80	13.22	13.45	13.55	13.41	Breakable
6	Weed grass	30/70	15.31	15.45	15.38	15.38	Breakable
7	Charcoal carbon	10/90	22.78	22.68	22.50	22.65	Unbreakable
8	Charcoal carbon	20/80	25.44	25.48	25.37	25.43	Unbreakable
9	Charcoal carbon	30/70	27.38	27.15	27.30	27.28	Unbreakable

Through Three Different Test Conducted

From the table above, it is clearly seen that carbon charcoal fiber is more resitant and stronger than other fibers to use as bumper material after three different test conducted. Since, the highest average of charcoal carbon found is 27, 28.

Then, the final test result of compressive strength is seen in the following table.

Table 4. Test result of Compressive Strength

No	Fibers	Test Result
		Compressive Strength
1	Charcoal	22.50+/-22.65
2	Banana Stem	11.98+/-12.06
3	Wedd	15.38+/-16.15

c. After two tests above conducted the result of impact strength to three natural fibers used are visually shown in table 5.

Table 4. Test result of Impact Strength

No	Fibers	Test Result
		Impact Strength (kJ/m2)
1	Charcoal	67.14+/-7.59
2	Banana Stem	15.75+/-7.80
3	Wedd	12.50+/-6.70

Based on the result above, the highest result belongs to charcoal carbon fiber which is 67.14+/-7.59 . It extremely shows that natural charcoal carbon fiber is most appropriate natural fiber to be used as bumper material. In other words, the charcoal carbon fiber is the most resistant and stronger to the collision.

Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)

CONCLUSIONS

Based on findings and discussions, the conclusions were stated as the following;

1. The tensile, compressive and impact static of charcoal carbon were more resistant to the crash than other natural fibers when two cars crash. It would be done to all mixture of resin and fibers (10/90%, 20/80% and 30/70%).

2. The tensile, compressive and impact static of weed carbon were less resistant to the collision and crash.

3. The tensile, compressive and impact static of weed carbon were less resistant to the collision and crash as well.

4. Naturally, the charcoal carbon fiber is the most appropraite natural fiber which can be used as the bumper material. Since the impact strentgh of charcoal carbon is 67.14 kJ/m2 which is higher than the SNI (Standar Nasional Indonesia) or Indonesia National Standard impact standard was 50kJ/m2.

Suggestions

In relation to the conclusions, some suggestions are offered ;

1. Comprehensive treatments and requirements must be considered from the beginning to the single procedure of research in order to produce a good quality composites as expected..

2. Weed and banana stem fibers could be used for other purposes.

REFERENCES

Cheon. Choi J.Eand LyDG (2008).Standard ofthe composite bumper beam for passengercar. composite Structure245;643-532.

Surdia (1992) Pengetahuan bahan Teknik PT.Pradaya ParamitaJakarta

OksmanK Skriafars M Selin J-F(2003) Naatural Fiber as ReinforsmentinPolylactic Acid(PLA)Composite Science andaTechnology63 hal1317and 1324.

GereMJ &Timoshenko, PS1987 Mekanika Bahan terjemahan oleh Hans J Wospakrik Jakarta Penerbit Erlangga.

Bertscfie, Bernd, 2008, *Fundamentals of Statistics andProbability Theory*, 10th Ed., Berlin: Springer Berlin Hiedelberg.

Fajar SN (2008) optimasi kekuatan bending dan impact compositeberpenguatserat ramibermatrik PolyesterBQTN157terhadap fraksi Volumetebal Skin.

HasyimJ2003PemerosesanbahancompositeEdisipertamaJohorBahru Cetak Ratu Sdn Berhad.

Edward,B.M.,*IntegratedProductandProcessDesignandDevelopment*, New York: CambridgeUniversityPress, 1981.

HibbelerR.C2004StatikandMecanics ofMaterials SI EditionNewYork Prentice-Hall, Inc.

ZhengY(2010) PreliminaryEvaluationofImpact of local accidentInformationonthe Publicperception ofroadsafety RealibilityEngineering and SystemSafety.

Zabinsky Z.Bet.al2006CompositeStructureDesign OptimizationJournal of Nonconvec optimizationandits ApplicationVolume85pp507-52.

Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)

Roozenburg,N.F.M.,andEekels,J.,1991,*ProductDesain:Fundamentalsand Methods*, New York:JohnWilley&Sons.

Agreement Concerning The Approval Of Vehicles With RegardToTheir FrontandRear Protective Devices (Bumper,Etc),Addendum 41, Regulation No.42 Geneva,1980.

[1998], AnnualBookofASTMStandard,Vol,03,01,E23, AmericanSociety for Testing andMaterial.

Print ISSN: ISSN 2055-6551(Print), Online ISSN: ISSN 2055-656X(Online)