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Matrix Exposion's Hemp Fiber Composite Bending Test Endurance For Electric Car Body Specimen

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Abstract **To reduce the load of the electric car, a light yet strong body is needed. Therefore electric car's body is made of hemp fiber. The purpose of this research is to know the bending strength towards the variation of hemp fiber structure. The compositions used in this research are Explosion Resin *General Purpose (Bisphenol A-Epichlorohydrin)* and *Hardener* type *General Purpose (Polyaminoacid)*, carbides silicone 120 and hemp fiber. Tools used in this research are: scissor, specimen cast with testing bending measurement cast is 5 cm x 19 cm, mixer, grease, measuring glass, compass and bending tester machine. After boiling the hemp for 1 minute, mix and stir along with carbides silicon for about 1 minute and mix it with catalyst then it is ready to be poured on the cast. The result of bending test is 1,259 kgf/mm2 average. Structure off hemp fiber structure randomly has bending strength average 1,428 kgf/mm2. Hemp fiber structure variation at an angle 45 degree has average bending strength 1,070 kgf/mm2.**

Index Terms - Hemp fiber, Composite, Matrix, Explosion, Electric Car, Bending Test

I. INTRODUCTION

Automotive industry is expanding recently, so the need of fuel is also increasing. As we know that fuel is an renewable energy, so that is why an innovation to create the future transportation without using fossil energy is commonly discussed recently. One of the innovations is to create an electric car. Electric car is a solution to reduce the fossil fuel usage.

In Indonesia the innovation in composite engineer is popular recently. Some of them is vehicle body testing. To make the vehicle body lighter, one of the innovation is composite engineering.

The benefit of using hemp fiber than fiber glass is that hemp fiber is easy to be composed so it is environment friendly and it is cheaper than fiber glass. Hemp is a plant that has high fiber material and longer fiber, stronger and more absorb power. But today the usage of hemp is only in fabric cloth only and paper, but of course it will have plus value if hemp fiber is used to change the usage of fiber glass which is only available imported from overseas. The minus of hemp fiber are only rough in fiber and the low stretching power than cotton fiber (Edy Yusuf, 2008).

Explosion is one of polymer thermosets whis is made of resin reaction and hardener. It has benefit to be easy to be shaped and anti-corrosion yet has weakness that is brittle. Silicon Carbide (SiC) is an expensive ceramic material because big energy is needed for the production and needs many mixture materials. Mixtures in order to create silicon carbide are silica sand, carbon, phosphate steel, and nitrium silicate.

II. THEORETICAL BACKGROUND

The body vehicle development cannot be separated with the history of the engine vehicle discovery. Generally, vehicle body is made of metal, but there is problem in making vehicle body that is too heavy. That is why there is an innovation to make it lighter by using composite material instead of metal.

Generally, fiber divided into two kinds those are natural fiber and artificial fiber. Natural fiber divided in three categories, fiber which is from animals, plants and inorganic fiber. Cotton, hemp, and compose are the example of plants fiber, while wool and sold came from animals and asbestos came from inorganic fiber material (Abdul latief sulam, 2008).

A. Composite Car Body

car body is a part of a vehicle that is shaped in the thickness 0,6 mm-0,9 mm. besides anti-rust, composite body is easy to make a shape. In the future, the design of car body is no longer using metal but composite material.

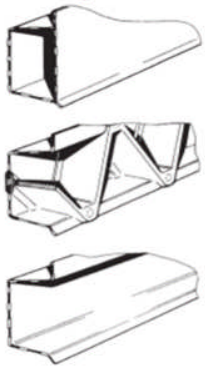

Fig. 2.1 Composite hybrid structure

B. Hemp Plant

Hemp plant (*Boehmerianivea*) is a tropic plant. Hemp plant is a plant that is 2, 5 cm to 50 cm with height from 12, 5 cm to 15 cm. the diameter is about 25 to 75 with average 30-50. The shape of hemp fiber is cylinder with lines surface yet wrinkle and create lumps, while latitude cut has a long oval shape with a thick cell wall (IndustriTeksti, 2014).

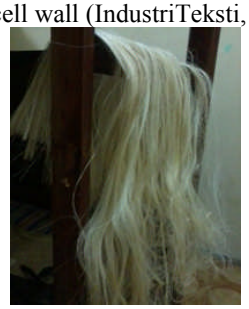

Fig. 2.2 Degummed Hemp Fiber

The purpose of degumming process is to loss as many as possible gum compound. Degumming can be done by cooking 25%-30% china grass with alkali in hours. There are degumming processes those are using NaOH 0,5%, Na2C03, Na-tripolifosfat 3% sand wet material (teepol) as much as 3% .

C. Composing Hemp Fiber Structure

the other important thing in using hemp fiber is reducing environment pollution (*biodegradability*) because in Indonesia there are many hemp plants that can be used to make hemp fiber and the economic value will be increasing. To make material structure stronger, structure variation of hemp fiber is needed. There are four kinds of variations from the hemp fiber, there are:

- variation of hemp fiber webbing structure.
- Variation of vertical hemp fiber structure.
- Variation of random hemp fiber in 45-degree angle.

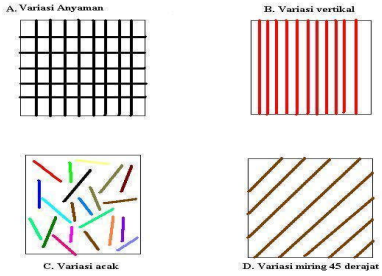

Fig. 2.3.Variation of hemp fiber structures to be tested

In webbing variation figured in figure 2 is using basket webbing. It has plain weave that is simple yet strong in receiving pressure (RafudinSyam, 2012). Hemp fiber direction's orientation, measurements and the shape as well as fiber material are the factors influencing mechanic and laminate character.

D. Understanding Composite

Composite is an adjective that means structure or compound. Composite came from the verb "to compose" means structuring or arranging. Composite material consists of two compound those are filler and matrix. Composite material has some benefit besides it is light and anti-rust, cheap and has strength (Arumaarifu, 2010).

E. Silicon Carbide (SiC)

Silicon carbide is mainly made of silica sand and carbon. Carbide silicone with structure tetrahedral from atom silicone and carbon with strong crystal compound. It creates strong and hard material. Carbide silicone endures towards acid or alkali and salt to 1800-1900 degree (Daud Simon Anakottapary, 2010).

III. RESEARCH METHODOLOGY

This research is using experimental method, that is making specimen out of resin explosion mixture and hardener as strengthener with sick as the matrix material and hemp fiber as strengthener composite. This research searches the influence of sick addition and the variation of hemp fiber structure composite matrix explosion towards bending strength. The mixture is 70% explosion and 30% strengthener, then preparing hemp fiber variation those are webbing, horizontal, random and at an angle 45 degree.

Material used in this research is Resin explosion General Purpose type and Hardener General *Purpose (polyaminoacids type),* carbide silicone with size 120 and hemp fiber. Tools used in this research are: scissor, specimen cast with testing bending measurement cast is 5 cm x 19 cm, mixer, grease, measuring glass, compass and bending tester machine. After boiling the hemp for 1 minute, mix and stir along with carbides silicon for about 1 minute and mix it with catalyst then it is ready to be poured on the cast.

IV. RESULT AND DISCUSSION

A. Bending test

In bending test using Torsi's Universal testing machine Type = AMU – 5 – DE, Production = Tokyo, Japan 1987. The measurements of the specimen refers to ASTM standard D 790 02 span testing specimen dimension (the distance between center spot load with buttress testing), total length, wide and thickness. Referring to imposition condition that is centered in buttress condition of tester material that is called "three point bending".

Fig. 4.1 Bending tester machine

Formula used to find the maximum load strength that is received by specimen is:

$$\sigma_f = \frac{3PL}{2bh^2}$$

Where :
σf =bending strength (*Kgf/mm²*)
P = Maximum load*(Kgf)*
b = Tester width (*mm*)
h = Tester thickness (*mm)*
L = Distance between buttress (*mm*)

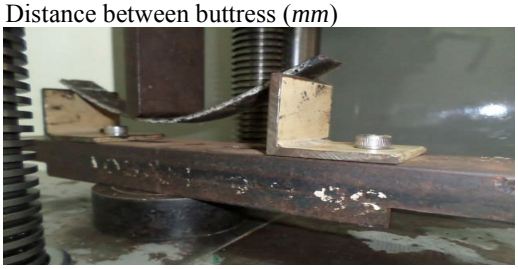

Fig. 4.2 Bending test process

Fig. 4.3.bending test specimen after bending test

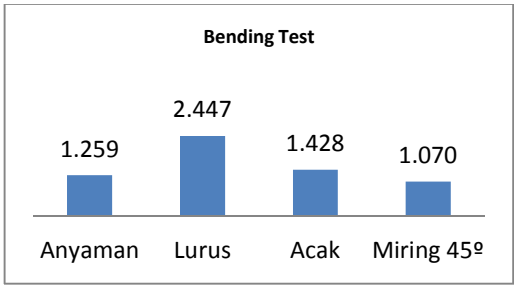

Fig. 4.4 bending test graphic's result

From the table and graphic of the test result shows that the strongest bending of the hemp fiber structure variation in straight is 2,447 (Kg/mm2). While the impact happened to specimen at angle 45 degree underwent low bending strength that is 1,070 (Kgf/mm2).

V. CONCLUSION AND SUGGESTION

A. *Conclusion*

Bending test using ASTM D790-02 standard "three point bending" got the biggest maximum load result happened in the hemp fiber which has 45 degree angle with average bending power 1,070 kgf/mm2.

B. *Suggestion*

Based on the research there are some suggestions given for the next research:

1. Use resin *General Purpose (Bisphenol A-Epyclorodhyrin)* dan *Hardener* type A.
2. Resin and hardener mixing process do not take a long time because it will harden.
3. Bending test specimens have to reach 4 specimens at least for the result to be more valid.

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