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Influence of Addition Steel Powder on Characteristics Biocomposite Cements - Fiber Sugarcane Powder

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Abstract: Development of composite technology began to grow rapidly, composites are now many who use natural fibers as a substitute for synthetic fibers. The composite function in a variety of components, among others, used for automotive, electric cars, aircraft, ships and sports equipment. Preparation of composites containing cane powder and portland cement matrix was carried out with the variables used: sugae cane powder size 0.18 mm, 0.25 mm and 0.42 mm. Steel powder sizes: 1.2 mm, 1.8 mm and 2.4 mm. The observed parameters were tensile strength and impact strength of composite materials. From this research, the optimum tensile strength value was found on the size of 0.18 mm cane powder and 1.2 mm steel powder size with a tensile strength value of 0.38 N/mm^2. The optimum impact strength value occurred on the size of 0.18 mm cane powder and 2.4 mm steel powder size with impact strength value of 1.44 J/mm^2. From the results of macro observation for the impact test results the type of fracture formed is a brittle fracture.

Keywords: Composite, Sugarcane, Tensile test and Impact test.

1. Introduction

The emergence of the issue of synthetic fiber inorganic waste problem that increasingly able to push the trend of composite technology toward envsteelmentally friendly composite. One type of natural fiber that is available in abundance is sugarcane powder. Benefits of using composites include light weight, corrosion resistance, water resistance, performance is attractive, and without machining process. Construction costs also become lighter (Bilba, 2001). One of the most potential natural fiber types is sugar cane powder. Sugarcane waste is a waste of sugar processing which utilization is not optimal. (Savastano, 2003). Sugarcane bagasse produced as much as 32% of the weight of sugar cane. As much as 60% of the bagasse is utilized by sugar factories fuel, raw materials for paper, industrial raw materials, brake canvas, mushroom industry and others (Teixeira, 2012). The bagasse contains many elements of silica, the composition of the elements contained in bagasse consists of: SiO2 83%, Fe2O3 7%, K2O 6% and other content 4% (Marcos Oliveara, 2009).

Sugarcane waste has been widely used as a mixture of cement aggregate mixture used for concrete structure, the addition of 1% sugar cane will raise the strength of concrete increased by 9% (Dipan Patel, 2015). The addition of 6% Styrene butadine catalyst to the cement composite - the sugarcane fiber will increase the strength and hardness of the composite by more than 30 kGy in general the addition of styrene butadine will improve the mechanical strength of the composite material (Ghazali, 2008). The cement composite is also elastic in the use of concrete with a mixture of sugarcane fibers in the extrusion process, after the fatigue test it appears that the composite is degraded after 200 cycles for 28 days (Teixeira, 2012). Meanwhile, cement composite-cane fibers can also be used for heat inhibitors, the result with a fraction of 1.5% and 3% sugarcane fiber volume will decrease the thermal conductivity of the composite (Onesippe, 2015)

The utilization of sugarcane powder as material of reinforcement of composite material is not maximal yet. During this time bagasse is only used as fuel substitute for firewood. Judging from the potential availability of raw materials, this research is directed to utilize sugarcane powder from waste bagasse as fiber material of composite material. Based on the above description, the research on cementland composite engineering of portland-powdered sugarcane fiber is a very interesting study to be investigated further. The purpose of this research is: how the effect of the size of sugarcane powder to the tensile strength and impact strength of cement-powdered sugarcane composite composite. The mechanical testing of the laminate composite structure carried out included tensile test (ASTM D638-2) and impact test (ASTM D6110-04). So the main problem that is important to be studied is the need for the utilization of natural materials (especially sugar cane powder) as a composite reinforcement material for engineering vibration damper structure.

2. Material

Materials used in this research are: sugar cane powder, steel powder, portland cement, calcium chloride and distilled water (PH 7). Sugarcane and steel powder are used for composite filler and reinforcement, portland cement is used as fiber composite matrix / binder, calcium chloride is used to accelerate the reaction (catalyst) and distilled water as a dough mixing medium. Equipment used in this research is crusher machine, universal testing machine and impact test machine. The crusher machine is used to grind the sugarcane fibers into a powder/particle shape, universal testing machine used for tensile test and impact testing machine is used to determine the impact strength of the composite based on ASTM standard.

3. Method

Independent variables in this study are: size of sugar cane with size 0.18 mm, 0.25 mm and 0.42 mm, 1.2 mm steel powder, 1.8 mm and 2.4 mm bermatiks portland cement. While the dependent variable is: tensile strength and bending strength. Tensile strength is used to determine the mechanical strength of the material. The maximum load is divided by the area of the initial cross-sectional area of the specimen. This strength is useful for the purpose of specification and quality control of materials, composite material is tensile test in accordance with ASTM D638-2. The impact force (blow) is used to calculate the amount of energy absorbed by the composite on the specimen, the composite material is subjected to a impact test in accordance with ASTM Standards D6110-04.

Fiber Processing

The materials used are sugarcane powder and portland cement. The fiber is taken by grinding the sugar cane first for five times the milling then soaked and washed from the dirt with water. The fiber is aerated to dry in the shade. The fibers that have been cleansed of dirt are then immersed in 5% alkaline NaOH solution for 2 hours. Immersion is done to remove lignin that attaches to the fiber. After the immersion is completed, neutralize the fiber by immersion of water for 3 days, then the fiber is dried naturally.

Manufacturing Composite Powders

The process of making sugarcane powder composite composite - portland cement is done by hand-printing method, the type of sugarcane fiber used as a composite reinforcement is alkali treatment fiber for 2 hours. Portland cement composites are made with 0.18 mm, 0.25 mm and 0.42 mm powdered sugar cane sizes, 1.2 mm, 1.8 mm and 2.4 mm steel powder sizes. The finished composite is made into a tensile test specimen in accordance with ASTM D638-2 and impact specimens according to ASTM Standards D 6110-04 with a width of 15 mm and a length of 150 mm.

Composite Test

Tensile composite test of sugar cane particles was performed using universal testing Machine and impact testing carried out with a charpy impact test machine, referring to ASTM D6110-04 standard. The spacing between the specimens is 6 times the specimen thickness. The length of the span is 96 mm.

(a)

(b)

Figure 1. Test of composite cement-sugarcane particles. (a) tensile test and (b) impact test

From figure (1a), data retrieval of tensile strength test on universal machine testing machine whereas in figure (1b) data impact strength testing on a charpy impact machine.

4. Result and Discussion

Tensile strength test value

It is known that the volume capacity of the tensile test print with size (27 x 17 x 0.6) cm for 14 specimens is 275.4 cm^3. Where the density is mass per unit volume. As for the capacity of the mold volume of impact test with size (20 x 6.5 x 1.2) cm for 17 specimens is 156 cm^3. Thus the composite composition of each variation can be calculated by the formula:

Fiber volume fraction = Vs x 100%

Portland cement volume = Vtotal – Vs

Where:

Vs = Volume of fiber, Vps = Portland cement volume, Vtotal = Total volume

Based on the result of tensile testing and hypothesis testing it can be concluded that there is influence of the size of sugar cane powder and the size of steel powder to the composite tensile strength produced. The graph of tensile strength values resulting from variations in the size of sugar cane powder and steel powder size can be seen in figure 2.

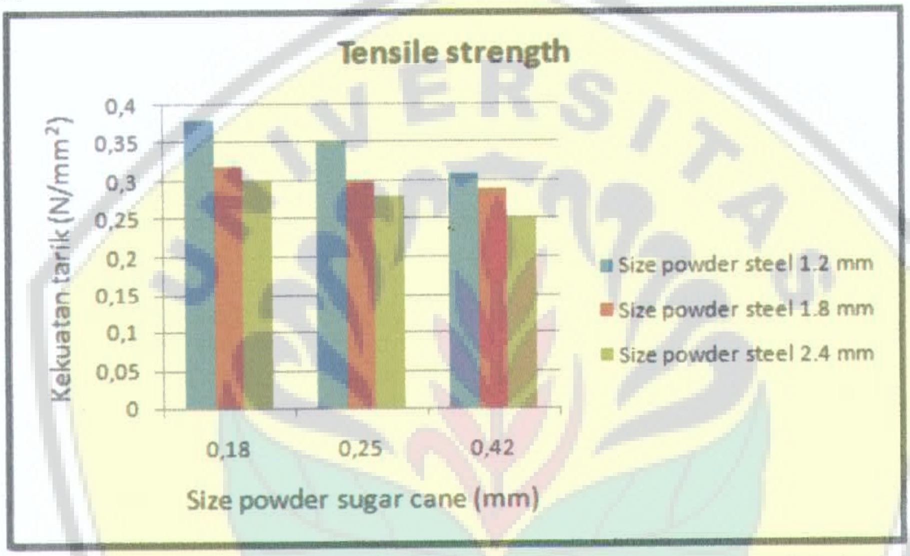

Figure 2. Graph of tensile strength and variations size sugar cane powder and steel powder.

From Figure 2 it can be seen that the optimal tensile strength value occurs at the size of 0.18 mm cane powder and 1.2 mm steel powder size with the value of 0.38 N/mm^2. Then the value of tensile strength decreased to the lowest in the condition of the size of 0.42 mm cane powder and 2.4 mm steel powder size with a tensile strength value of 0.25 N/mm^2. The decrease in composite tensile strength occurs on the increase in the size of large sugarcane powder, due to the imperfect bond between the fiber grains and the portland cement matrix, the large particle size of the sawes causes many cavities between the sugar cane, the steel powder and the portland cement Not filled so as to lead to the easy occurrence of fiber pull out. Therefore, the particle size of this sugar cane is not capable of filling the existing cavities in the mats and steel powder particles so that it is unable to resist the longitudinal force acting in the direction of the composite elongation.

Impact Strength Test Value

Composite powder of molded cane fibers ready for impact testing and taken value impact strength. From the treatment by varying the size of sugar cane powder and the size of steel powder, the impact value is obtained. The calculation of impact strength or Price Impact (HI) is generated by the equation:

E absorption = initial energy - remaining energy

From result of calculation of data of impact strength and hypothesis testing can be concluded that there is influence of size of powder of sugar cane and size of steel powder to composite impact strength value. Fiber as a reinforcer in composite material obviously has a very important role when the composite receives a load because the load received will be transferred to the composite part of the powder. Therefore, the strength of the composite material with a powdery amplifier is strongly influenced by the strength of the fibers and the bond between the matrix and the powder. The effect of the size of sugar cane powder and the size of steel powder to the result of mechanical strength that occurs can be seen in Figure 3 below:

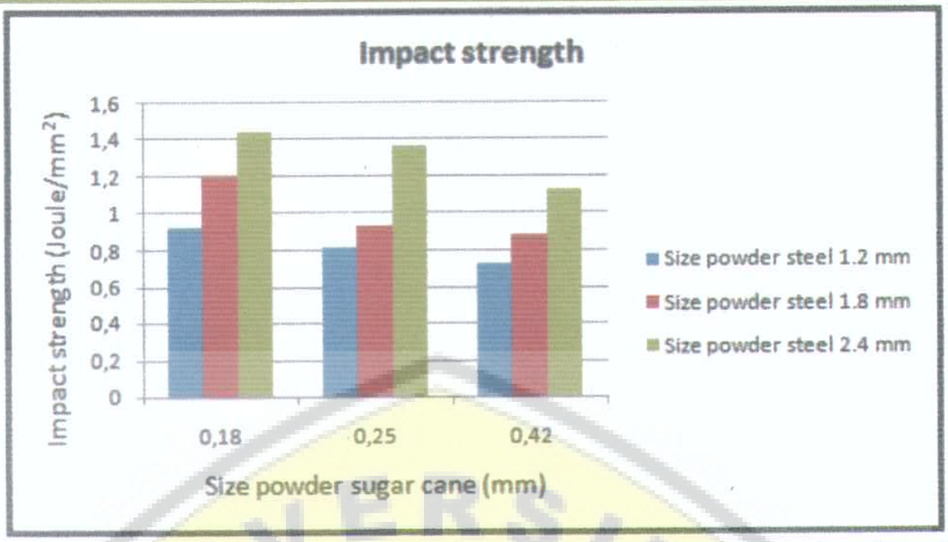

Figure 3. Graph of impact strength on variations size of sugar cane powder and steel powder

From Figure 3 it can be seen that the optimum impact strength value occurs in the size of 0.18 mm cane powder and the size of the 2.4 mm steel powder with the impact strength value of 1.44 Joule / mm2. Then the impact strength value decreased to the lowest in the condition of the size of 0.42 mm cane powder and 1.2 mm steel powder size with the impact strength value of 0.73 Joule / mm2. The increase in compact impact strength is proportional to the increase in the size of steel powder, the larger the size of the steel powder the impact strength will be even greater. This is due to the transverse forces that work can be retained by the size of a large steel powder so that the impact strength is greater. The type of fracture formed is a brittle fracture, since the fracture surface is relatively flat and there is no plastic deformation in the fault zone.

5. Conclusion

Based on the results of this study of sugar cane biocomposite manufacturing, the following conclusions can be drawn:

1. From the results of graphical analysis, it can be concluded that the optimal tensile strength value on sugarcane powder with the size of 0.18 mm cane powder and 1.2 mm steel powder size with a tensile strength value of 0.38 N/mm^2. So that the size of sugar cane powder and steel powder size significantly influence the composite tensile strength.
2. The optimal impact strength value occurred on the size of 0.18 mm cane powder and 2.4 mm steel powder size with impact strength value of 1.44 J/mm^2. So the size of the cane powder and the size of the steel powder have a significant influence on the price of the composite impact toughness.

Suggestions for further research are:

1. The pressing process at the time of printing should be carried out evenly so that the mold is filled with a cement mix thoroughly so that the bond between the fiber and the matrix is perfectly sealed.
2. For further research, in making the specimens to make the dough more evenly and smoothly to use the prints from Teflon.

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