

Effect of Particle Size On Mechanical Properties for Natural Powder Composite

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Abstract

The research has been carried out to check effect of particle size on mechanical properties of Sugarcane and Banana fibre composite. The aim of the study is to check effect of particle size on mechanical properties on Sugarcane and banana fibre composite. For this purpose, bagasse powder was obtained after grinding the dried waste from sugar mills having particle sizes of 53,106,150,212,300,425 μm which is obtain from sieves of sieve shaker machine. And Banana fibre obtained from husk of the banana tree having 53, 106, 150, 212, 300, 425 μm which is obtained from sieves of sieve shaker machine. The particle size had a large effect on the properties of composites, and for sugarcane fibre the components at 700 rpm with applying load having particle size 300 and 425 μm gave less frictional loss as compared to other particle size of 53, 106, 150 and 212 μm . For 350 rpm with applying load having particle size 53,150, 212, 300 and 425 μm gave less frictional loss as compare to other particle size 106 μm . For Banana fibre component at 700 rpm with applying load having particle size 425 μm gave less frictional loss as compare to other particle size 53,106, 150, 212 and 300 μm . For 350 rpm with applying load having particle size 425 μm gave less frictional loss as compare to other particle size 53, 106, 150, 212 and 300 μm .

Keywords: Collection of data; Method; Natural powder; Wear test

1. Introduction

Composite materials are created by combining two or more materials with different molecular structures and properties that are bound together to form a material that has different properties but acts as a single material. Natural fibres are materials derived from plants and animals that can form filaments, strings, or threads, which can then be woven, matted, or bound by combining fibres together to form a bunch or bulk. Natural fibres have largely replaced synthetic fibres in academic settings and a variety of industries in recent years. Composite materials are being used in new markets for a variety of purposes. The most common benefit of using natural fibre composites is weight reduction, which can range from 50% to 90%. loss of weight can be easily done by using natural fiber composites.

2. Method

2.1 Selection of Natural Powder Obtained from Natural Ingredients

In this stage literature survey is made based on available literatures on internet and collected data in the past on natural fiber and natural powder. Literature survey helps in selection of best natural fibre and powders used before for making composites. The literature survey get the properties of materials like corrosion resistant, tensile property, hardness, toughness etc. from that we get idea about selection of materials available in markets. For this I selected sugarcane fibre and banana fibre because these are easily available.

2.2 Properties of sugarcane fiber

It is a by-product of the sugarcane industry with approximately 32-34% cellulose, 19-24%

hemicellulose, 25-32% lignin, 6-12% extractives, 2-6% ash (Sakdaronnarong and Jonglertjunya, 2012; Rezende et al., Pandey et al., 2000). Chemical Composition of sugarcane bagasse is similar to the other plant cell walls.

2.3 Properties of Banana Fiber

Banana fibers have light weight, fire resistance quality, high strength, smaller elongation, biodegradability, great potentialities and robust moisture absorption quality.

2.4 Preparation of Good Quality Dies Molding for Manufacturing of Natural Composite Material

In this step, the preparation of the die will be done with suitable required dimensions which are required to manufacture composite material. The composite will be fabricated using hand lay-up technique. The mould which we are going to use for fabrication composite is made up of part with specific dimensions. The Die design made will be robust and user friendly for proper alignment and such that which has less possibility of misalignment. In Every Die manufacturing the main objectives are proper and appropriate alignment, easiness of handling, mechanism, etc. that way we will try to complete die. In this die is manufactured with the help of liquid silicone rubber and curing agent. Curing agent is mixed in liquid silicone rubber. Stir the mixture thoroughly. Chock is placed in to form a cavity. It kept curing for 24 hours. After 24 hours' chocks are removed and mould is ready of chock size. The mould is as shown in figure 1.



Figure 1 Mould

2.5 Experimental Setup and Preparation Method of Natural Composite Material Specimens

The preparation method used here which is decided is hand lay-up method followed by applying required pressure in order to get good bonding. First sugarcane bagasse and banana fibre are collected. Then it dried for some days, after that it make fine with help of mixture and mortar. The sugarcane bagasse and banana fibre are as shown in figure 2 and 3 respectively.



Figure 2 Sugarcane Bagasse



Figure 3 Banana Fiber

Then powder is making of proper size with the help of sieves of sieve shaker machine. Powder is making of 53 microns, 106 microns, 150 microns, 212 microns, 300 microns, and 425 microns with the help of sieves of sieve shaker machine. The sieve shaker machine is as shown in figure 4.



Figure 4 Sieve Shaker Machine

Then component is made from sugarcane and banana fibre. First from bottom size the mould is fixed with clipboard with tape and fevi kwik. Vaseline is used for inside portion of mould for easy removal of component. Powder of proper size and epoxy resin of Oytra taken as 4:30 ratio in can with the help of weighing scale. This mixture is mixed well for 3 mins. Then it pours in mould with the help of spoon and small wood pin for proper mixing. Kept it curing for 24 hours. After 24 hours' components are removed from mould with the help of pen. Check it's having good bonding. Then it makes proper size with help of grinding machine. These components are used for testing. Weight of the powder taken with help of weighing scale, sugarcane and banana fibre components are as shown in figure 5, 6, and 7 respectively.



Figure 5 Weight of the Powder Taken with The Help of Weighing Scale



Figure 6 Sugarcane Fibre Components



Figure 7 Banana Fibre Components

2.6 Conduction of Different Tests and Property Checking Along with Quality Checking and Inspection

The natural composite will be cut based on suitability of sample for conduction of different tests. Different tests require different sample size which will be cut as per requirements. For both sugarcane and banana fibre composites wear test is taken.

2.7 Collection of Data and Comparative Analysis of Results Obtained from Various Tests

After performing different tests, testing results will be optimized to find best suitable composite and different optimization techniques the data obtained gets tabulated. The results are collected and comparative analysis is made to reach at effective conclusion for further researchers in order to perform research.

3. Results and Discussion

3.1 Results

3.1.1 Wear Test

Wear test is performed by using wear testing machine (POD). Wear testing machine (POD) as shown in figure 8. Wear testing machine (POD-Pin On Disc) consist of rotating disc which is made up of EN 31 material, liver and weighing attachment on

which weights are attached. Component which is wear tested is fixed on the fixing device of the liver with the help of allen bolt such that liver remains parallel.



Figure 8 Wear Testing Machine (POD)

3.1.2 Procedure

- First check weight of the component without load and note down it.
- Fix the component on the disc of fixing device with help of allen key such that liver remains horizontal.
- Power supply is ON, switch on machine, start motor and set rpm of disc 700 with help of rpm adjuster.
- Set frictional force zero with the help of knob.
- After 10-minute speed of the disc is reduced to zero, motor is OFF and switch of machine.
- Remove the component from fixing device with the help of allen key.
- Take weight of the component and note down reading.
- Calculate frictional loss
- Frictional loss = (Initial weight – Final Weight)
- Time Required
- Then take reading by applying load for ex. 1, 2, 3, 4, 5 etc.
- After applying load note down the disc rpm reading and frictional force.
- Take same procedure for both powders

For wear testing of sugarcane and banana fibre following components are fixed and variables as shown in Table 1.

Table 1 Fixed and Variable Components for Wear Testing of Sugarcane and Banana Fibre

| Fixed components | Time 10 minute |
|----------------------|--|
| Variables components | Frictional loss, Load applying rpm, Frictional force |

3.1.3 Wear Test of Various Sizes Components of Sugarcane Fibre Having Disc Rpm 700

Graph of Load v/s Frictional Force of 53 micron, 106 micron, 150 micron, 212 micron, 300 micron and 425 micron for sugarcane fibre components at 700 rpm as shown in figure 9.

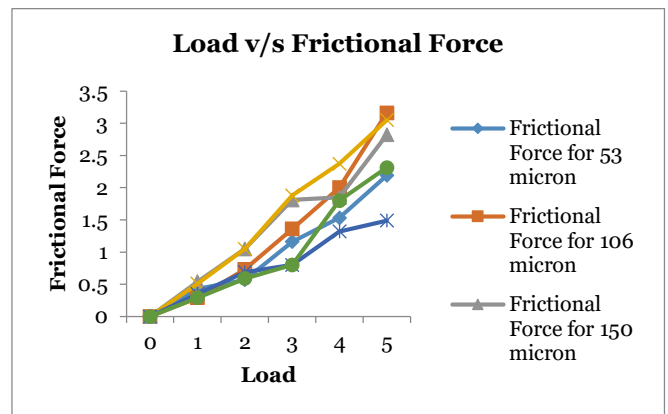


Figure 9 Load v/s Frictional Force

From figure 9 it has been shown that as load increases frictional force for all micron sugarcane fibre components increases due to increase in load. This happens because as friction is opposing force or resistance experienced by two objects sliding against each other. Friction is the result of the interaction between surfaces of two objects. When weight of the object increases, this interaction becomes stronger, so the resistance also increases.

3.1.4 Wear Test for Various Sizes Components of Sugarcane Fibre Having Disc Rpm 350

Graph of Load v/s Frictional Force of 53 micron, 106 micron, 150 micron, 212 micron, 300 micron and 425 micron for sugarcane fibre components at 350 rpm as shown in figure 10.

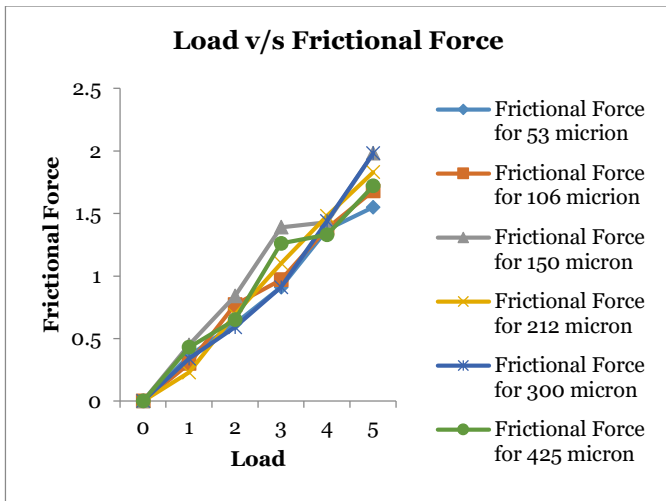


Figure 10 Load v/s Frictional Force

From figure 10 it has been shown that as load increases frictional force for all micron sugarcane fibre components increases due to increase in load. This happens because as friction is opposing force or resistance experienced by two objects sliding against each other. Friction is the result of the interaction between surfaces of two objects. When weight of the object increases, this interaction becomes stronger, so the resistance also increases.

3.1.5 Wear Test for Various Sizes Components of Banana Fibre Having Disc Rpm 700

Graph of load v/s Frictional Force of 53 micron, 106 micron, 150micron, 212 micron, 300 micron and 425 micron of banana fibre components at 700 as shown in figure 11.

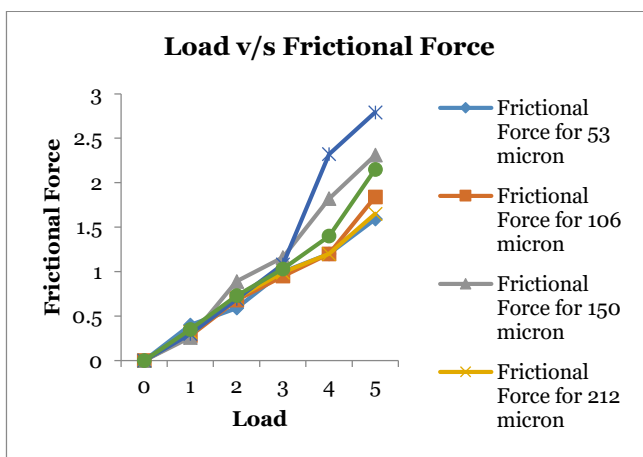


Figure 11 Load v/s Frictional Force

From figure 11 it has been shown that as load increases frictional force for all micron banana fibre components increases due to increase in load. This happens because as friction is opposing force or resistance experienced by two objects sliding against each other. Friction is the result of the interaction between surfaces of two objects. When weight of the object increases, this interaction becomes stronger, so the resistance also increases.

3.1.6 Wear Test for Various Sizes Components of Banana Fibre Having Disc Rpm 350

Graph for Load v/s Frictional Force of 53 micron, 106 micron, 150 micron, 212 micron, 300 micron and 425 micron for banana fibre components at 350 rpm as shown in figure 12.

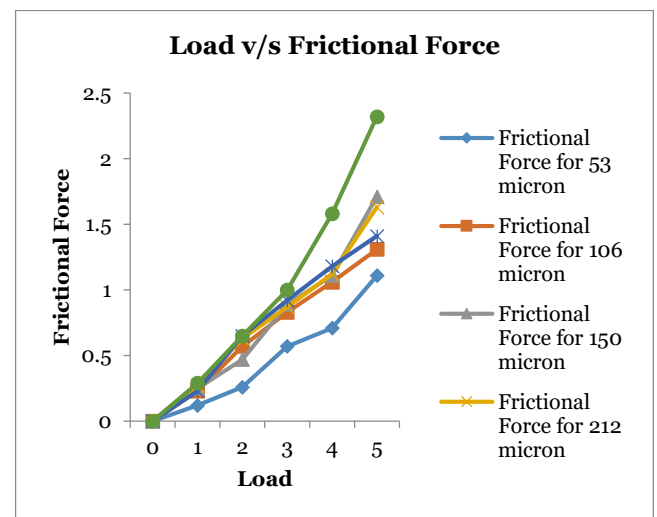


Figure 12 Load v/s Frictional Force

From figure 12 it has been shown that as load increases frictional force for all micron banana fibre components increases due to increase in load. This happens because as friction is opposing force or resistance experienced by two objects sliding against each other. Friction is the result of the interaction between surfaces of two objects. When weight of the object increases, this interaction becomes stronger, so the resistance also increases.

3.2 Discussion

The results presented in figure 9, 10, 11 and 12 respectively showed that as load increases frictional force for all micron sugarcane and banana fibre

components increases due to increase in load. This happens because as friction is opposing force or resistance experienced by two objects sliding against each other. Friction is the result of the interaction between surfaces of two objects. When weight of the object increases, this interaction becomes stronger, so the resistance also increases.

Conclusion

The experimental results show that frictional loss for sugarcane fibre components having disc rpm 700 for without applying load is zero except 212-micron component, it is 0.0001. With applying load frictional loss for sugarcane fibre component of 53 micron is increases with increasing load, for 106 micron component it also increases but for 3Kg it decreases, for 150 micron component it also increases but it decreases for 5Kg, for 212 micron component it also increases but it decreases for 3Kg and 5Kg, for 300 micron component it zero for 1Kg, increases for 4Kg, it remains constant for 2 and 3Kg and decreases for 5Kg, and for 425 micron component it remains constant for 1, 2 and 3Kg and increases also remains constant for 4 and 5Kg. For sugarcane fibre components at 700 rpm with applying load having particle size 300 and 425 μm gave less frictional loss as compare to other particle size of 53, 106, 150 and 212 μm . Frictional forces for all components increase with increasing load. For disc having 350 rpm. Frictional loss for without applying loads is zero for 106, 300 and 425 micron components. For 53 and 150-micron component it is 0.0001 and for 212-micron component it is 0.0002. With applying load disc having rpm 350 frictional losses for 53-micron component it increases for 1Kg, decreases for 2Kg, zero for 3Kg, decreases and remains constant for 4 and 5Kg. For 106-micron component it increases for 1Kg, decreases for 2 Kg, zero for 3Kg and increases for 4 and 5Kg. For 150-micron component it remains constant for all loads. For 212-micron component it decreases for 2Kg, remains constant for 3 and 4Kg and increases for 5Kg. For 300-micron component it increases for 1Kg and 2Kg, zero for 3 and 4Kg and increases with 5Kg. For 425-micron component it zeros for 1 and 3Kg, increase for 2 and 4Kg and remains constant 5Kg. For 350 rpm with applying

load having particle size 53, 150, 212, 300 and 425 μm gave less frictional force as compare to other particle size 106 μm . Frictional forces for all components increase with increasing load. For Banana fibre components For banana fibre components disc having 700 rpm without applying load frictional loss is zero for 106, 212, 300 and 425 micron components. And for 53-micron component it is 0.0003, for 150-micron component it is 0.0001. With applying load frictional loss for 53-micron component increases for 4Kg, remains constant for 3Kg and decreases for 1, 2, 3, and 5Kg. For 106-micron component it zero for 1Kg, increases for 2, 4, and 5Kg but for 3 Kg it decreases. For 150-micron component it zero for 1Kg, increases for 2, 3 and 5Kg, decreases for 4Kg. For 212-micron component it zero for 1 and 2Kg, increases for increasing load for 3 and 5Kg and decreases for 5Kg. For 300-micron component it decreases for 2Kg, remains constant for 2 and 3Kg, increases for 1 and 4Kg and decreases for 5Kg. For 425 micron component it increases for 2 and 5Kg, but zero for 1, 3 and 4Kg For banana fibre components at 700 rpm with applying load having particle size 425 μm gave less frictional loss as compare to other particle size of 53, 106, 150, 212 and 300 μm . Frictional forces for all components increase with increasing load. For disc having 350 rpm. Frictional loss for without applying load is zero for 106, 150, 212, 425 micron components, for 53 micron component it is 0.0001 and 300 micron component it is 0.0002. With applying load frictional loss for 53 micron component it zero for 1Kg, increases for 2 and 5Kg, decreases for 3Kg, remains constant for 3 and 4Kg. For 106-micron component it increases for 1, 2 and 5Kg, decreases for 3Kg and remains constant for 3 and 4Kg. For 150-micron component it remains constant for 1, 2 and 3Kg, decreases for 4Kg and increases for 5Kg. For 212-micron component it zero for 1, 3, and 5Kg, increases for 2 and 4Kg. For 300-micron component it increases for 2 and 3Kg, decreases for 1, 4 and 5Kg. For 425-micron component it increases for 1Kg and zero for 2, 3, 4 and 5Kg. For 350 rpm with applying load having particle size 425 μm gave less frictional loss as compare to other particle size of 53, 106, 150, 212 and 300 μm . Frictional forces for all components

increase with increasing load From these the particle size had a large effect on the properties of composites, and for sugarcane fibre the components at 700 rpm with applying load having particle size 300 and 425 μm gave less frictional loss as compared to other particle size of 53, 106, 150 and 212 μm . For 350 rpm with applying load having particle size 53, 150, 212, 300 and 425 μm gave less frictional loss as compare to other particle size 106 μm . For Banana fibre component at 700 rpm with applying load having particle size 425 μm gave less frictional loss as compare to other particle size 53, 106, 150, 212 and 300 μm . For 350 rpm with applying load having particle size 425 μm gave less frictional loss as compare to other particle size 53, 106, 150, 212 and 300 μm .

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