

Experimental study and Investigation of composite coir fibre in disk brake rotor

A Nagarajan

*Research Scholar, Department of Mechanical Engineering,
Maharishi University of Information technology Lucknow, India*

Dr Aditya chauhan

*Department of Mechanical Engineering
Maharishi University of Information technology*

Lucknow, India

Abstract - This research briefly describes the evolution of fibre composite in natural fibre as coir. The Innovative implementation of coir fibre in disk brake rotor. The fabrication process includes the production of composite base coated layes of epoxy resin along with material of reinforced polymer as silicon carbide as catalyst. Thus concluding with testing results the perfect strength of the coir fibre composite is derived.

Keywords - Epoxy resin, silicon carbide, coir fibre.

1. Introduction

Composite material (also called a composition material or shortened to composite) is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons: common examples include materials which are stronger, lighter, or less expensive when compared to traditional materials. More recently, researchers have also begun to actively include sensing, actuation, computation communication into composites, which are known as Robotic Materials.

2. Metal composites

Ceramic composites

Composite materials are generally used for buildings, bridges, and structures such as boat hulls, swimming pool panels, race car bodies, shower stalls, bathtubs, storage tanks, imitation granite and cultured marble sinks and countertops. The most advanced examples perform routinely on spacecraft and aircraft in demanding environments. Concrete is the most common artificial composite material of all and typically consists of loose stones (aggregate) held with a matrix of cement. Concrete is a very robust material, much more robust than cement, and will not compress or shatter even under quite a large compressive force. However, concrete cannot survive tensile loading (i.e., if stretched it will quickly break apart). Therefore, to give concrete the ability to resist being stretched, steel bars, which can resist high stretching forces, are often added to concrete to form reinforced concrete.

Fibre-reinforced polymers or FRPs include carbon fiber reinforced polymer or CFRP, and glass-reinforced plastic or GRP. If classified by matrix then there are thermoplastic composites, short fiber thermoplastics, long fibre thermoplastics or long fibre-reinforced thermoplastics. There are numerous the rmoset composites, but advanced systems usually incorporate aramid fibre and carbon fibre in an epoxy resin matrix. Many commercially

produced composites use a polymer matrix material often called a resin solution. There are many different polymers available depending upon the starting raw ingredients. There are several broad categories, each with numerous variations. The most common are known as

polyester, vinylester, epoxy, phenolic, polyimide, polyamide, polypropylene, and PEEK. The reinforcement materials are often fibers but also commonly ground minerals.

The various methods described below have been developed to reduce the resin content of the final product, or the fiber content is increased. As a rule of thumb, lay up results in a product containing 60% resin and 40% fibre, whereas vacuum infusion gives a final product with 40% resin and 60% fiber content. The strength of the product is greatly dependent on this ratio. Martin Hubbe and Lucian A Lucia consider Wood to be a natural composite of cellulose fibres in a matrix of lignin.

3. Related Work

Sanjay Choudhry

Bio fibres are have recently become attractive to researchers, scientist and engineers a as a reinforcement for FRP (fibre reinforced polymer) composite. Due to their less economic, and also good mechanical properties, more aspect strength .Four tons of human hair fibre wasted in India per year .These fibre pose claiming challenge In order to find profitable application the shrivelled human hair fibre mixed with polypropylene.

Jimmy LoluOlajide

This research has inspected the tensile characteristics and fracto graphy of animal fibre-reinforced less density polyethylene composites. The composites were making by heat compression moulding by using chemically adjusted cow hair bio fibres as the reinforcing chapter of composites. Alkaline solutions of modifying molarities were used to make the chemical treatments in this current study. Tensile characteristics of the developed composites were calculated based on molarities of chemical medication and % fibre load. Electron microscopy was used to Scanning properties the morphologies of the cracked surfaces of composites. Obtained tensile experiment results expose significant enhancement in the tensile characteristics of composites, with the optimum combo of tensile characteristics presented by 2 wt% of cow hair bio fibre reinforcement treated with 0.15 M sodium hydroxide. Review from the fracto graphic analysis of the increment of composites revealed shearing of the polymer matrix at and no fibre pick out nature the fibre-matrix interface.

K. Suseetharan

Understanding about environmental degeneration and a wanted for a consistent continual development for the progress of the environment has a straight influence over restoration of by natural fibres and synthetic fibres. Major research work on plant fibre based bio composites. Now our research work is based on manufacture and analysis of mechanical characteristics of fibre based bio composites. Out of a large collection of animal fibres, Bombyxmori silk and human hair fibres are selected by us, for this research work were which establish the dispersed point, and the matrix point is created by epoxy resin.

One of the main logic for choose of hair as a reinforcement material is due to the fact that human hairs are renewable thing and also it was waste in large quantity and there is a want to devise a novel technique to adequately applying this wasted hair. Silk fibre was chosen owing to the broad characteristics consumed by it. The hand layup technique is used to

Manufacturing in which three samples. First sample wash air based bio composite, another was silk based bio composite and the last was mixing of one and two bio composite using the hair and silk fibre.

GnanavelBabu

Composite materials are mixing of two or more materials form in the layer one on the layer by the help of conclusive material through some recommended ways. In the coconut fibre and Glass fibre people hair hybrid composite technique, the binding material is epoxy resin, in which one layer is formed of coconut fibre, followed by glass fibre and then by hair of the human. By the help of hand layup technique and by modifying the mentioned form of layers, by using the resin and hardness we already make the six layers

4. Constituents of Composites

Matrices

Typically, most common polymer-based composite materials, including fiber glass, carbon fiber, and Kevlar, include at least two parts, the substrate and the resin. Polyester resin tends to have yellowish tint, and is suitable for most backyard projects. Its weaknesses are that it is UV sensitive and can tend to degrade over time, and thus generally is also coated to help preserve it. It is often used in the making of surfboards and for marine applications. Its hardener is peroxide, often MEKP (methyl ethyl ketone peroxide). When the peroxide is mixed with the resin, it decomposes to generate free radicals, which initiate the curing reaction. Hardeners in

5. Fabrication Method:

Hand lay-up method

A release agent, usually in either wax or liquid form, is applied to the chosen mold. This will allow the finished product to be removed cleanly from the mold. Resin – typically a 2-part polyester (opted), vinyl or epoxy – is mixed with its hardener and applied to the surface. Sheets of fiberglass matting are laid into the mold, then more resin mixture is added using a brush or roller. Hand pressure, vacuum or rollers are used to make sure the resin saturates and fully wets all layers, and any air pockets are removed. The work must be done quickly enough to complete the job before the resin starts to cure, unless high temperature resins are used which will not cure until the part is warmed in an oven. In some cases, the work is covered with plastic sheets and vacuum is drawn on the work to remove air bubbles and press the fiberglass to the shape of the mold. Here we have chosen Hand lay-up method for fabricating specimen and also final component.

Hand lay-up technique is the simplest method of composite processing. The infrastructural requirement for this method is also minimal. The processing steps are quite simple. First of all, a release gel is sprayed on the mold surface to avoid the sticking of polymer to the surface. Thin plastic The time of curing depends on type of polymer used for composite processing. For example, for epoxy based system, normal curing time at room temperature is 24-48 hours. This method is mainly suitable for thermosetting polymer based composites.

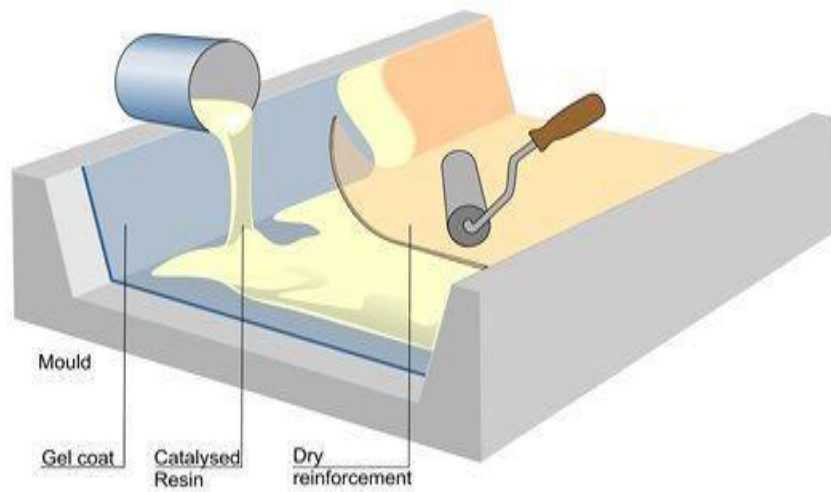


Figure 1. Hand lay-up method

Capital and infrastructural requirement is less as compared to other methods. Production rate is less and high volume fraction of reinforcement is difficult to achieve in the processed composites. Hand lay-up method finds application in many areas like aircraft components, automotive parts, boat hulls, diase board, deck etc.

Table No 1. Material Used

Reinforcement	Natural fibre such as cotton fibre, glass fibre, hair fibre ,jute etc
Matrix	Epoxy ,polyester, polyutherea, resin

6. Fabrication:

Table No 2. Combinations Based On Various Parameters

COMBINATION	GLASS FIBRE TYPE	FIBRE %	RESIN %	HAI R %	NO OF LAYERS	ORIENTATION
C1	E-Glass + Epoxy + hair	50	40	10	8	0°/45°/45°/45°/45°/45°/0°
OTHER POSSIBLE COMBINATIONS (Future Aspect)						
C2	E-Glass + Epoxy + hair	54	35	11	8	0°/90°/90°/90°/90°/90°/0°
C3	E-Glass + Epoxy + hair	48	40	12	8	0°/45°/45°/45°/45°/45°/0°
C4	E-Glass + Epoxy + hair	42	45	13	8	0°/90°/90°/90°/90°/90°/0°

For additional strength lining material can be kept on both the side of the composite disc. Thereby it increases wear resistance and other mechanical properties are also improved.

7. Volume Calculations

For Combination-1 (C1):

E glass + Resin (Epoxy) + Catalyst + accelerator (if required)

Type of glass fiber used = E-GLASS (180gsm)

Total number of sheets/laminates of glass fiber used = 8

Orientation = $0^\circ/45^\circ/45^\circ/45^\circ/45^\circ/45^\circ/0^\circ$

Ratio of fiber and resin= 50:40:10

Density of E-glass fiber(ρ_f)

= 2500 kg/m³

Density of resin(ρ_r)

= 1150 kg/m³

Volume fraction of fiber(V_f)

= 50%

Volume fraction of resin(V_r)

= 40%

Volume fraction of hair(V_h)

= 10%

Mass of fiber(w_f)

= 0.409 kg (51g per sheet x 8 sheets)

Density of human hair (ρ_h)

= 1320 kg/m³

Density of composite(ρ_c)

= (ρ_f) (V_f) + (ρ_r) (V_r) + (ρ_h) (V_h)

Density of composite (ρ_c)

= (2500) (0.5) + (1150) (0.4)

= 1842 Kg/m³

Mass fraction (weight fraction) of fiber(Wf)

$$= (\rho_f / \rho_c) \times V_f$$

$$= (2500/1842) \times (0.5)$$

$$(W_f) = 0.67861$$

Mass fraction (weight fraction) of resin (Wr)

$$= (\rho_r / \rho_c) \times V_r$$

$$= (1150/1842) \times (0.4)$$

$$(W_r) = 0.24972$$

Mass fraction (weight fraction) of hair(Wh)

$$= (\rho_h / \rho_c) \times V_h$$

$$= (1320/1842) \times (0.1)$$

$$= 0.071661$$

Sum of mass fractions (weight fractions)

$$= [(W_f) + (W_r) + (W_h)]$$

$$= [(0.67861) + (0.24972) + (0.071661)]$$

$$= 0.9991$$

$$= 1$$

Sum is 1, therefore safe.

To find mass of FIBER:

Mass of fiber(wf) = (ρ_f) x (vf)

$$0.67861 = (2500) \times (vf)$$

$$\text{Volume of fiber}(vf) = 0.0002714 \text{ m}^3$$

$$(vf) = (V_f) \times (vc)$$

$$0.0002714 = (0.5) \times (vc)$$

$$\text{Volume of composite}(vc) = 0.0005428 \text{ m}^3$$

$$(vc) = (wc) / (\rho_c)$$

$$0.0005428 = (wc) / (1842)$$

$$\text{Weight of composite (wc)} = 0.9999 \text{ kg}$$

$$\text{Volume of resin (V}_r) = (V_r) \times (vc)$$

$$(V_r) = 0.4 \times 0.0005428$$

$$= 0.00021712$$

To find mass of RESIN:

$$\text{Volume of resin (V}_r) = 0.0002171 \text{ m}^3$$

$$\text{Mass of resin (w}_r) = (\rho_r) \times (V_r)$$

$$(w_r) = 1150 \times 0.0002171$$

$$\text{Mass of resin (w}_r) = 0.24966 \text{ kg (or 250 g)}$$

To find mass of HAIR:

$$\text{Volume of hair (V}_h) = (V_h) \times (vc)$$

$$(V_h) = 0.1 \times 0.0005428$$

$$\text{Volume of Coir (V}_h) = 0.00005428 \text{ m}^3$$

$$\text{Mass of Coir (w}_h) = (\rho_h) \times (V_h)$$

$$(w_h) = 1150 \times 0.00005428$$

$$\text{Mass of coir (w}_h) = 0.06242 \text{ kg (or 62.42 g)}$$

8. Testing Results

Three point bending (Flexural test)

Test Name :Bending Test		Test type :Normal		Test Mode:	
Bending Test					
Elongation Device: Crosshead		Test Parameter: Peak Load		Test	
Speed(mm/min):2.00					
S. No	Cross section Area of the composite (mm ²)	Load (N)	Flexural strength (MPa)	Flexural modulus (Gpa)	
1	70.000	85.151	68.776	2208.228	
2	70.000	181.338	146.465	2873.225	
3	70.000	38.131	56.303	8295.993	
4	70.000	441.5538	119.215	5204.228	

Summary report

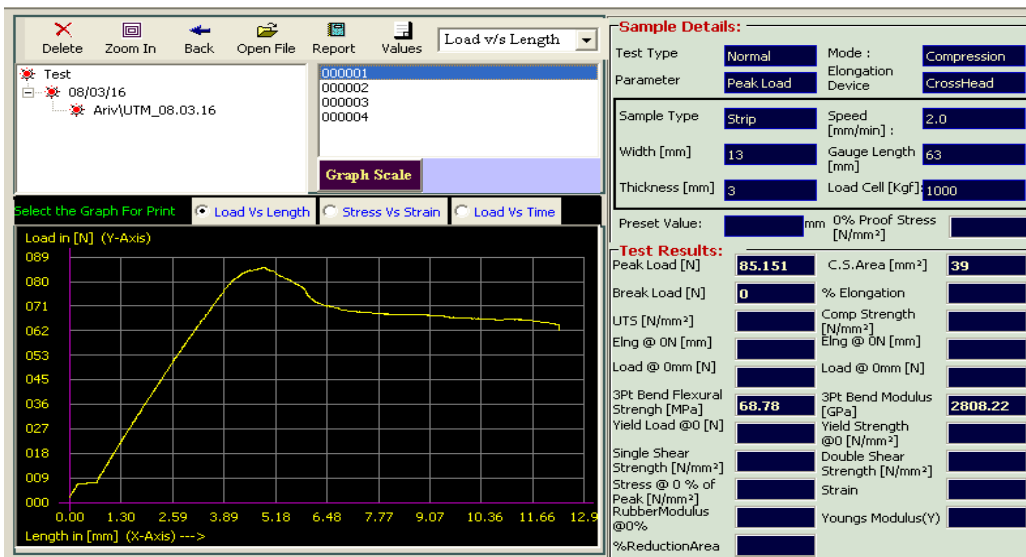
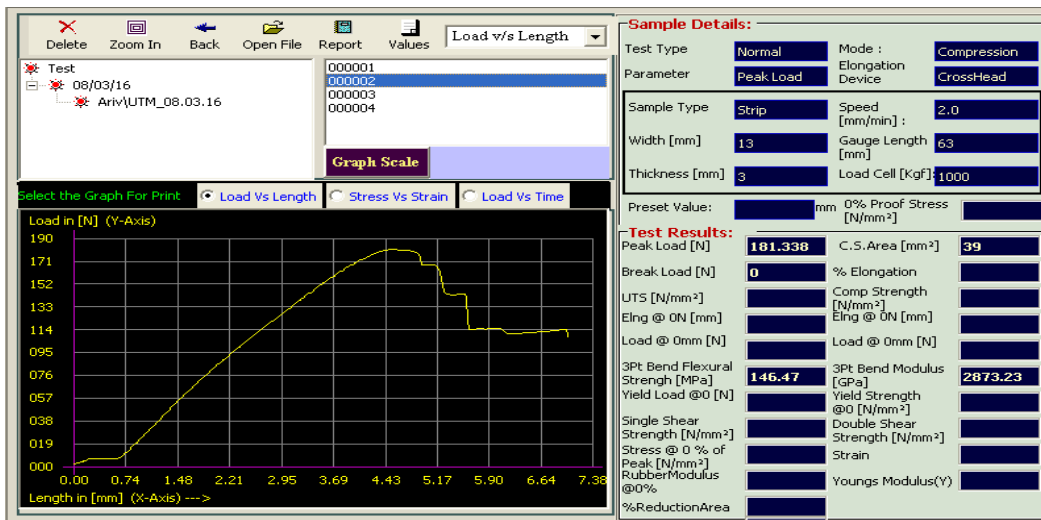


Figure2. C₁ – Flexural Test – Load vs. Length

Table No.3 Bending test result

	Load	Flexural strength	Flexural modulus
	(N)	(MPa)	(Gpa)
Min	38.131	56.303	2808.220
Max	441.538	146.465	8295.993
Avg	186.540	97.690	4795.412586.1777
StdDev	180.144	42.392	2586.177
Verience	32452.017	1797.075	6688310.922
Median	133.244	93.996	4038.727



C₂Figure3. Flexural Test – Load vs. Length

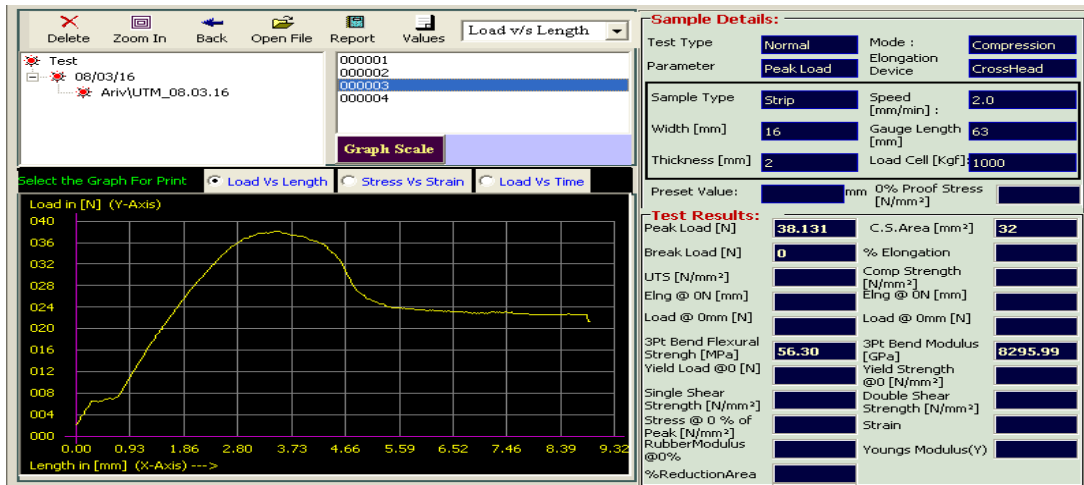


Figure 4. Flexural Test – Load vs. Length

Impact Test

S.No	Izod Impact Value in J
1	5.70
2	5.50
3	5.00
4	5.05

Table No.5 Impact test result

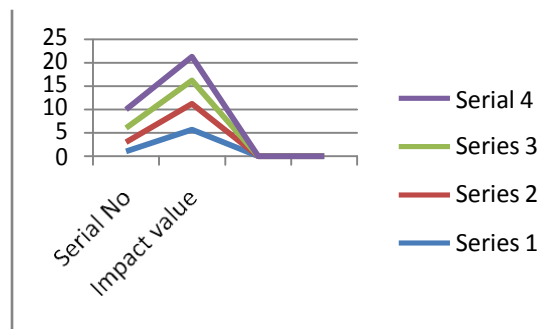


Figure 2. Graph for impact test

Ultimate Tensile Strength

Test Name :Tensile Test		Test type :Normal		
Test Mode: Tensile				
Elongation Device: Crosshead		Test Parameter: Peak Load		
Test Speed(mm/min):2.00				
Sample No	Cross section Area of the composite (mm ²)	Load (N)	% Elongaion	UTS (N/mm ²)
1	110.000	6277.095	3.333	99.640
2	110.000	10807.834	3.667	150.113
3	110.000	2784.206	901.1333	63.275
4	110.000	14391.868	5.127	130.836

Summary report

Table No.6 Tensile test result

	Load (N)	% Elongaion	UTS (N/mm ²)
Min	2784.20	3.333	63.275
Max	14391.868	901.333	150.113
Avg	8565.251	228.365	110.966
StdDev	5087.068	448.646	37.991
Verience	25878264.049	201283.242	1443.342
Median	8542.465	4.397	115.238

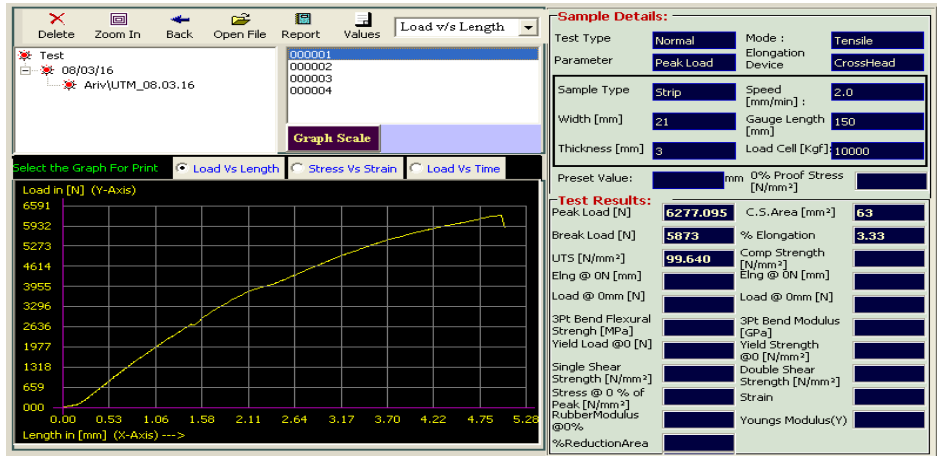


Figure 4. C₁ – Tensile Test – Load vs. Length

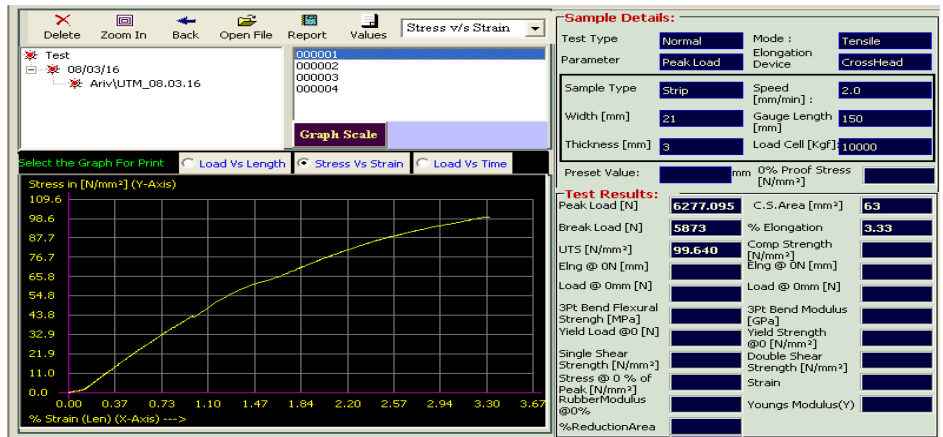


Figure5. C₁ – Tensile Test – Stress vs. Strain

Wear test

	FIRST TRIAL	SECOND TRIAL	THIRD TRIAL	FOURTH TRIAL
Volume (%)	0	5	10	15
Load (Kg)	1300	2000	3000	3000
Sliding Distance (m)	750	1300	2000	2000
Sliding Speed (m/s)	0.5	2.0	2.8	3.0

Table No.7 Wear test result

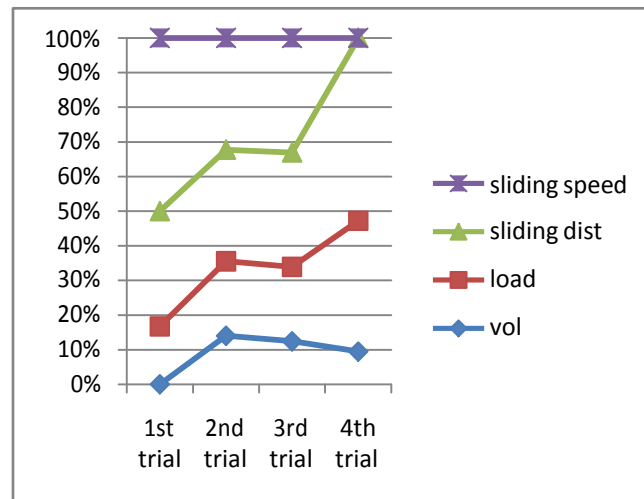


Figure 6. Graph for wear test

9. Conclusion

In this research the vehicle Brake Disc is fabricated by using composite content of polymer epoxy and resin along with coir fibre. Mechanical properties is improved by changing the orientation and epoxy content By real time testing results are concluded. We made brake disc using first combination (C1). The sample piece of Composite along with epoxy modification is carried out. Tabulation of tested results is reported. As the future aspect the amount of reading obtained in the testing are reported as tensile,compressive,and wear.

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