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Experimental Analysis and Fabrication of Coir Fiber Disk Brake Rotor

A.Nagarajan[1], M.R.Narayanan[2]
[1]*Research Scholar,* [2]*Professor,*
[1,2]*Department of Mechanical Engineering,*
[1,2,]*North East Frontier Technical University, Arunachal Pradesh, India*
[1]*nagarajanphd456@gmail.com,*[2]*narayananmech567@gmail.com*

Abstract*—This study presents fabrication of composite disk brake plate using coir fibre composite and also experimental testing of coir composite disk brake. The Disk brake of material we are making vehicle Brake Disc using Bi-directional glass fiber with epoxy resin along with coir fiber as reinforcement material with catalyst as silicon carbide .After the fabrication Three point bending (Flexural test),Impact Test ,Ultimate Tensile Strength, Wear Tests are conducting on the composite disk brake.*

***Keywords*—** *Disk brake, coir fiber, Hardness testing.*

I. INTRODUCTION

Composite material is a material in which two or more materials with different physical and chemical properties which combines to produce a different material of varying properties than the original material of individual components. The finished structure is distant and separate than the individual components. The proposed material is selected and preferred as they are lighter, stronger and also cheap. When compared to original material mainly robotics materials are made up of these composite materials.

II. COMPOSITES OF METALS

COMPOSITES IN CERAMIC

Composite material is made for the application as machine structures such as hulls of boat, panels in swimming pool, bodies of race car, stalls of shower, bathroom tubs, tanks of storage, granite of irrigation, cultured sinks of marble sand countertops .The aircraft and space craft of demanding environments have the latest advanced examples .Matrix of cement is one of the best composites of loose stones and sand. One of the best robust materials is concrete which withstand a large compressive force. Tensile load cannot be undergone on the cement structure. To withstand the ability to stretch the bars of steel. Resin solutions are a polymer matrix material which is more commercially used. The numerous variations are classified as PEEK, polypropylene, polyimide, polyamide, and epoxy. The commonly ground materials are often called as fibre or reinforced material.

III. RELATED WORK

A. SANJAY CHOUDHRY

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

B. JIMMY LOLUOLAJIDE

This research has inspected the tensile characteristics and fractography of animal fibre-reinforced less density polyethylene composites. The composites were making by heat compression molding by using chemically adjusted cow hair bio fibers 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 % fiber 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.

C. SUSEETHARAN K

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 fibers and synthetic fibers. Now our research work is based on manufacture and fibre based bio composites with their Mechanical characteristics are analyses. Out of a large collection of animal fibers, Bombyxmori silk and human hair fibers 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.

D. GNANAVEL BABU

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.

IV. CONSTITUENTS OF COMPOSITES

MATRICES

The substrate and the resin are the two parts which include carbon fiber Kevlar, fiber class. Polyester resin tends to have yellowish tint, and is suitable for most .For backyard projects the polyester resin trends to yellowish tint..

V. FABRICATION METHOD OF FABRICATION

METHOD OF HAND LAY-UP

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 temperatur is 24-48 hours. This method is mainly suitable for thermosetting polymer based composites. Capital and infrastructural reuirement 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

Material Used	
Matrix	Epoxy,Polyester,Polyvinyl ester,phenotic resin,unsaturated polyester,polyurethane resin
Reinforcement	Glass fiber,carbon fiber,aramid fiber,natural plant

VI. FABRICATION

TABLE NO 2. COMBINATIONS BASED ON VARIOUS PARAMETERS

Combination	Glass fibre type	Fibre %	Resin %	Hair%	No of Layers	Orientation
C1	E-Glass+Epoxy+hair	50	40	10	8	0^0/45/45/45/45/45/45/0^0
Other possible combinations						
C2	E-Glass+Epoxy+hair	54	35	11	8	0^0/90/90/90/90/90/90/0^0
C3	E-Glass+Epoxy+hair	48	50	12	8	0^0/45/45/45/45/45/45/0^0
C4	E-Glass+Epoxy+hair	42	45	13	8	0^0/90/90/90/90/90/90/0^0

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.

VII. 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°/45°/45°/45°/45°/45°/0°
Ratio of fiber and resin= 50:40:10
Density of E-glass fiber(∂f)= 2500 kg/m3
Density of resin(∂r) = 1150 kg/m3
Volume fraction of fiber (Vf)= 50%
Volume fraction of resin(Vr)= 40%
Volume fraction of hair(Vh)= 10%
Mass of fiber (wf)= 0.409 kg (51g per sheet x 8 sheets)
Density of human hair (∂h)= 1320 kg/m3
Density of composite(∂c)= (∂f) (Vf) + (∂r) (Vr) + (∂h) (Vh)
Density of composite (∂c) = (2500) (0.5) + (1150) (0.4)= 1842 Kg/m3
Mass fraction (weight fraction) of fiber(Wf) = (∂f / ∂c) X Vf= (2500/1842)(0.5)*
(Wf)= 0.67861
Mass fraction (weight fraction) of resin (Wr)= (∂r / ∂c) X Vr= (1150/1842)(0.4)*
(Wr) = 0.24972
Mass fraction (weight fraction) of hair(Wh)= (∂h /∂c) X Vh=(1320/1842)(0.1) =0.071661*
Sum of mass fractions (weight fractions) =[(Wf) + (Wr) + (Wh)] = [(0.678610)+(0.24972)+(0.071661)= 0.9991 = 1
Sum is 1, therefore safe.
To Find Mass Of FIBER:
Mass of fiber(wf) = (∂f) x (vf)
0.67861 = (2500)(vf)*
Volume of fiber(vf)=0.0002714m3
(vf) = (Vf) x (vc)
0.0002714 = (0.5) (vc)*
Volume of composite(vc) = 0.0005428 m3
(vc)=(wc) /(∂c)
0.0005428= (wc) / (1842)
Weight of composite (wc) = 0.9999 kg
Volume of resin (Vr) = (Vr) x (vc)
(Vr) = 0.4 x 0.0005428= 0.00021712
TO FIND MASS OF RESIN:
Volume of resin (Vr) = 0.0002171 m3
Mass of resin (wr) = (∂r) x (Vr)
(wr) = 1150 x 0.0002171
Mass of resin (wr) = 0.24966 kg (or 250 g)
To find mass of HAIR:
Volume of hair (Vh) = (Vh) x (vc)
(Vh) = 0.1 x 0.0005428
Volume of Coir (Vh) = 0.00005428 m3

Mass of Coir (wh) = (∂h) x (Vh)
(wh) = 1150 x 0.00005428
Mass of coir (wh) = 0.06242 kg (or 62.42 g)

VIII. 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(mm2)	Load (N)	Flexural strength (MPa)	Flexural modulus (Gpa)
1	70	85.151	68.776	2208.228
2	70	181.338	146.465	2873.225
3	70	38.131	56.303	8295.993
4	70	441.5538	119.215	5204.228

TABLE NO.3 BENDING TEST RESULT

	Load	Flexural strength	Flexural modulus
	(N)	(MPa)	(Gpa)
Min	38.131	56.303	2808.22
Max	441.538	146.465	8295.993
Avg	186.54	97.69	4795.412586.1777
StdDev	180.144	42.392	2586.177
Verience	32452.017	1797.075	6688310.922
Median	133.244	93.996	4038.727

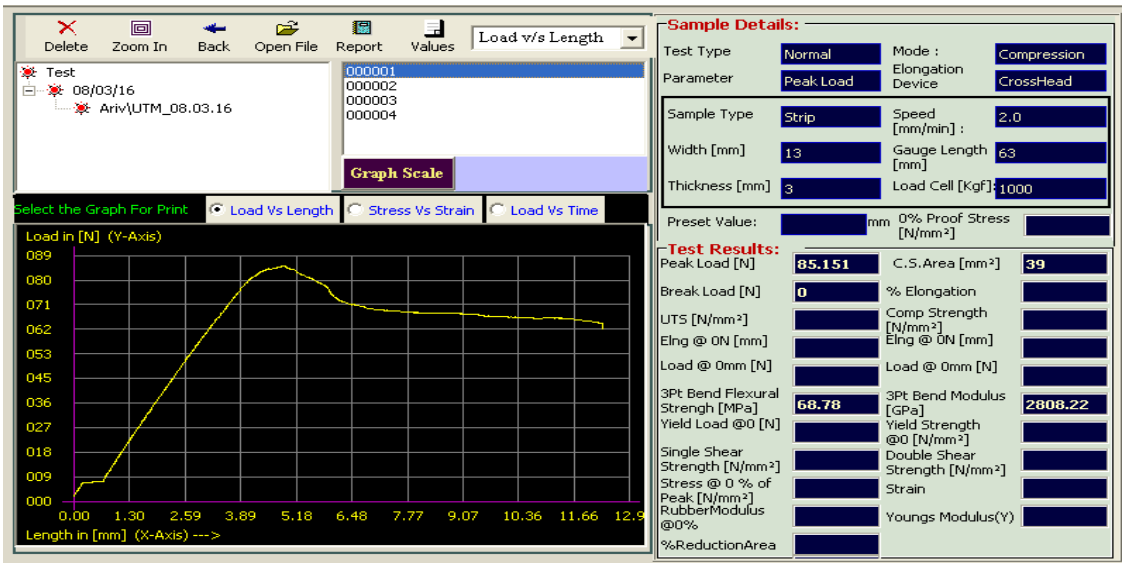

Fig. 2. C_1 – Flexural Test – Load vs. Length

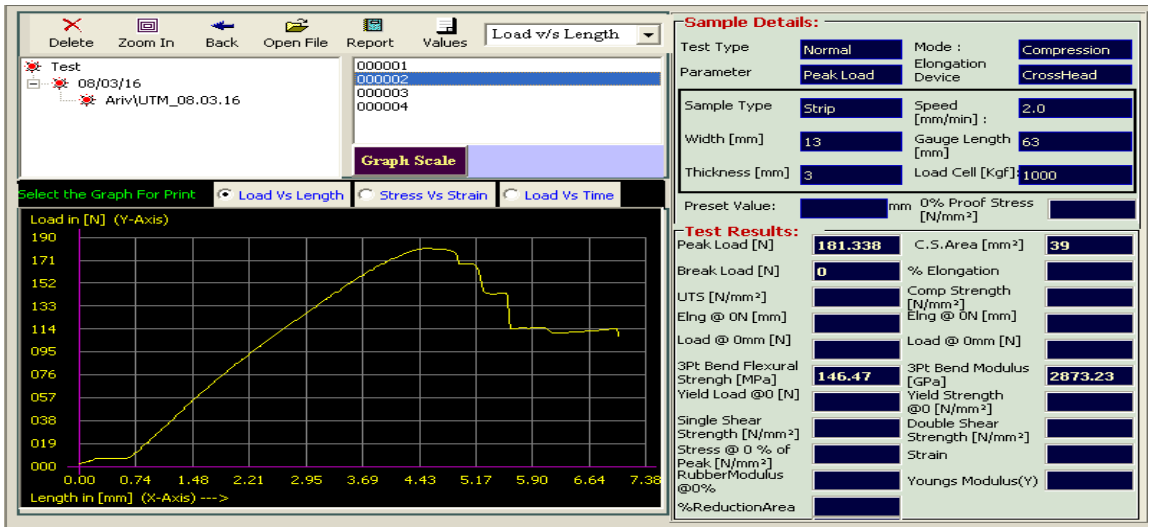

Fig. 3. C_2 Flexural Test – Load vs. Length

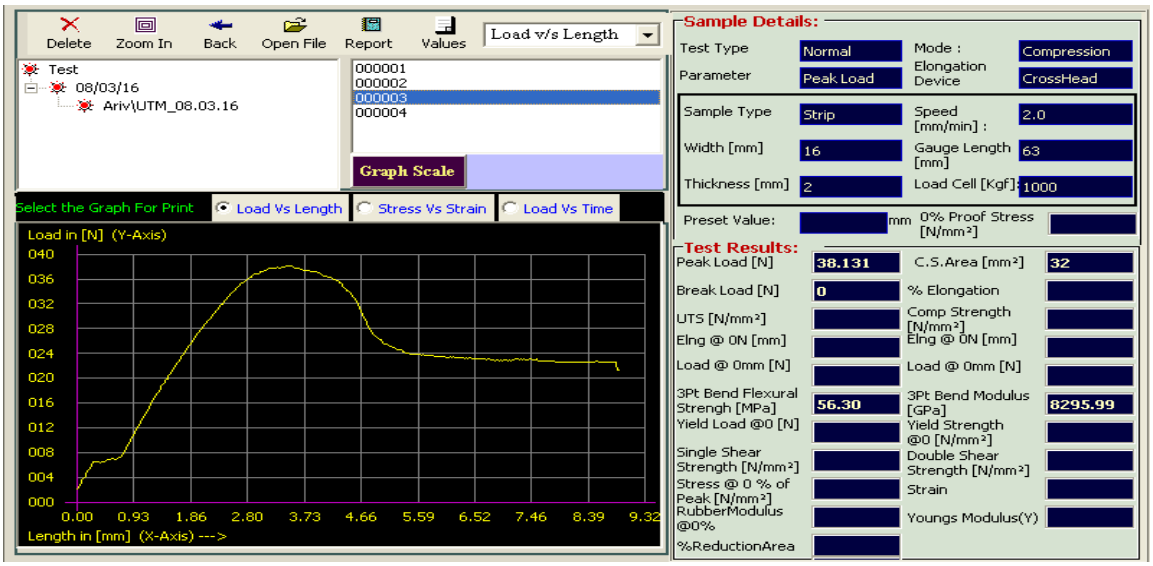

Fig. 4. Flexural Test – Load vs. Length

IMPACT TEST

S.No	Izod Impact Value in J
1	5.7
2	5.5
3	5
4	5.05

TABLE NO.5 IMPACT TEST RESULT

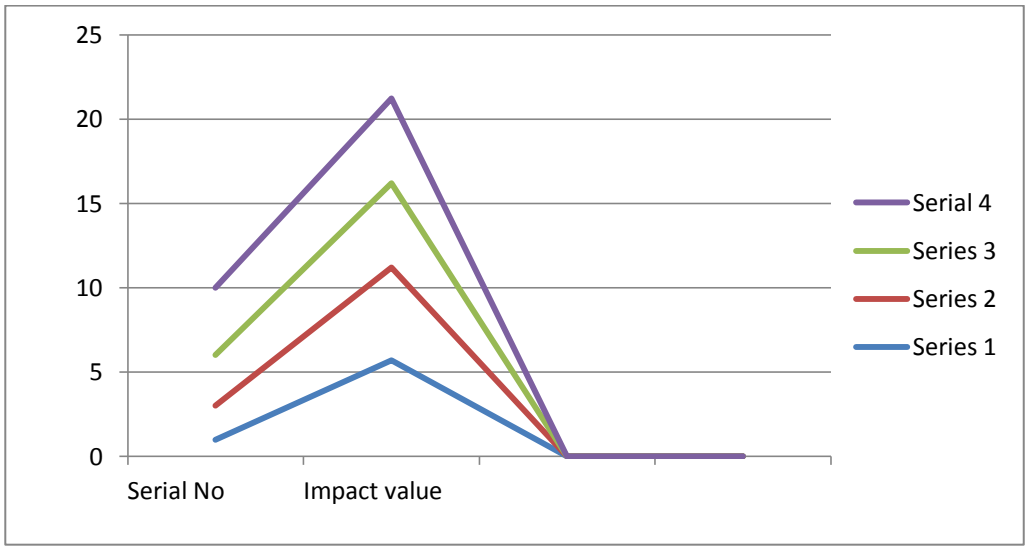

Fig 5. Graph for impact test

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 (mm2)**	**Load (N)**	**% Elongaion**	**UTS (N/mm2)**
1	110	6277.095	3.333	99.64
2	110	10807.834	3.667	150.113
3	110	2784.206	901.1333	63.275
4	110	14391.868	5.127	130.836

SUMMARY REPORT

TABLE NO.6 TENSILE TEST RESULT

	Load (N)	**% Elongaion**	**UTS (N/mm2)**
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

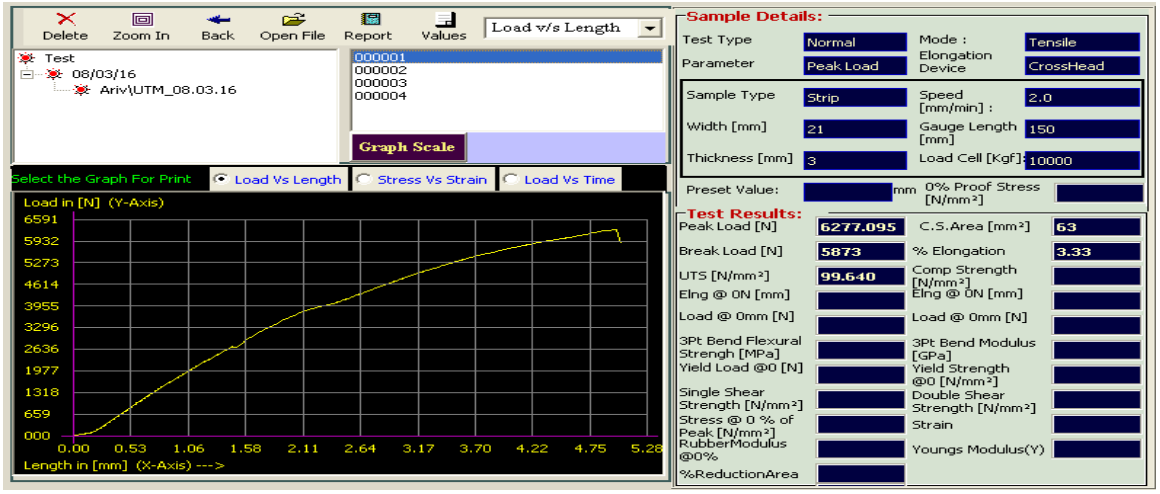

Fig. 6. C_1 – Tensile Test – Load vs. Length

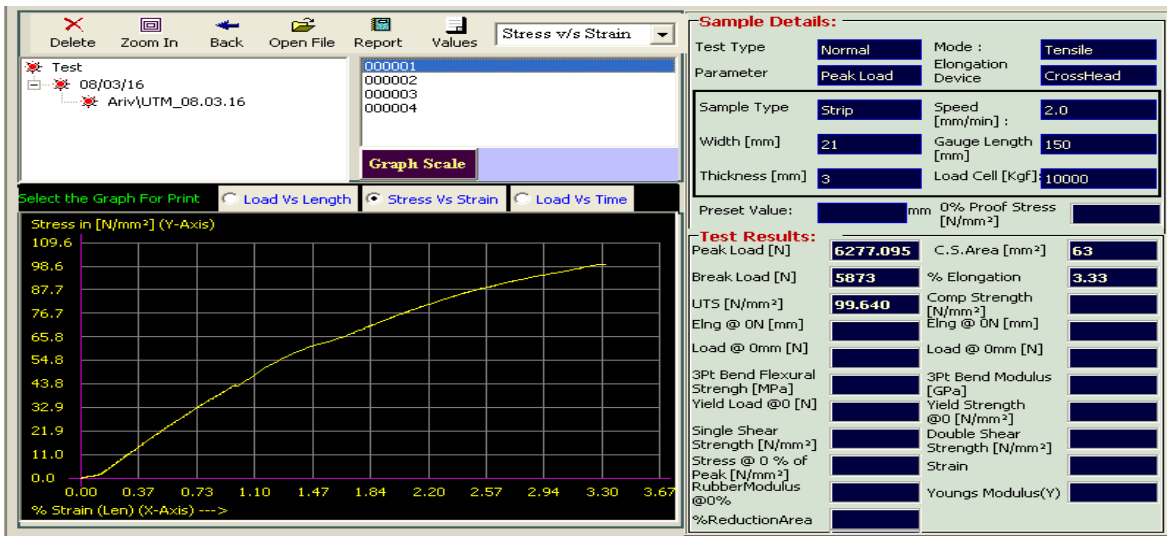

Fig. 7. C_1 – Tensile Test – Stress vs. Strain

TABLE NO.7 WEAR TEST RESULT

	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

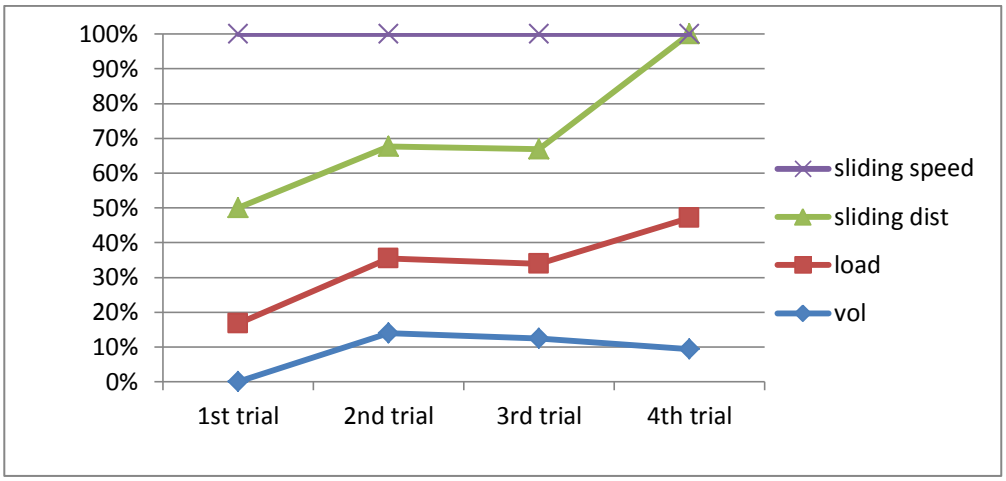

Fig 8. Graph for wear test

IX. CONCLUSION

Here in this project we fabricated vehicle Brake Disc using Bi-directional 200gsm E - glass fiber with epoxy resin along with coir fiber as reinforcement material. Thereby aiming to reducing the amount of resin used and also improve its mechanical properties. Results are obtained from real time testing. We made brake disc using first combination (C1). We first made specimen for all four combinations and tested. Test results are also mentioned. In our future aspect we fabricate for all other combinations and will check it by implementing it in bikes. Our composite brake disc has high strength to weight ratio, corrosion and wear resistance.

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