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Maximization of Efficiency For Disk Brake Material Using Composite Material by Modelling and Analysis

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ABSTRACT

This study presents the modeling and analysis of Disk brake of composite material with the cast iron. The Disk brakes exhibited wear resistance over the Existing material. Brake disk are steel plates with coating of friction material around the surface of the plate. The modeling is done according to the boundary conditions of the existing Disk brake the analysis and testing of composite Disk brake is reported. Modeling of a brake disk is carried out by existing dimension. Normal Disk brake is selected and subjected to various load condition and the reports are plotted. Stress and strain is derived as results for composite material.

Keywords: Disk brake, coirfibre, solidworks, ansys**.**

1. INTRODUCTION

The disc brake is a wheel brake which slowly rotates along with the vehicle. The vehicle used to stop by the motion of friction caused by calliper present in the brake pads. Once the brake is applied the caliber forces and causes the friction and makes the wheel to stop. The disk brake is made by the material of alloy steel.

1.1. Mechanical Brake

Mechanical discs use the same cables and housing found on traditional cantilevers and V-brakes. Cables offer certain advantages over hydraulic systems, including simpler installation and adjustment, lighter weight, and less complicated maintenance (cables can be found at any bike shop and are less expensive than hydraulic lines).

1.2. Hydraulic Disc Brakes

Hydraulic discs feature a closed system of hoses and reservoirs containing special hydraulic fluid to operate the brakes. When the lever is activated, a plunger pushes the fluid through the hoses and into the caliper where the pads are pushed onto the rotor, stopping the bike. Coir fibre extracted from the husk of coconut after long period of retting is basically ligno-cellulosic fibre. They are golden to dark brown in color depending upon color. These lingo cellulosic fibres are formed by encrustation of cellulose chains of lignin, which impart strength to the fiber. But the disadvantage is that the lignin component makes the fiber stiff. The higher the lignin content stiffer is the fibre. Because of the presence of higher degree of lignin especially on the surface, the coir looks dull and dark.

Since, cellulose chains are entangled with hemi cellulosic chains and lignin, attempts should be made to remove these two components partially. Delignification’s can be done by fungal treatment. Many species

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Figure 1: Coir fiber

Table 1
Properties of coir fiber

Ultimate length	0.6 mm
Diameter/ Width	16 micron
SINGLE FIBRE	
Length	6 to 8 inches
Density	1.4 g/cc
Tenacity	10 g/tex
Breaking elongation	30 %
Moisture regain at 65 % RH	10.5 %
Swelling in water	5 % in diameter

of white rot fungi can selectively degrade lignin from wood without extensive loss of cellulose. On the other hand, soft and brown rot fungi can degrade cellulose and hemicelluloses in preference to lignin.

1.3. Epoxy Resin

Epoxy resins, also known as poly peroxides are low molecular weight pre polymers or higher molecular weight polymer which normally contains at least two epoxide groups. Epoxy resins may reacted (cross-linked) either with themselves through catalytic homo polymerization, or with a wide range of co-reactants including poly functional amines, acids, phenols, alcohols, and idols.

2. PHENOL FORMALDEHYDE RESIN

Phenol formaldehyde is the synthetic high polymers. These are formed by the reaction with phenol and substitute phenol with formaldehyde. Besides polyurethanes and polyesters, phenolic and epoxy resins are the most prominent applications for technical lignin's in thermo setting materials. Phenolic resins are formed by a step growth polymerization reaction that can be either at the presence of acid or base which are used as catalyst. It is normally in liquid state and it's specific gravity varies from 1.12 to 1.16.

3. SILICON CARBIDE

Silicon Carbide is the only chemical compound of carbon and silicon. It was originally produced by a high temperature electro-chemical reaction of sand and carbon. Silicon carbide is an excellent abrasive and has been produced and made into grinding wheels and other abrasive products for over one hundred years. Silicon carbide is composed of tetrahedral of carbon and silicon atoms with strong bonds in the crystal lattice. This produces a very hard and strong material.

Figure 2: silicon carbide

Density	=	3.10 g/cm³
Yield strength	=	30 mpa
Compressive Strength	=	3900 MPa
Modulus of Elasticity	=	410 GPa
Vickers Hardness	=	2800
Poisson's Ratio	=	0.14
Thermal Conductivity	=	120 W/m K
Coefficient of Thermal Expansion	=	4 x 10^{-6} /^{o}C

4. FEATURES AND PROBLEMS IN DISK BRAKE

Discs are fabricated by gray cast iron, the defect and damage of disk brake is aused by scarring, cracking, warping or excessive rusting. Service shops will sometimes respond to any disc problem by changing out the discs entirely. This is done mainly where the cost of a new disc may actually be lower than the cost of workers to resurface the original disc. Mechanically this is unnecessary unless the discs have reached manufacturer's minimum recommended thickness, which would make it unsafe to use them, or vane rusting. severe (ventilated discs only). Most leading vehicle manufacturers recommend brake disc skimming (US: turning) as a solution for lateral run-out, vibration issues and brake noises.

5. DESIGNING OF DISK BRAKE

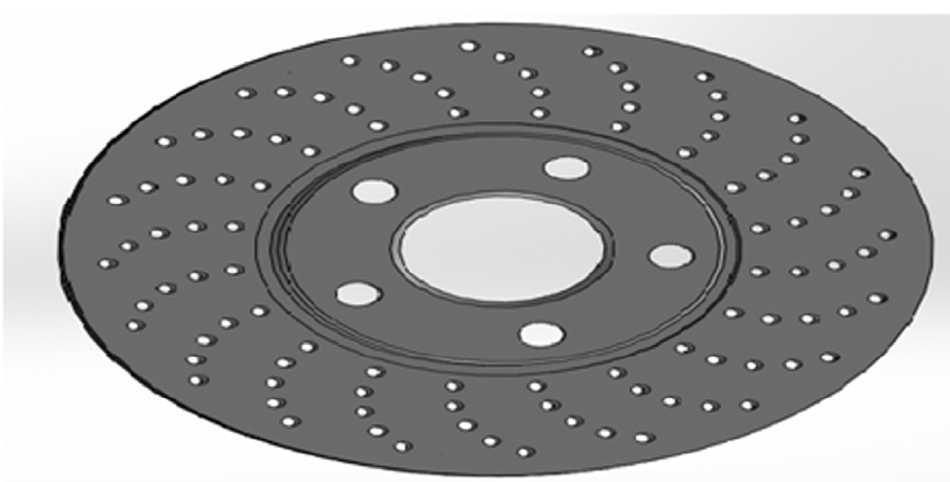

Figure 3: Modeling disk brake

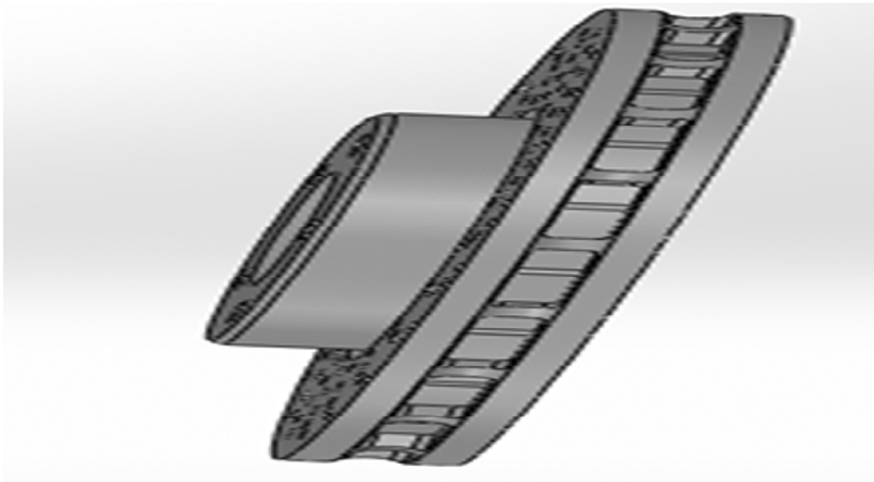

Figure 4: Side view of modeling disk brake

6. VOLUME CALCULATIONS

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°/45°/0°
Ratio of fiber and resin	=	50:40:10
Density of E-glass fiber(?f)	=	2500 kg/m3
Density of resin (?r)	=	1150kg/m3
Volume fraction of fiber (Vf)	=	50%
Volume fraction of resin (Vr)	=	40%
Volume fraction of hair (V_h)	=	10%
Mass of fiber (wf)	=	0.409 kg (51g per sheet x 8 sheets)
Density of coconut coir = (?h)	=	1320 kg/m3
Density of composite (?c)	=	(?f) (Vf) + (?r) (Vr) + (?h) (V_h)
Density of composite (?c)	=	(2500)(0.5) + (1150)(0.4)
Mass of fiber (wf)		
Volume of composite (vc)	=	0.0005428 m^3
Weight of composite (wc)	=	0.9999 kg
Mass of resin (wr)	=	0.24966 kg (or 250 g)
Volume of resin (V_r)	=	0.0002171 m^3
Volume of hair (V_h)	=	0.00005428 m^3

Table 2
composite material combination

S. No	*Type of Material*	*Weight %*		
		S1	*S2*	*S3*
1	Coir fibre	60	55	50
2	Epoxy resin & hardener	30	30	30
3	Phenol formaldehyde	5	10	15
4	Silicon carbide	5	5	5

Meshing

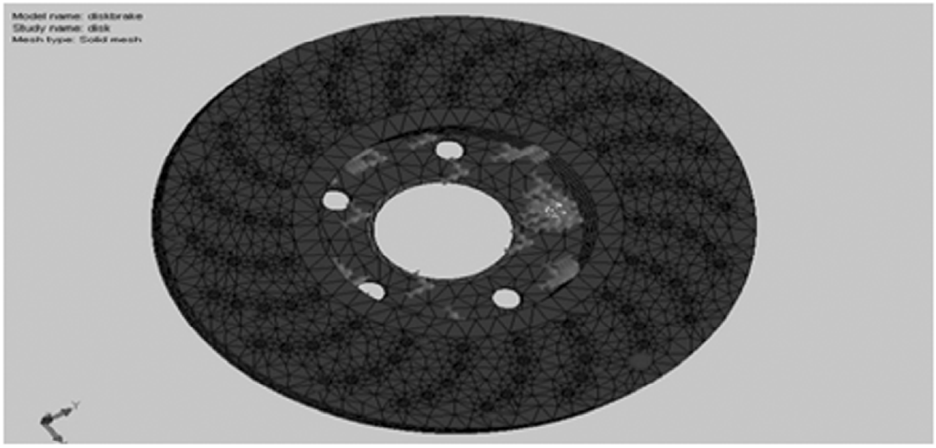

Figure 5: Meshing Model

7. RESULTS

Table 3
Comparison of result at 100 RPS

S. No	*Material*	*100 RPS*			
		Stress(MPa)	*contact sliding(mm)*	*Displacement(mm)*	*contact Pr(mm)*
1	Old material(Cast iron)	22.966	0.422e-3	0.505e-5	8.082
2	New material(Coir composite)	7.369	0.105e-3	0.124e-4	6.972
3	Percentage difference	65.38	74.46	78.68	5.13

Table 4
Comparison of result at 150 RPS

S. No	*Material*	*150 RPS*			
		Stress(MPa)	*contact sliding(mm)*	*Displacement(mm)*	*contact Pr(mm)*
1	Old material(Cast iron)	132.565	0.001167	0.187e-3	8.988
2	New material(Coir composite)	48.504	0.879e-3	0.149e-3	7.928
3	Percentage difference	63.51	18.35	16.72	9.366

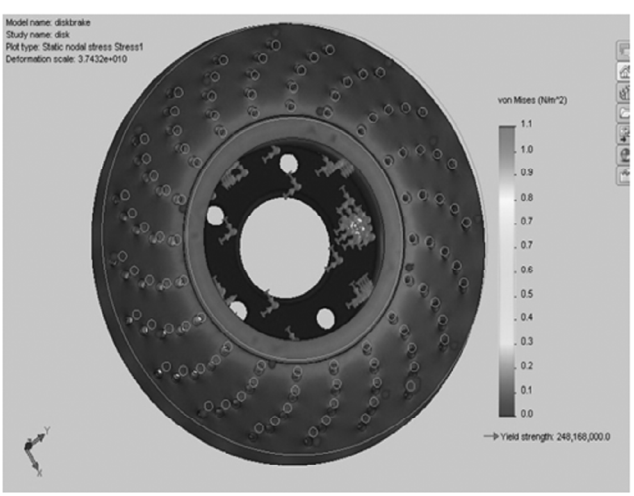

Figure 6: Stress deformation

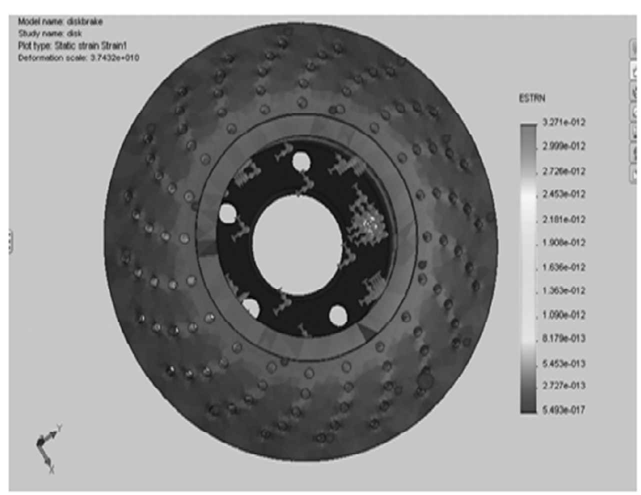

Figure 7: Strain deformation

8. CONCLUSION

Thus the modeling and analysis part shows the strain and stress constants in the field of research and the values has been derived. The fabrication, testing, and the product is derived from future work.

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