MECHANICAL BEHAVIOUR OF GROUNDNUT SHELL POWDER/ CALCIUM CARBONATE /VINYL ESTER COMPOSITE

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Abstract— In recent years, natural fiber along with mineral fillers is used to fabricate hybrid composite which shows improved mechanical properties. In this study the effect of calcium carbonate on the mechanical properties of groundnut shell powder based composite was investigated. To meet this objective, groundnut shell powder(GNP) and calcium carbonate(CC) reinforced vinyl ester(VE) were prepared by hand lay-up process. The effects of calcium carbonate on tensile and flexural properties of the composites were investigated. The test result shows that increase in calcium carbonate increases the tensile and flexural properties of composites.

Index Terms— Groundnut shell powder, Calcium Carbonate, Vinyl ester, Natural Fiber Composite

I. INTRODUCTION

Natural fibers have become alternative reinforcement for synthetic fibers in polymer composites, due to their advantages like low density, less tool wear during processing, low cost, non-toxic, easy to process, environmental friendly, and biodegradability[1,8].

The natural fiber-containing composites are more environmentally friendly, and are used in various applications like automobiles, aerospace, railway coaches, military applications, building and construction industries and ceiling paneling, partition boards, packaging, consumer products, etc [2].

Several studies have been carried out on the composites made of groundnut, calcium carbonate and vinyl ester

G.C. Onuegbu et al(2013) [3] investigated the mechanical properties of polypropylene composites with ground nut husk powder at different particle sizes and found that the presence of ground nut husk improved the tensile strength, modulus, flexural strength and impact strength of the composites.

Behzad Kord (2011) [4] studied the effect of calcium carbonate as mineral filler on the physical and mechanical properties of wood based composites and found that the mineral filler loading had significant effects on the mechanical properties of wood based composites Vasanta V Cholachagudda et al (2013) [5] found that coir fiber as the major reinforcement and rice husk as an additional fiber improves the mechanical property of polymer composites were prepared by hand lay-up process according to ASTM standards, he also found that there is an increase in tensile and flexural.

II. MATERIALS AND PROCESSING

Lignin binds individual fiber cells together, the lignin content of groundnut shell fiber is much

greater than that of banana, baggase, rice husk, jute, hemp, kenaf and sisal fibers and the hemicellulose influence moisture absorption of composites, the hemicellulose content of groundnut shell is less than rice husk, banana, wood, baggase and kenaf fibers[6]. Groundnut shell treated properly to remove impurities and it crushed to powder. Groundnut shell powder and calcium carbonate are mixed in different composition.

Table.1. shows the Chemical composition of various natural resources [6]

Species	Cellulose (wt%)	Hemi cellulose (wt%)	Lignin (wt%)
Pine (softwood)	40-45	25-30	26-34
Maple (hardwood)	45-50	22-30	22-30
Banana	63-64	19	5
Coir	32-43	0.15-0.25	40-45
Sisal	63-64	12	10-14
Jute	61-71.5	12-20.4	11.8-13
Kenaf	31-39	21.5	15-19
Hemp	70.2-74.4	17.9-22.4	3.7-5.7
Bagasse	40-46	24.5-29	12.5-20
Groundnut shell	**35.7**	**18.7**	**30.2**
Rice husk	31.3	24.3	14.3
Pineapple	81	-	12.7

Table.2. shows the volume and mass fraction of reinforcement and polymer used in the work.

	% of volume fraction			%mass (gram)		Volume (ml)
S.No	GNP	CC	VE	GNP	CC	VE
1	35	0	65	21.546	0	175.5
2	30	5	65	18.468	36.585	175.5
3	25	10	65	15.39	73.17	175.5
4	20	15	65	12.312	109.755	175.5

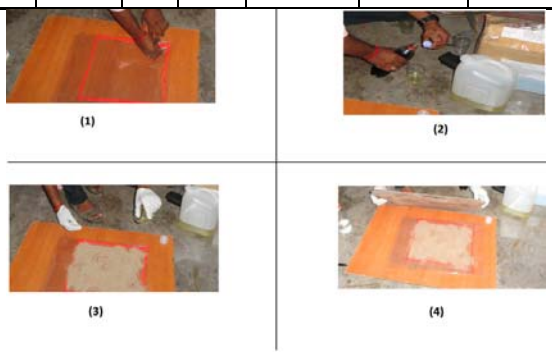

Figure.1. Shows the hand lay-up technique

(1) Placing the bottom mould plate with silicon rubber

(2) Adding catalyst, accelerator, promoter to resin

(3) Mixing resin to the fiber

(4) Closing with the top mould plate

The composite fibre is prepared by hand lay-up technique. A mould with the dimension of 300 mm × 300mm × 3mm was used to prepare the composite specimen[7]. Measured quantities of groundnut shell powder, calcium carbonate and vinyl ester resin were taken in a glass beaker and stirred thoroughly to get homogeneous mixture. Methyl Ethyl Ketone Peroxide is used as a catalyst to support the moulding process. Cobalt Naphthenate is used as an accelerator to speed up the reaction[9]. Dimethyl Acetamide is used as promoter to increase adhesion between a polymer and reinforcement. After adding the suitable quantity of resin, catalyst, accelerator and promoter, the mixture was again stirred for 10 minutes and thoroughly mixed mixture was placed in the mould and compressed uniformly. This set up allowed for curing and then the composite specimen was taken out from the mould.

III. Cutting Of Laminates Into Samples Of Desired Dimensions

A Wire Hacksaw blade was used to cut each laminate into smaller pieces, in accordance with ASTM standard.

The tensile test was generally performed on flat composite sample. The length of the test specimen was as per ASTM D638. The dimension of the specimen is 250 mm x 25 mm x 3 mm.

Flexural test is a 3-point bend test, which generally promotes failure by inter-laminar shear. This test is conducted as per ASTM standard D790 using Universal Testing Machine. The dimension of the specimen is 20mm x 150mm x 5mm.

IV. EXPERIMENTAL RESULTS

A. Tensile Test

The tensile strength of a material is the maximum amount of tensile stress that it can take before failure. The commonly used specimen for tensile test is the flat type. During

the test a uniaxial load is applied through both the ends of the specimen. The results are tabulated in the table.3.

B. Flexural Test

Flexural strength is defined as a material's ability to resist deformation under load. It is a 3-point bend test, which generally promotes failure by inter-laminar shear. The results are tabulated in the table.4.

Table.3. shows tensile load of specimen

Sample no.	Percentage of volume fraction			Maximum load (N)
	Ground nut powder	Calcium carbonate	Vinyl ester	
1	35	0	65	443
2	30	5	65	535
3	25	10	65	580
4	20	15	65	650

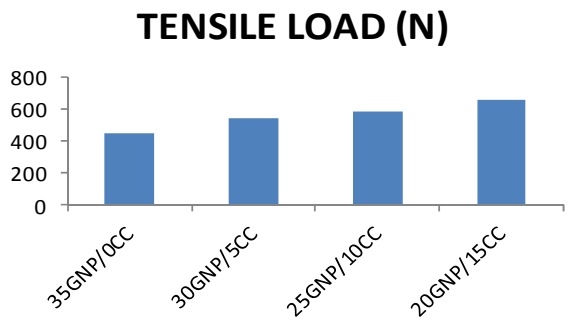

Figure.2. shows graph of tensile load of specimens

Table.4.shows flexural load of specimen

Sample no.	Percentage of volume fraction			Maximum load (N)
	Ground nut powder	Calcium carbonate	Vinyl ester	
1	35	0	65	20
2	30	5	65	40
3	25	10	65	42
4	20	15	65	48

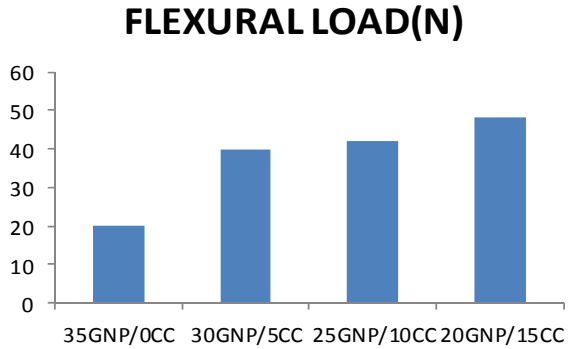

Figure.3.shows graph of flexural load of specimens

V. CONCLUSION

A new class of natural fiber based polymer composites groundnut shell powder and calcium carbonate reinforcement in the vinyl ester polymer is developed.

The experimental investigation on mechanical properties ie Tensile strength and flexural strength, groundnut shell powder/ calcium carbonate /vinyl ester composite ,material is greatly influenced by the groundnut shell powder/ calcium carbonate composition.

The maximum tensile load is obtained for the composite prepared With 20%GNP/15%CC. The tensile load graph (See Figure.2) shows an increase of calcium carbonate volume, increases the tensile load.

The maximum flexural load is obtained for the composite prepared with 20%GNP/15%CC. The flexural load graph (See Figure.3) shows an increase of calcium carbonate volume, increases the flexural load.

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