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Evaluation of Electrical and Mechanical Properties of Particulate Filled Natural Fiber Reinforced Vinyl ester Composites

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Abstract -- Globally natural fiber based structured polymer composite materials are emerging material of various disciplinary. In general the natural fiber composites are low cost, no health hazard, electrical insulation, good mechanical properties etc. The objectives of this present work, to investigate the suitability of natural fiber reinforced polymer composites using sisal fiber with alumina and coconut shell particulate. Initially the sisal fibers were soaked 4% of NaOH concentration about 3 hour to improve the interfacial bonding between fiber and matrix. The composite plates were fabricated by various concentration of alumina and coconut shell particulate. The plates were fabricated by compression molding technique. The electrical property of dielectric constant was calculated based on various concentrations of the alumina and coconut shell particulate composites. Finally fabricated composites were sized based on ASTM standards to discover the mechanical properties such as tensile and impact strength for commercialize this work.
Keywords -- Sisal fiber, composites, alumina, coconut shell, dielectric constant, Mechanical properties

I. INTRODUCTION

In general the natural fiber reinforced composite materials are having tremendous application in various disciplinary. Natural fibers are easy available source and biodegradables comparatively manmade fibers such as glass, carbon etc, and also there is no health hazard, low cost, good electrical insulation and mechanical properties (1,2). The main weakness of the natural fiber is binding ability. The biding natures of the natural fibers with polymer matrix are basically poor, to increase the binding ability the natural fibers (3), the fibers are treated by various chemical agent. There were a number of chemical treatments available such as alkali treatment, silane, acetylation, benzoylation, acrylation, isocyanates and permanganate to change the hydrophilic nature of the surface into hydrophobic surface nature (4). In that the alkaline or mercerization treatment was good and economical treatment to removing the wax, foreign particles and improving the surface nature of the fiber surface (6). The hydrophilic surface behaviors of the natural fibers are easily absorbing the water, based on the surface chemical composition (5). In order to improve the surface behavior the fiber chemical treatments carried to the natural fibers, which is to remove the hydroxyl group from the surface of the fiber and it tends to change the fiber as water repels (hydrophobic) (4,7). The mechanical properties such as tensile, flexural and impact strength of sisal fiber based on various fiber loading was analyzed (Ref). Furthermore the adding of particulates to improve the composites tensile and flexural strength mainly increases the impact strength up to optimum level. The electrical property of dielectric constant, conductivity and permittivity of the coir polyester composites were discovered (10). The mechanical and electrical performances of Roystonea regia/glass fiber were analyzed different frequencies (8). The dielectric behavior of brown grass flower broom evaluated based on various fibers loading (9, 10).

Moreover the volume fraction of fiber and particles were major influences in mechanical and electrical properties. Many of research fellows were analyzed the variation of fiber loading in volume percentage of composites. Taking these considerations in this investigation mainly focus the various volume concentrations of the particulates in sisal composites. The particulates such as alumina and coconut shell powder. The sisal fibers were pretreated by NaOH solution of 4% about 3 hour. The composites fabricated based on compression technique and the plates were sized based in ASTM standard. The electrical property of dielectric constant was calculated and also the mechanical properties such as tensile and impact strength were discovered.

II. MATERIALS AND METHODS

A. Materials

The main aim of this present work is to investigate the suitability of natural fiber reinforced polymer composites using sisal fiber with alumina and coir dust particulate. The major materials are sisal fiber reinforcement, alumina, coconut shell particulates and vinyl ester matrix. The sisal fiber reinforcement (Density of 1.44g/cm^3 and Tensile strength of 615MPa), alumina and coconut shell particulates were purchased from inside of the Tamilnadu. The matrix unsaturated vinyl ester resin purchased from sheenu & co Coimbatore. Methyl Ethyl Ketone Peroxide and cobalt Octoate were used as catalyst and accelerator respectively.

B. Composite Fabrication & Composite Testing

The composites were fabricated through compression molding technique by various concentrations of sisal fiber and particulates. There were a two set of composites fabricated. The table 1 (a) & (b) clearly gives the various concentrations of Alumina and Coconut shell particulate composites. A total number of 8 composite plates were fabricated. The fabricated composites matrix (75%), reinforcement & particulates (5&20, 10&15, 15&10, 20&5 %) ratios were maintained respectively. The sisal fiber and particulate were randomly oriented in the composites. The matrix phase vinyl ester incorporates cobalt octoate and methyl ethyl ketone peroxide catalyst. Finally the fabricated composites sized based ASTM standard for mechanical testing. The ASTM standard for tensile test (ASTM D-638) and impact test (ASTM D-256), based on this standard the composites was sized and tested respective testing machines. Finally the dielectric properties measured using a frequency response analyzer (FRA) and Chelsea Dielectric interface (CDI).

Table.1 Combination of sisal and particulate (a) Sisal and Alumina (b) Sisal and Coconut shell

b. Set 1 : Alumina Particle

Samples	Composition (Matrix 75%)	
	Fiber (%)	Particle (%)
A	5%	20%
B	10%	15%
C	15%	10%
D	20%	5%

a. Set 2 : coconut shell Particle

Samples	Composition (Matrix 75%)	
	Fiber (%)	Particle (%)
A1	5%	20%
B1	10%	15%
C1	15%	10%
D1	20%	5%

III. RESULTS AND DISCUSSION

A. Tensile strength and Impact strength of composites

A figure.1 (a) and (b) evidently expose the tensile strength of the composites by various concentrations of sisal fiber and alumina, coconut shell particulates. The figure 1(a) gives the tensile properties of sisal & Alumina composites, in that the maximum tensile strength property achieved combinations was 15% of sisal fiber and 10 % of alumina particle. As similar the figure 1(b) shows the maximum tensile strength property attained mixtures was 15% of sisal fiber and 10% coconut shell particle remaining vinyl ester matrix 75%. Both the maximum tensile properties of alumina and coconut shell particulates composite were 24.34MPa and 28.74MPa respectively. In this experimental analysis the fiber and particle content of 15% and 10% takes as an optimum fiber and particulate content. Similarly both fiber and particle ratios exceeds or decreases based on optimum level means there were changes in tensile properties both in alumina and coconut shell particulates. 24.34MPa

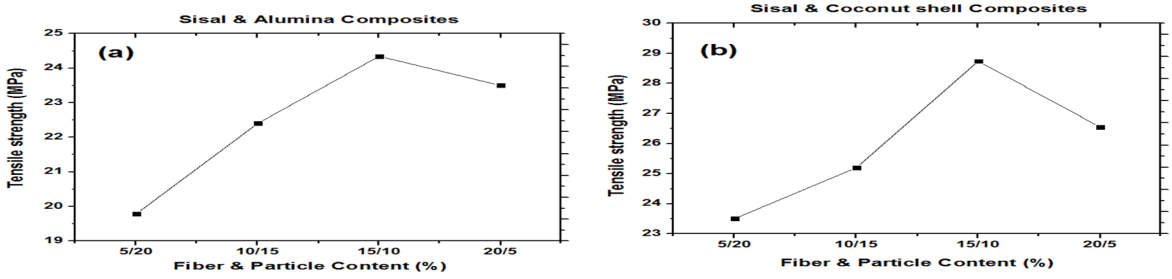


Figure.1 Tensile strength for (a) Sisal & Alumina (b) Sisal & Coconut shell composites

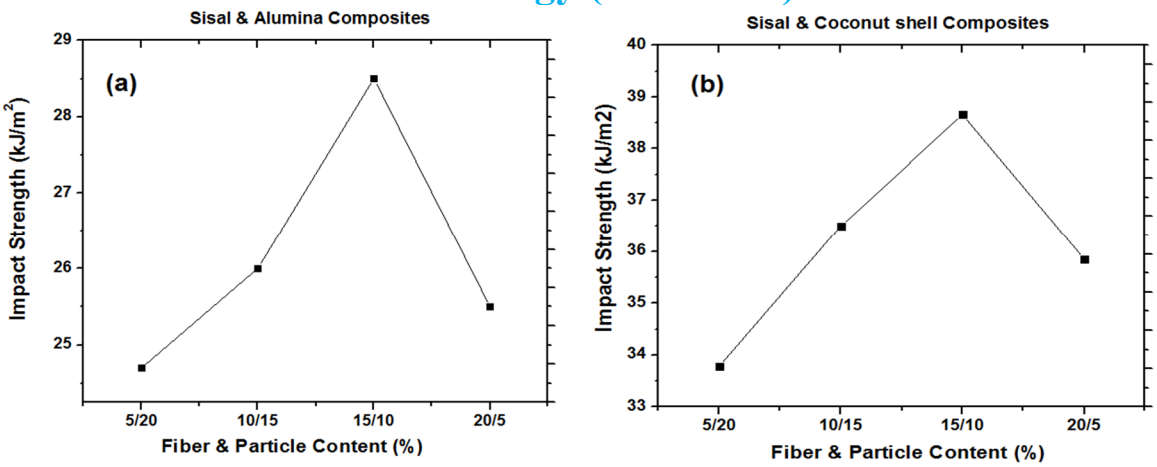
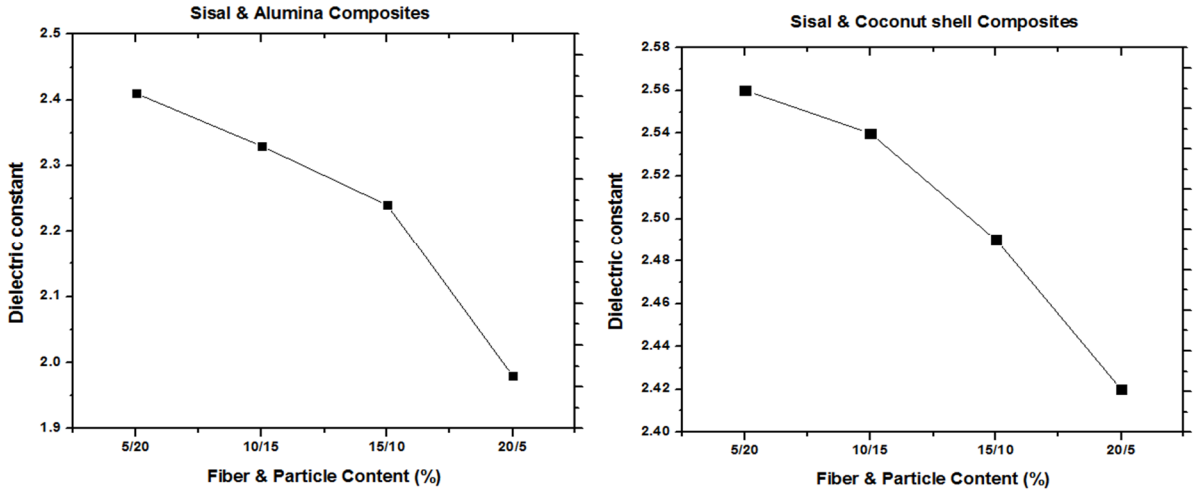


Figure.2 Impact strength for (a) Sisal & Alumina (b) Sisal & Coconut shell composites

Considering the figure.2 (a) and (b) clearly explain the impact strength of the composites by various concentrations of sisal fiber and alumina, coconut shells particulates. The maximum impact properties of alumina and coconut shell particulates composite were 28.5 kJ/m^2 and 38.66 kJ/m^2 respectively. The figure 2(a) and (b) gives the impact properties of Alumina and coconut shell composites.

B. Dielectric properties of composites

The figure 3(a) and (b) shows that properties of dielectric constant of sisal composites filled with particle of alumina and coconut shell. Both of this figures clearly exposed the increasing of particle content directly influenced in dielectric constant, which means increasing of dielectric constant value. The chemical treatment of alkali treatment also influenced the dielectric constant.



The maximum value of dielectric constant attained at the maximum value of fiber and particle content. Considering the sisal alumina composites the maximum value of dielectric constant was 2.41 at 20% of particle and 5% of fiber content. Similarly the dielectric constant of sisal and coconut shell was 2.56 at similar fiber and article content.

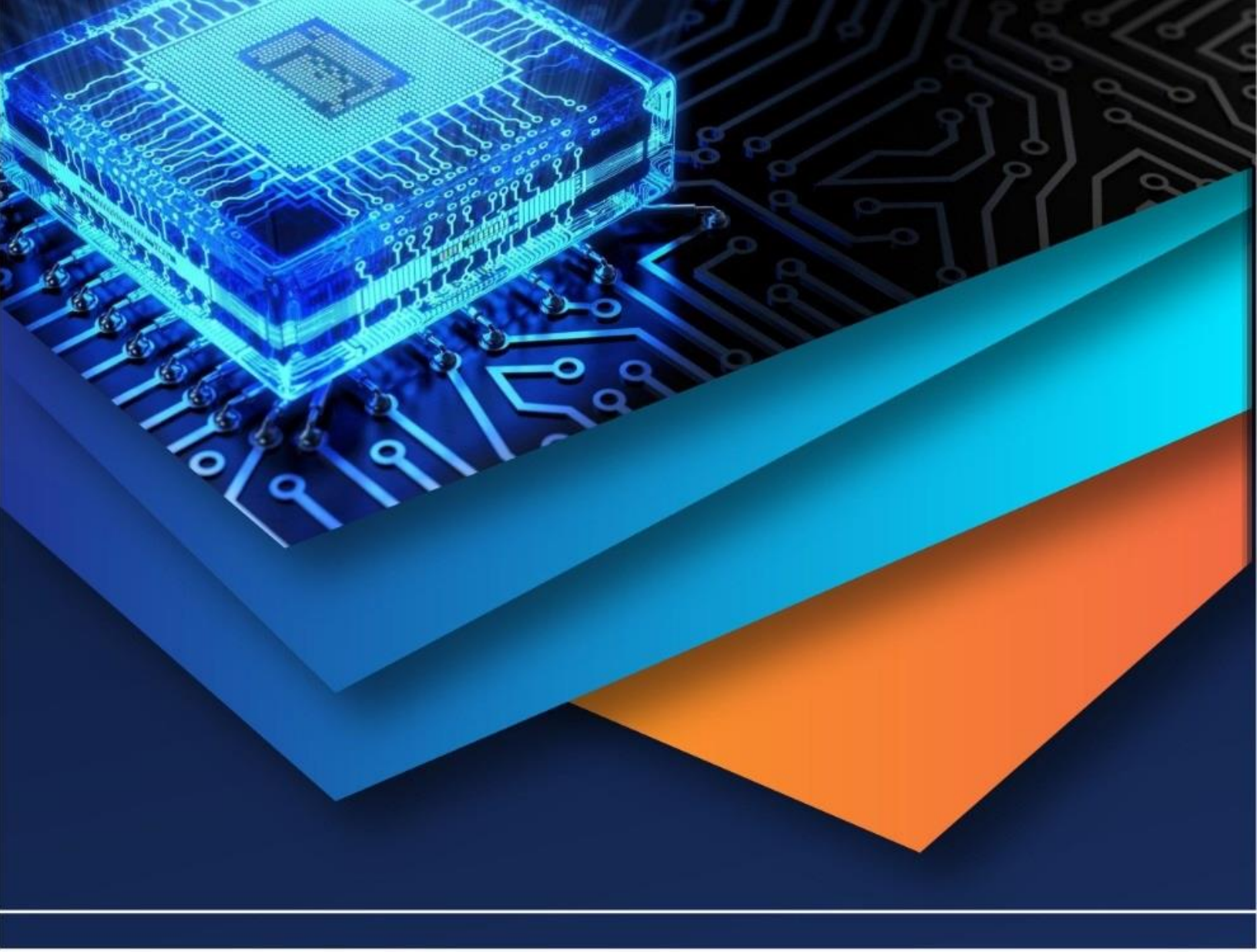
IV. CONCLUSION

The result of this work was to checking the suitability of natural fiber reinforced polymer composites using sisal fiber with alumina and coconut shell particulate. The tensile and impact properties were evidently exposed the suitability of natural fiber reinforced polymer composites using sisal fiber with alumina and coconut shell particulate. The maximum value of tensile and impact properties sisal and alumina composition of fabricated composites were 24.34 MPa and 28.5 kJ/m^2 respectively similarly sisal and

coconut shell composites 28.74 MPa and 38.66 kJ/m^2 respectively. The dielectric constant of the sisal alumina composites and sisal coconut shell composite were increased with increasing of particle content of both alumina and coconut shell.

REFERENCES

[1] Cao Y, Shibata S, and Fukumoto I, "mechanical properties of biodegradable composites1reinforced with bagasse fibre before and after alkali treatments composites," Part 37, 423–429,2006.
[2] Satyanarayana K G, Sukumaran K, Mukherjee P S, Pavithran C and Pillai S G K, "natural fiber-polymer composites," Journal of cement and concrete composites, vol. 12, no.2, pp. 117-136-1990.
[3] Dipa ray, Sarkar B K, Rana A K and Bose N R, "Effect of alkali treated jute fibres on composite properties," Bull. Mater. Sci., vol. 24, no. 2, april 2001, pp. 129–135.
[4] Jochen gassan, Andrzej K, Bledzki, "Possibilities for improving the mechanical properties of jute/epoxy composites by alkali treatment of fibres- composites science and technology," 59 (1999) 1303-1309.
[5] Varga C, Tóth, Gergó P, Bartha, "Effect of a new type of coupling agent on the mechanical properties of various multi-walled carbon nanotube/rubber composites," vol. 40 (2) pp. 69–75 (2012).
[6] B. Sutharson, Rajendran, R. Devadasan and Selvam B, "Effect of chemical treatments on mechanical properties of jute fiber hybrid composite laminates. Arpn journal of engineering and applied sciences," Vol. 7, no. 6, june 2012-760-765.
[7] Satyanarayana K G, sukumaran K, kulkarniA. G, pillai S. G. K, and rohatgi P K, "Fabrication and properties of natural fiber-reinforced polyester composites", journal of composites," vol 17, no.4, pp. 329-333, 1986.
[8] Pooja P, Adroja A, S, Koradiya A, Patel B. H. Parsania, "A preparation, mechanical and electrical properties of glass and jute–epoxy/epoxy polyurethane composites.polymer-plastics technology and engineering," 50:9,937-940 2011,
[9] Govardhan goud and R N Rao, "mechanical and electrical performance of *roystonea regia*/glass fibre reinforced epoxy hybrid composites," Bull. Mater. Sci., vol. 35, no. 4, august 2012, pp. 595–599.
[10] Xingyi huang and pingkai jiang, "A review of dielectric polymer composites with high thermal conductivity".



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