REVIEW ON ELECTRICAL CONDUCTIVITY OF NATURAL FIBER COMPOSITE

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Abstract

Since recent few decades natural fiber composites have been gaining more and more importance and attention over synthetic fibers on account of their various advantages and applications. An appropriate electric al application of natural fiber composite s depends on the electrical conductivity of the composite known very well. Also electrical conductivity due to moisture absorption of natural fiber plastic composites is one major concern in their outdoor applications. Dry natural fiber composite has no measurable electrical conductivity. After absorbing moisture from atmosphere or any other means natural fibers impart electrical conductivity to composites which is undesirable even though it is very low. This conductivity increases with the amount of fiber loading and not depends on the orientation of fiber in matrix. A proper setup is made to measure electrical conductivity of natural fiber composite sample at different fiber loading which gives the conductivity values in close proximity to the earlier made approaches to find electrical conductivities with different samples and compare the values obtained to get a graph showing that after percolation threshold value the conductivity of natural fiber composite increases with increase in fiber loading.

Keyword- *Natural fiber, instrument, electrical conductivity.*

INTRODUCTION

Composites can be defined as combinations of two materials one of which is called the reinforcing phase which can be in the form of fiber sheets or particles and are embedded in the other material called the matrix phase. The objective is to take benefit of the superior properties of both the materials without compromising on the weakness of either. Mechanical properties of composites depend on the size, shape and volume fraction of the reinforcement, reaction at the interface matrix material. The composites are compound materials which differ from alloys by the fact that the individual components retain their characteristics but are so incorporated into the composite as to take advantage only of their attributes and not of their short comings, in order to obtain improved materials. There are two categories of constituent materials of composite materials: matrix and reinforcement. The matrix material supports and surrounds the reinforcement materials and simultaneously maintains there relative position. The reinforcements impart their special mechanical and physical properties to enhance the matrix properties.

Matrix Phase

1. The primary phase, having a continuous character.
2. Usually more ductile and less hard phase.
3. Holds the reinforcing phase and shares a load with it.

Reinforcing Phase

1. Second phase (or phases) is embedded in the matrix in a discontinuous form,
2. It is sometimes called reinforcement phase as it is usually stronger than matrix phase.

LITERATURE SURVEY

Literature survey/review is carried out as a part of this project work to have an overview of the natural based composite and their electrical conductivity characteristics.

W. Jia et al. analyzed electrical conductivity of composites based on epoxy resin with polyaniline-DBSA fillers. Due to their vast applications electrically conductive thermosetting composite materials containing metallic filers are widely used now a day. The composite material used was conductive filler PANI-DBSA in form of powder and paste in matrix polymer bisphenol, an epoxy resin, anhydride hardener and an accelerator. The variation of electrical resistivity which is the inverse of electrical conductivity was plotted with content of PANI powder. With 40% wt. /wt. of filler content electrical conductivity of the order of 10-8 ohm-cm was observed which gradually increases or the resistivity gradually decreases as the wt. % of filler material increases. At higher filler content conductivity of the order 10-3 was also achievable in the experiment.

M.M. Pavlović et al. studied electrical conductivity of lignocellulose composites loaded with electrodeposited copper powders at different pressures and compared the results with previous researches in this field and percolation theories. It stated that the electrical conductivity of the composites is < 10-15 MS/m, unless the metal content reaches the percolation threshold of 14.4% (v/v), beyond which the conductivity increases markedly. As lignocellulose based fibers have some interesting properties, they are widely used. The metal fibers alter the electrical properties of the composite keeping the mechanical properties unvaried. The electrically conducting polymer composites have several benefits over their pure metal counterparts, such as ease of manufacture, corrosion resistance, reduced weight, lower cost, high flexibility, and conductivity control and mechanical shock absorption ability, . In order to have more contact between filler materials for better conduction copper in the form of powder was used as a filler material. It was observed that the samples with low filler content were nonconductive and increases as the filler amount increases. The significant increase in the electrical conductivity was observed as the copper content reached the percolation threshold at 14.4% (v/v) for all the processing pressures. As the surface to volume ratio of the filler material added was high the percolation threshold was much lower. Logarithmic value of electrical conductivity was plotted against percentage volume of filler content, of lingo cellulose composites filled with copper powder under different processing pressures which showed typical S-shaped dependency with three distinct regions: dielectric, transition and conductive. The average value of conductivity obtained at percolation threshold value was obtained to be of the order 10-5 which increased to 10-2-0.1 with increase in fiber loading to 30 %.

Gelfuso et al. did research on Polypropylene Matrix Composites Reinforced with Coconut Fibers with the goal to combine low cost and eco-friendly treatments to improve fiber-matrix adhesion for which electrical resistivity (inverse of electrical conductivity) of prepared sample were also calculated. Coconut fiber-polypropylene composite boxes containing up to 20 vol. (%) of coir fibers were formed by injection molding. Square specimens of 50×50 mm dimensions and 3 mm thickness were put between copper plates, which were used as electrodes. An electric voltage of 5 kilo-Volt DC was applied to the samples to obtain the electrical resistance measurements, and lastly the electrical conductivity values were obtained using the conductivity formula: s= (L/R*A). The conductivity of the sample was found to be of the order 10-7 Siemens/meter at 10 vol. (%) to 10-3 S/m at 20 vol. (%) of fiber loading.

MATERIAL AND METHODOLOGY

A natural fiber plastic composite with rice husk (natural fiber) as reinforcement phase in epoxy as matrix phase is prepared. Four samples with different percentage by weight of rice husk loading is prepared i.e 40%, 50%, 60%, 70% by weight to measure and compare the electrical conductivities of different samples. The important properties of Rice husk is that, it is a fibrous material and has a varied range of aspect ratio (length to diameter ratio of fiber). Its composition makes it potential filler for making lightweight polymer composites. Samples of dimension 2cm×2cm×0.4 cm is cut out from each composite sheet. As from the literature review we come to know that for natural fiber composite to conduct electricity it has to absorb moisture as dry natural fiber composite has no measurable conductivity, Samples were immersed in distilled water at room temperature, i.e., 23 0C. After specific time intervals, samples were removed from water, their surface moisture was removed by tissue paper, and their electrical conductivities were measured.

CONCLUSION

Following conclusion are made

1. The electrical conductivity increases as the natural fiber content in the fiber increases beyond percolation threshold value.

2. The equipment can be further modified by using other materials like steel or iron in place of wood to make adjustable fixtures and fixed foundations which could not be done due to time constraint. It can also be

used for measuring electrical conductivities of composites other than natural fiber composites with slight modifications in arrangement if required.

REFERENCES

1. Wang W, Sain M, Cooper P.A: “Study of moisture absorption in natural fiber plastic composites”, composites Science and Technology 66 (2006) 379–386
2. Jia W, Tchoudakov R, Segal E, Joseph R, Narkis M, Siegman A: “Electrically conductive composites based on epoxy resin with polyaniline-DBSA fillers”, synthetic metals 132 (2003) 269-278
3. Pavlović M.M, Cosovic V, Pavlović M.G, Talijan N, Bojanić V: “Electrical Conductivity of Lignocellulose Composites Loaded with Electrodeposited Copper Powders” Int. J. Electrochem. Sci., 6 (2011) 3812 - 3829
4. Berghezan, Nucleus A, 8(5), 1966,(Nucleus A Editeur,1,rhe,Chalgrin,Paris, 16(e).
5. Maldas D, Kokta B.V, Raj R.G, and Danealut c, Polymer, 29, 1255 (1988).
6. Paul Augustine and Thomasz samu, Journal of Applied Polymer Science, Vol. 63, 247-266 (1997)
7. Poblete V.H, lvarez M.P.A and Fuenzalida V.M, Polymer Composites, 30 (2009) 328.
8. Pramila Devi D.S, Bipinbal P.K, Jabin T, Kutty Sunil K.N : “Enhanced electrical conductivity of polypyrrole/polypyrrole coated short nylon fiber/natural rubber composites prepared by in situ polymerization in latex”, Materials and Design 43 (2013) 337–347
9. Gelfusoa Maria Virginia, Pedro Vieira Gurgel da Silvab, Thomazinia Daniel: “Polypropylene Matrix Composites Reinforced with Coconut Fibers”, Materials Research. 2011; 14(3): 360-365.
10. Clemons, Craig M., Caulfield, Daniel F., 2005, “Natural Fibers, Functional fillers for plastics,” Weinheim: Wiley-VCH: pp.195-206.