Studies on Dielectric and Conductivity properties of Bio-Waste reinforced Polymer Composites

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Summary

In the present work we have prepared one pure epoxy and four bio-waste coir dust reinforced polymer composites by hand lay out method under the same conditions of temperature and pressure. Dielectric behavior of the composites were performed by using salortron 1296 dielectric interface equipment, in the frequency range 100Hz-1MHz and at temperature range of 30°C-150°C. The experimental results shows that, the dielectric constant (K), Dielectric loss (tan δ), and A.C conductivity (σ) increased and A.C resistivity (ρ) decreased with addition of coir dust in epoxy resin this is because of presents of water content and voids. It is also observed that the Dielectric and electrical properties of the composite material showed a strong dependence on frequency of applied electric field and testing temperature.

Key Words: epoxy resin, polymer composite , polarization, conductivity, resistivity.

1. Introduction

It was known that composite can be produced exhibiting enhanced properties that the constituent materials may not exhibit[1-4].The combination of different fillers or fibers with polymer matrices can produce polymer matrix composites, these materials are important to the electronic industry for its dielectric properties in the use of capacitors[5-7].The effective utilization of polymer composites depend strongly on the homogeneous dispersion ability of the reinforcement throughout the matrix[8].The performance of these materials also influenced by the interface properties[9].Filler reinforced composite material have a wide

range of applications in aircraft automobile, chemical, medical, and industries .In the electrical/electronics industry these composite material are used for making panels, switches, insulators and for many insulation purpose[10].In this present work we have analyze the dielectric and electrical properties of Bio-waste reinforced polymer composites .The dielectric and electric response of a normal material can be described by its dielectric constant(K),dielectric loss(tan δ) ,conductivity and resistivity.

2. Materials and Methods

2.1 Fabrication of the composite

Here the matrix material is epoxy LY556, chemically belonging to the epoxide family. The natural fiber coir dust was used as reinforcement. The epoxy resin and hardener were supplied by Ciba-Geigy India Ltd..The mixing ratio of the epoxy and hardener was taken as 8:1 by weight. Coir dust(cd) was mixed with the epoxy by stirring at room temperature and disc shaped five samples of epoxy resin, sample A(0 wt% coir dust),B(10 wt% cd),C(20 wt% cd),D(40 wt% cd),and E(60 wt % cd) were prepared by uniaxial pressing at 2.00 ton load.

2.2 Dielectric Measurement

Salorton 1296 dielectric interface instrument was used for carried out the dielectric measurements over the temperature range from 30C-150 C and a frequency range from 100Hz -1MHz.In this analysis after placing the each sample between the two electrodes(parallel plate sensors),an A.C voltage was applied ,this voltage produce polarization in the sample. Measurements of capacitance and conductance are used to calculate dielectric constant (K) and dielectric loss (tan δ).

3. Results and Discussion

Figure 1 gives the variation of the K-value and dielectric loss with the amount of coir dust, from the figure it is clear that with increasing the amount of coir dust the value of K and tan δ was increased, the reason may be that the absorption of moisture (due to humidity, as the experiment is conducted at 90% realative humidity condition).

(a) (b)

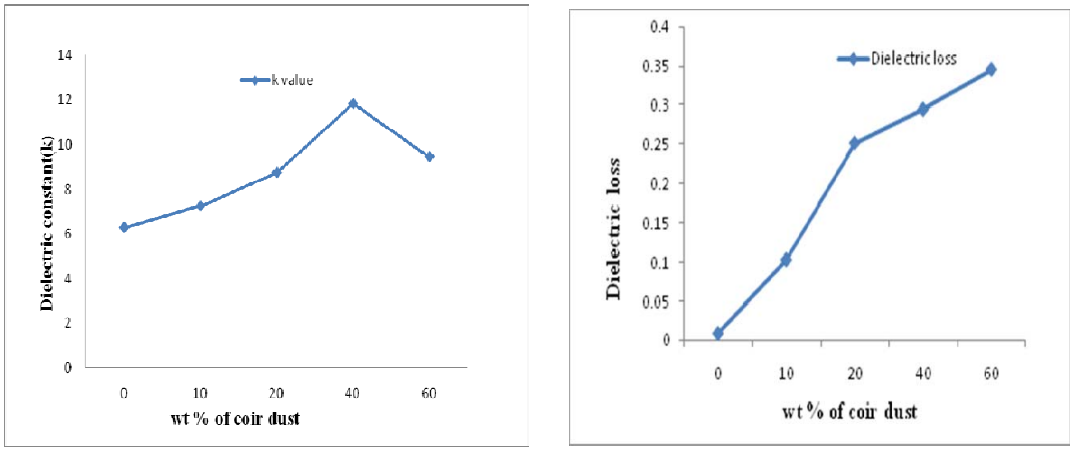

Figure 1: Influence of coir dust amount on (a) dielectric constant , and (b) dielectric loss at particular frequency and temperature.

Figure 2 shows the variation of the dielectric constant and dielectric loss with the temperature for different samples at a constant frequency, from the figure it was noticed that with increasing temperature the values of K and tan δ are increases,the reason is that the greater freedom of movement of dipole molecular chains, contribution of AC conductivity.It is usual behaviour in most of the dielectric materiaals.

(a) (b)

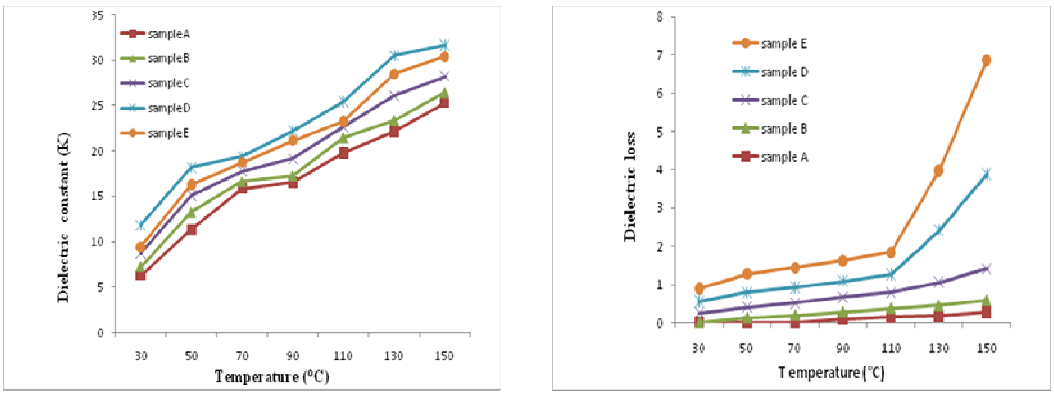

Figure 2: Temperature dependence of (a) dielectric constant , and (b) dielectric loss at a particular frequency for different samples.

Figure 3 gives the variation of the A.C conductivity and A.C resistivity varying with frequency of applied electric field for different amount of coir dust composites at room t

emperature. The resistivity of the material is decreased with increasing frequency and the conductivity of the material is increased with increasing frequency at room temperature. It is also observed that at 40 wt% coir dust the A.C conductivity is more pronounced.

(a) (b)

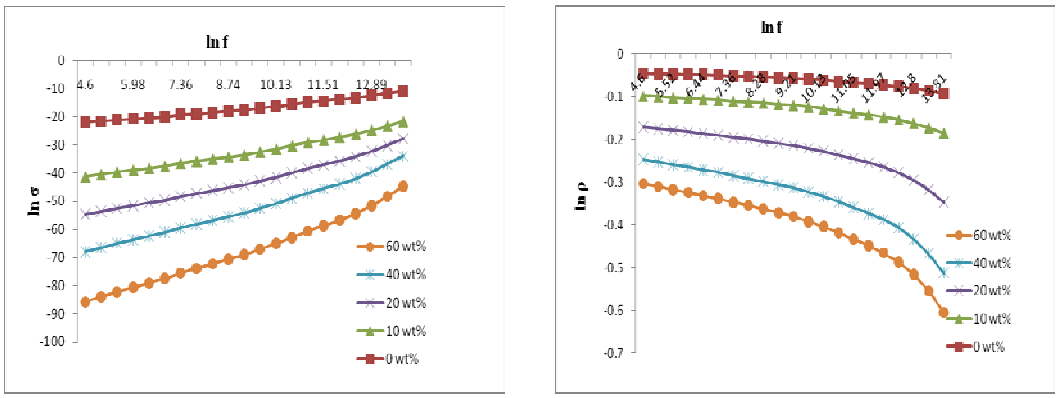

Figure 3: Frequency dependency of (a) A.C conductivity , (b) A.C resistivity at a constant temperature.

4.Conclusion

Electrical and dielctrical properties of the coir dust composite have been studied .The experimental results shows that the values of K and tan δ are strongly depends on the amount of reinforcement,testing temperature and frequency of applied electric field, especially we have noticed that the low frequency and high temperature having the effect is more prominent on dielectric constant and dielectric loss . The resistivity of the material is decreased with increasing frequency and the conductivity of the material is increased with increasing frequency at room temperature.

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