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Study of the Dielectric Properties of (PVA-PVAC-Rice Shell) Composites

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ABSTRACT

In this study, the samples have been prepared by adding rice shell to the poly vinyl alcohol and poly vinyl acetate with different weight percentages (0,5,10,15.20.25.30 and 35) wt%. The A.C electrical properties show that the dielectric constant and dielectric loss of the composites decrease with increasing the frequency of applied electrical field and they increase with the increase of the concentration of the rice shell . The A.C electrical conductivity increases with increasing the concentration of rice shell, increases with the increase frequency, and almost constant at high frequency.

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INTRODUCTION

Over the past two decades, plant fibers have been receiving considerable attention in the automotive, packaging, and construction industries as substitutes for synthetic fiber reinforcements. Unlike the traditional synthetic fibers these lignocellulosic fibers are able to impart certain benefits to the composites such as low density, high stiffness, low cost, renewability, biodegradability and high degree of flexibility during processing [1]. In recent years, natural fiber composites proved of interest for dielectric applications, showing also some potential for future application as dielectric materials in microchips, parts of transformers, and circuit boards [2,3]. The study of electrical properties of natural fiber reinforced polymer also indicates their suitability as insulating materials for special applications such as suspension insulators, bushing, studs, sleeves, gaskets, spacer panels and switch boards [4, 5]. Alongside the emergence of natural fibers there has also been a growing interest in electrically conductive polymer composites. A great deal of work has been performed to make polymers conductive by incorporating conductive fillers. For a given polymer type the electrical properties is determined by the amount and type of conductive additives. The electrical properties increase significantly with increasing water content and ions or ionic sites. Such electrically conductive composite materials are widely being used in the areas of electrostatic discharge dissipation, electro- magnetic interference shielding and various other electronic applications [3.6.7].

The dielectric constant of a material depends upon the polarizability of the molecules. The polarizability of non polar molecules arises from electronic polarization (in which the application of applied electric filed causes a displacement of the electrons relative to the nucleus) and atomic polarization (in which the application of applied electric filed causes a displacement of the atomic nuclei relative to one another). In the case of polar molecules a third factor also comes into play which is orientation polarization (in which the application of applied electric filed causes an orientation of dipoles) [3]. The dielectric properties of natural fibers - polymer composites such as jute, banana, coir, sisal, waste paper, pineapple, flax fibers, oil palm were investigated [5, 8].

Experimental part:

The samples have been prepared by casting method .The materials used in this paper are polyvinyl alcohol(PVA) and polyvinyl acetate (PVAC) as a matrix and rice shell as filler. The polyvinyl alcohol and polyvinyl acetate (30 wt.% polyvinyl acetate, 70 wt.% polyvinyl alcohol) were dissolved in ethanol. The rice shell was add to the polymer matrix by different weight percentages are (0,5,10,15.20.25.30 and 35) wt.% . The dielectric properties of composites were measured using LCR meter in the frequency range 100Hz to 5MHz at room temperature. The dielectric constant, $\acute{\varepsilon}$ can be calculated by using the following equation:

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$$C_p = \frac{\varepsilon' \varepsilon_\circ A}{d} \quad (1)$$

Where: Cp is capacitance, d is sample thickness and A is surface area of the sample, whereas for dielectric loss can be calculated using equation:

$$\tan\delta = \frac{I_p}{I_q} = \frac{\varepsilon''}{\varepsilon'} \quad (2)$$

Where : tanδ is dissipation factor . The AC conductivity **σac** can be calculated by the following equation:

$$\sigma_{a.c} = w\varepsilon''\varepsilon_\circ \quad (3)$$

RESULTS AND DISCUSSIONS

Figure (1) shows the variation of the dielectric constant of (PVA-PVAC-Rice Shell) composites as function of frequency. The figure shows that the dielectric constant is decreased with increasing of frequency which attributed to decrease the space charge polarization [9]. Also, we can see the dielectric constant is increased with increase of rice shell concentration which due to increase the charge carries numbers[10] , as shown in figure(2).

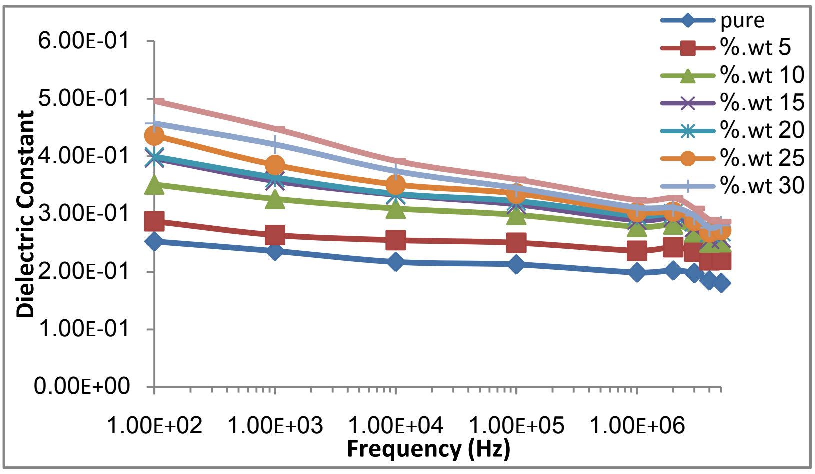

Fig. 1: variation of the dielectric constant of (PVA-PVAC-Rice Shell) composites as function of frequency.

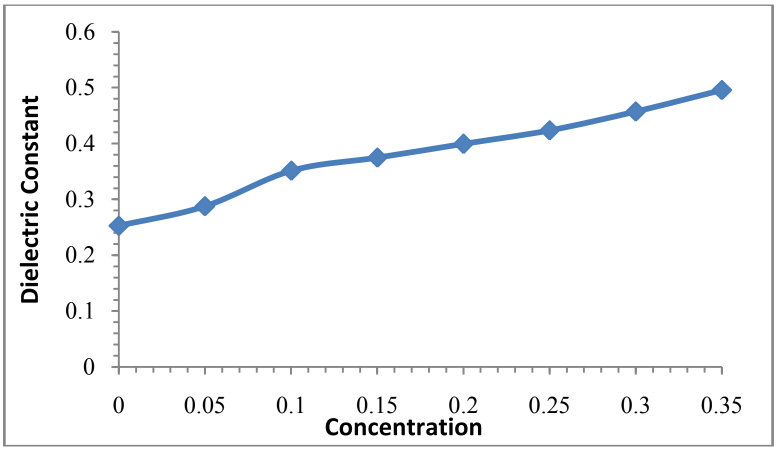

Fig. 2: variation of the dielectric constant with concentration rice shell at 100 Hz for (PVA-PVAC-Rice Shell) composites.

Figure (3) shows the effect of frequency on the dielectric loss of (PVA-PVAC-rice shell) composites for different concentration of rice shell. The dielectric loss is decreases with increasing the frequency which due to decrease the dipoles in composites [11]. The dielectric loss is increased with the increase of the weight percentages of rice shell attributed to increase the numbers of electrons in composites which is increase the electrical conductivity of polymer matrix [10], as shown in figure (4).

figure(5) shows The variation of A.C electrical conductivity of composites as a function of frequency .The A.C electrical conductivity is increased with increase of the frequency which attributed to the electronic polarization and the charge carriers which travel by hopping [11]. The A.C electrical conductivity is increased with increase of the concentration of rice shell, as shown in finger (6), which attributed to increase the numbers of charge carries [12].

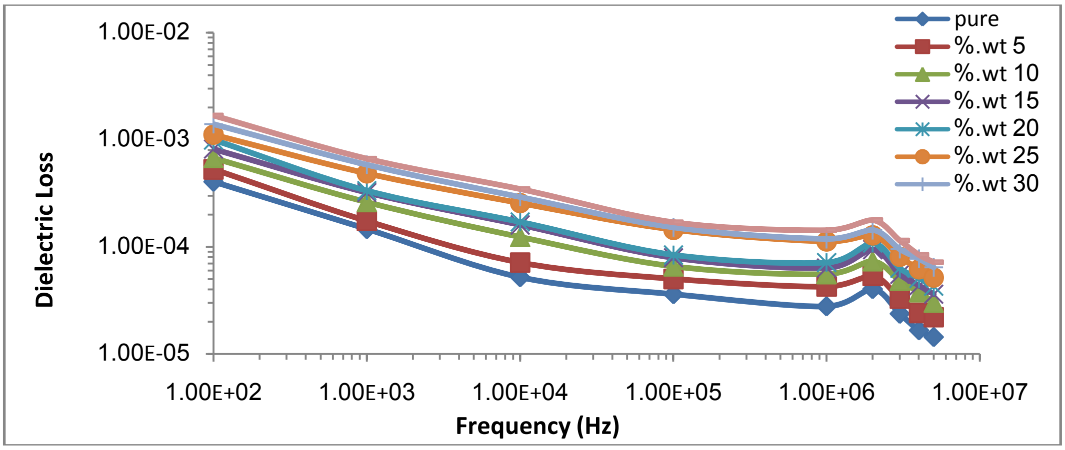

Fig. 3: variation of the dielectric loss of (PVA-PVAC-Rice Shell) composites as function of frequency.

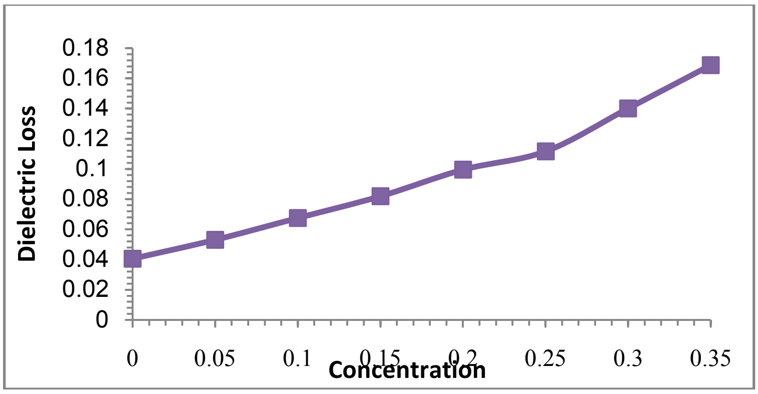

Fig. 4:variation of the dielectric loss with concentration rice shell at 100 Hz for (PVA-PVAC-Rice Shell) composites.

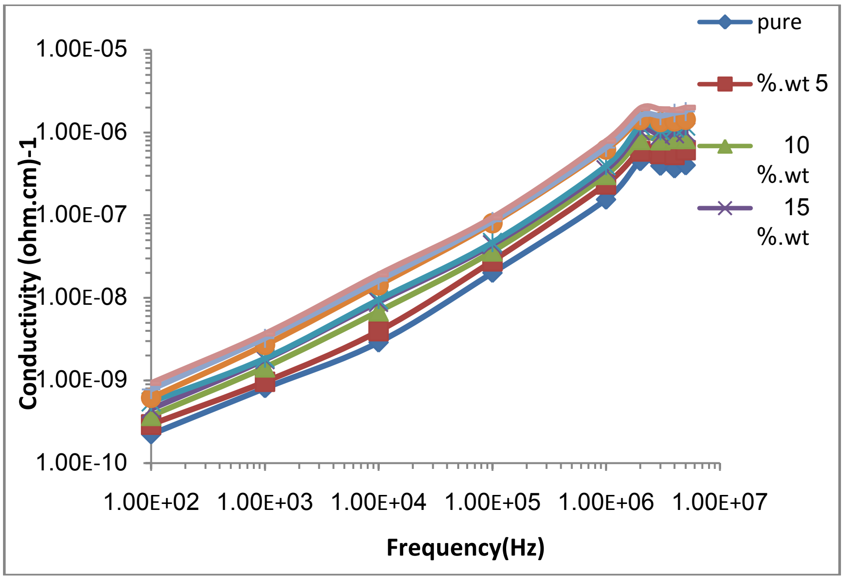

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Fig. 5: variation of the A.C electrical conductivity of (PVA-PVAC-Rice Shell) composites as function of frequency.

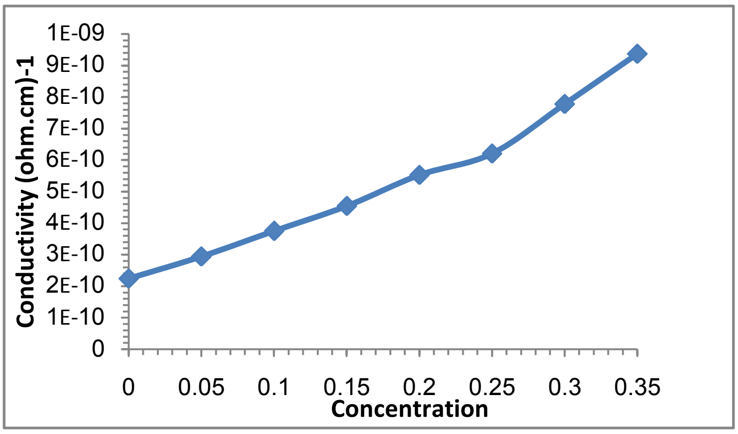

Fig. 6: variation of the A.C electrical conductivity with concentration rice shell at 100 Hz for (PVA-PVAC-Rice Shell) composites.

Conclusions:

1- The A.C electrical conductivity of PVA-PVAC-Rice shell) composites is increasing with increasing of the frequency and concentrations of rice shell.

2- The dielectric loss of (PVA-PVAC-Rice shell) composites decreases with increasing of the frequency and increasing with increasing of the rice shell concentrations.

3- The dielectric constant of composites is decreased with increasing of the frequency and it increases with increasing of the rice shell concentrations.

REFERENCES

[1] Murali, M.R.K., R.K. Mohana and P.A.V. Ratna, 2010. "Fabrication and testing of natural fibre composites: Vakka, sisal, bamboo and banana", Materials and Design, 31: 508-513.

[2] Andrzej, K.B., L. Marta, Abdullah Al Mamun and M. Jsnusz, 2009. "Biological and electrical resistance of acetylated flax fiber reinforced polypropylene composites", BioResources, 4(1): 111-126.

[3] Maya Jacob, K.T., Varughese Sabu Thomas, 2006. "Dielectric characteristics of sisal–oil palm hybrid biofibre reinforced natural rubber biocomposites", J Mater Sci., 41: 5538-5547.

[4] Maya, J.J. and D.A. Rajesh, 2008. "Recent Developments in Chemical Modification and Characterization of Natural Fiber- Reinforced Composites", Polymer Composites, 187-297.

[5] Rafah, A., Nassif, 2010. "Effect of Chemical Treatment on The Some Electrical And Thermal Properties For Unsaturated Polyester Composites Using Banana Fibers", Eng. And Tech. Journal, 28-10.

[6] Klemm, D., B. Philip, T. Heinze, U. Heinze and W. Wagenknecht, 1998. "Text Book of Comprehensive Cellulose Chemistry", Volume Fundamentals and Analytical Methods, Wiley-VCH, Weinheim, 37.

[7] Wang, J.H., G.Z. Liang, H.X. Yan and S.B. He, 2008. "Mechanical and dielectric properties of epoxy/dicyclopentadiene bisphenol cyanate ester/glass fabric composites", EXPRESS Polymer Letters, 2(2): 118-125.

[8] Cabral, H., M. Cisneros, J.M. Kenny, A. Vazquez, C.R. Bernal, 2005. J Compos Mater, 39(1): 51.

[9] Jacghelin, I., Kroschwitz, 1988. "Electrical and Electronic Properties of Polymers", John Wiley and Sons, New York.

[10] Maher, H.R., AL-humairi, 2013. "Study the Optical and Electrical Properties of (PVA-Ag) and (PVA-TiO2) Nanocomposites", M.Sc. thesis ,College of Education for pure sciences, University of Babylon.

[11] Ahmed Hashim, 2012. "Experimental Study of Electrical Properties of (PVA- CoNO3, AgCO3) Composites" ,American Jou. of Sci. Res., 68: 56-61.

[12] Gurland, J., 1982. "Electrical resistivity", J. Polym. Plast. Technol. Eng., 19(1): 21-51.