International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 11
November 2017

Study of Dielectric Properties of Roots of Banyan Tree at Low Frequencies for the Prediction of Seismic Activities

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ABSTRACT

Recent development in electromagnetic wave-assisted processing of biomass materials has significantly created a need for fundamental study to understand the dielectric properties of banyan tree which could give further insight about interaction between electromagnetic energy and biomass. In the present study, dielectric properties of (Ficus benghalensis) banyan tree were investigated using Hi-Tester Meter. The dielectric properties of latex of banyan tree were determined as a function of controlling factors such as electromagnetic wave frequency, biomass moisture content. The results showed that dielectric constant (ε) of latex of banyan trees was decreased with the increasing of frequency. The dielectric loss of Banyan tree was inversely correlated with its moisture content for all directions. We analyze and calculate the dielectric properties of banyan tree of different ages (10yrs, 25yrs, 50yrs and 100yrs). We have taken the latex of all the banyan trees differ in their ages and calculate the Dielectric Constant (ε), Dielectric loss (σ) and Impedance (Ω). We use Hi-Tester meter to calculate the dielectric properties of roots of banyan tree at room temperature and view the effect of dielectric on the latex at the time normal days and during the days of seismic hazards.

***KEY WORDS**: Dielectric constant, Dielectric loss, latex and Seismic hazards.etc.*

INTRODUCTION

The dielectric properties of wood have both theoretical and practical importance. Theoretically, they give a better understanding of the molecular structure of wood and wood-water interactions. The practical applications of the dielectric properties are that the density and moisture content of wood can be determined nondestructively. It has also been reported that knots, spiral grain, and other defects can be detected by measuring dielectric properties (Martin et al. 1987). The utilization of high frequency and electromagnetic wave techniques are also of growing importance for heating, gluing, drying, as well as improving the quality of wood and wood-based products. When wood is placed in an electric field, the current-carrying properties of the wood are governed by certain properties, such as moisture content, density, grain direction, temperature; and by certain components such as cellulose, hemi-cellulose and the lignin of wood. They also vary in an extremely complicated fashion with frequency. The overall effects of these parameters interact with each other and add to the complexities of the dielectric properties. The temperature dependence of wood's dielectric properties has been reported earlier by some workers using a few tropical and temperate wood species (James 1968, 1975, 1977; James and Hamil 1965; Tsutsumi and Watanabe 1965; Nanassy 1964, 1970). The effect of temperature on the dielectric properties at microwave frequencies has also been reported by (Tinga 1969). The mechanism of electromagnetic wave energy on biomass involves the transport of the electrical charges by the ions present in the biomass cell wall and cellulose. Once the electromagnetic wave energy is encountered the biomass, randomly oriented dipoles in dielectric material align themselves in a direction opposite to applied external electric field. The molecules absorb the energy and store as potential energy. This paper deals with variation of dielectric properties such as dielectric constant, dielectric loss, impedance, capacitance of banyan tree (10yrs, 25yrs, 50yrs, 100yrs) at various frequencies.

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MATERIALS AND METHODS

We have collected the latex of banyan trees differ in their ages (10yrs, 25yrs, 50yrs and 100yrs). We took equal volumes of latex in a conical shape vessel and with the help of Hi-Tester Meter we calculate the dielectric constant (ε) and dielectric loss (σ) at low frequencies ranging from (42-100) Hz. The mechanism of electromagnetic wave energy on biomass involves the transport of the electrical charges by the ions present in the biomass of tree. Once the electromagnetic wave is encountered the latex, randomly oriented dipoles in dielectric material align themselves in a direction opposite to applied external electric field. The molecule absorbs the energy and store as potential energy. By the mechanism of ionic conduction and dipole rotation, polar molecules vibrate and produce kinetic energy. Dielectric properties can be studied on the energy that is reflected, transmitted through the surface and absorbed by the materials. Each type of energy is specified with its term. Dielectric constant (ε) is the ability of material to store electric energy was discussed by (S. Ramasamy and B. Moghtaderi, 2010). Dielectric loss (σ) is the ability of material to convert the electromagnetic energy into heat was clearly explained by (A. A. Salema.et. al, 2013).

We use the well known formula for computation of dielectric constant as:

$$£ = \frac{Cp \times d}{£_o \times A}$$

Where: Cp is the capacitive resistance, d is the distance between the electrodes, ε_o is the permittivity of free space and A is the surface area of the sample holder. (Conical shape).

RESULTS AND DISCUSSION

Experiment was performed at frequency from 42 Hz to 100 Hz for investigate the effect of frequency on dielectric properties of latex of banyan tree and the results are shown in Fig.1. It shows the relationship between dielectric constant and frequency for all directions. When frequency was increased from 42 Hz to 100 Hz, dielectric constant was decreased for all of the latex of banyan tree of different ages. The result depicted that electric field of electromagnetic wave affected the interaction of latex of biomass with electromagnetic waves. When the frequency increased, a continuous varying electric field was created. This varying electric field created polarization in latex of banyan tree. Dipole moment in biomass gradually decreased as frequency increased. Therefore, dipole had shorter time to realign itself according to the oscillating electric field was discussed by A. A. Salema.et. al., 2013 and Z. Ahmad 2012. Conductive effect of electromagnetic wave heating also diminished quickly in high frequency was clearly explained by R. Omar et.al, 2011. Hence, dielectric constant which indicated the ability of material to store electric energy decreased. We have shown that the (SES) bio-potential signal with dielectric constant at low frequency signal received by 100 yrs banyan tree. In fig.1 we have clearly seen that the 100 yrs age banyan tree have good frequency response, its dielectric constant was over 700 at 42 Hz which is more in comparison to the other age banyan tree. As we know that when frequency is less than the wavelength is more and vice-versa. It means that 100 yrs banyan tree can store more electric charge in comparison to other age banyan tree and on increasing frequency it becomes low, (less ability to store charge). When the ULF wave’s approaches during the early phase of seismic hazards like earthquake, these waves diminish the latex present in the banyan tree and affect the xylem to phloem concentration of the banyan tree which is constant in long age’s tree and serve as a tool to find the precursory signature of an earthquake.

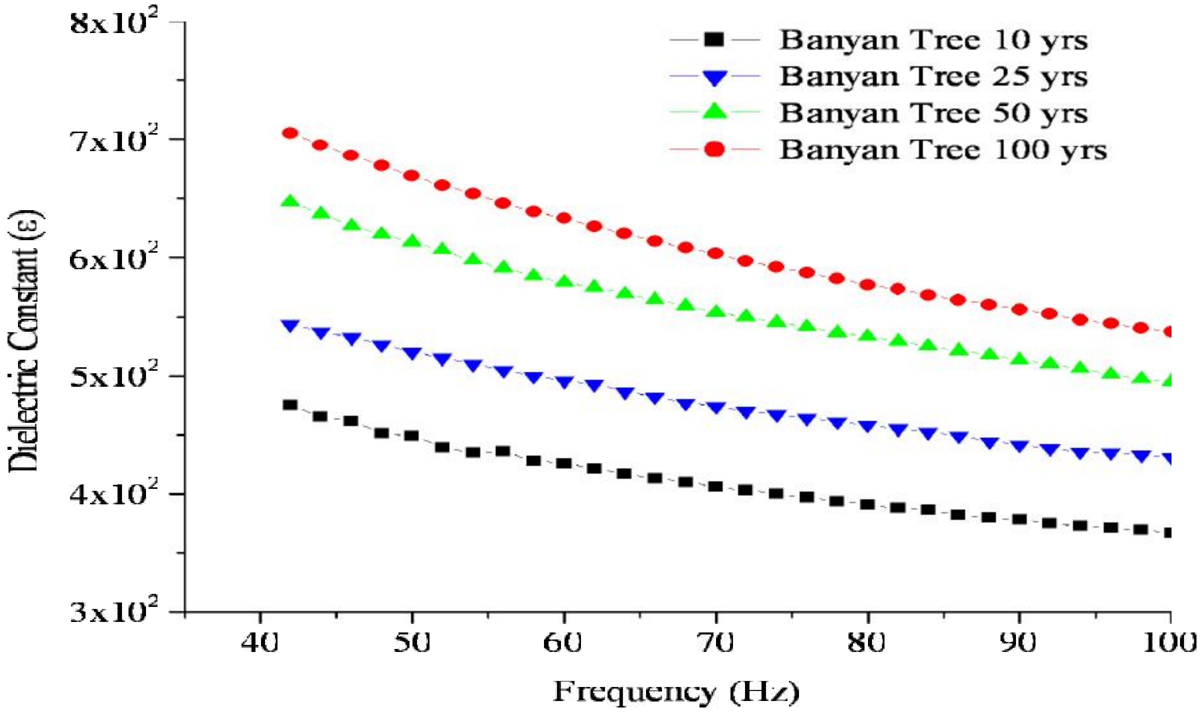

FIGURE1. Showing the effect of Dielectric constant on latex of banyan trees differs in their ages at various frequencies.

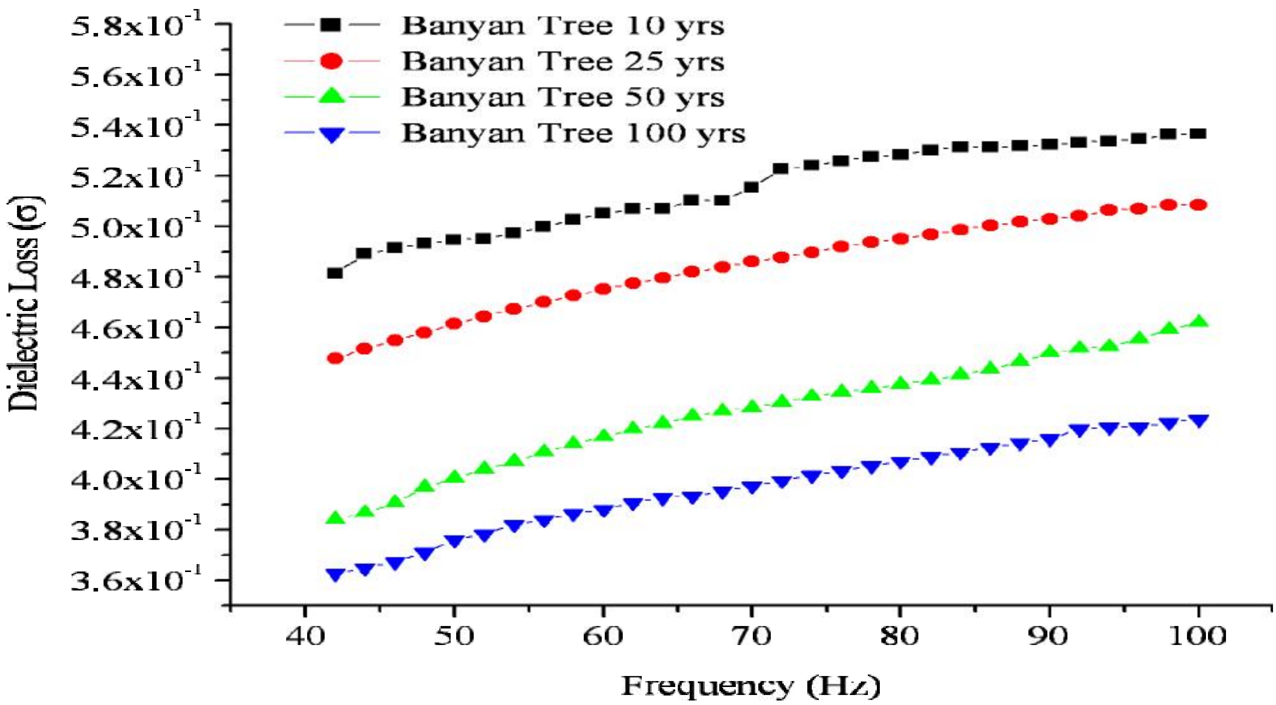

FIGURE2. Dielectric loss of all latex of banyan trees at various frequencies.

Dielectric loss of all latex of banyan trees was increased when the frequency increased from 42 Hz to 100 Hz beyond 100 Hz, the dielectric loss was slightly increased with the increasing of frequency. This dielectric loss trend was observed due to electrical conductivity of latex of banyan trees was different at varying frequency as reported in an earlier study by A. A. Salema et. al., 2013. Dielectric loss is the ability of the material to convert electric energy into heat, during the seismic hazards the energy absorbed by the latex of banyan trees the loss is increased means the signals or the waves received will convert into heat and affect the concentration of xylem to phloem which will helps us in finding the precursory signature of an earthquake. In 100 yrs banyan trees the dielectric loss is increasing rapidly with increasing frequency means the energy converted into heat is more in long ages tree, more heat generated due to high dielectric loss which will affect the tissues of tree roots i.e. xylem and phloem In Fig.2 we see clearly that the 100 yrs banyan tree have highest dielectric loss in comparison to other ages banyan trees. On increasing frequency the dielectric loss was increasing means more absorbed energy is converted into heat and serves as the informative tool for finding the precursory signature of such hazards.

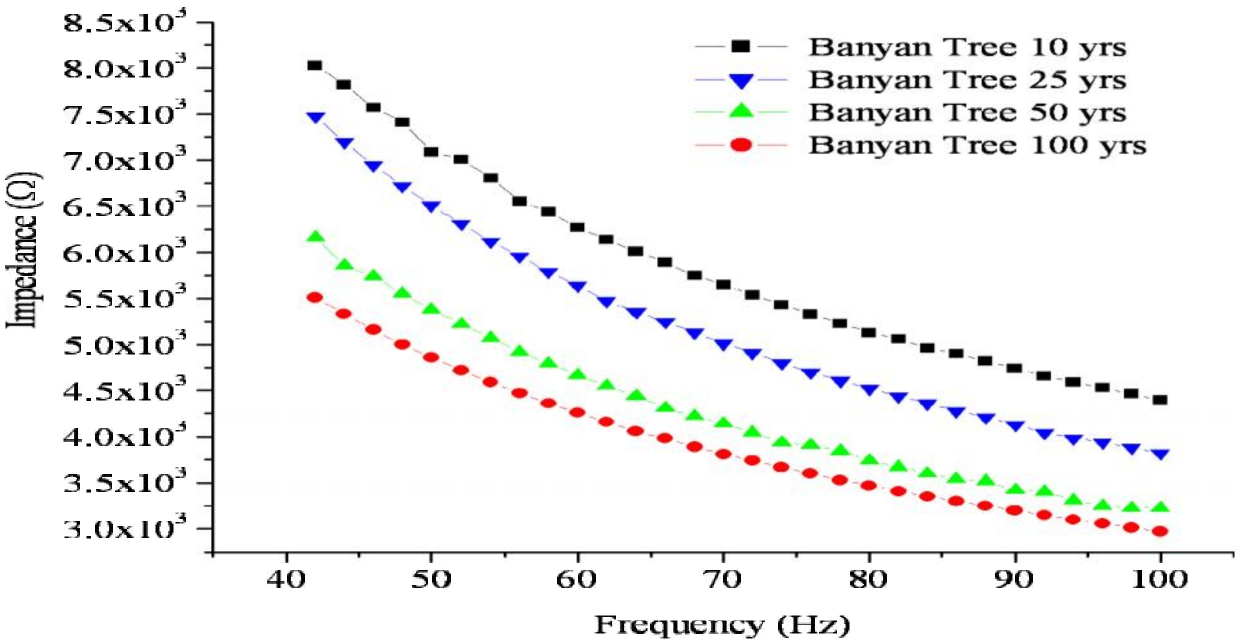

FIGURE3. Showing the effect of Impedance on latex of banyan tree differs in their ages at various frequencies.

In figure 3 we have calculated impedance (Ω) of latex of banyan trees at various frequencies. We have found that the impedance of all the latex was decreasing on increasing the frequency from 40 Hz to 100 Hz. We know that if the impedance of the material is decreasing with the increase in frequency, the value of current is increasing at the same frequency. Tsarev and Sasaki (1999) have reported in model calculation that the electromagnetic signals may be propagated to a long distance (>1000 km) in middle layer crust working as a waveguide. The signal (value of current) generated during the seismic activity will affect the tree and hence by measuring the change in dielectric properties we are in a position to give the correct explanation of any seismic hazard.

CONCLUSION AND INTERPRETATION

We have observed the data of bio-potential recorded by deep rooted banyan tree and analyze the latex characteristics by LCR Hi-Tester Meter and found the mechanism process of signal adopting technique. We compare the Dielectric properties of 100 yrs banyan tree, 50 yrs banyan tree, 25 yrs banyan tree and 10 yrs banyan tree and found that dielectric constant of 100 yrs banyan tree is more in comparison to 50 yrs banyan tree, 25yrs banyan tree and 10 yrs banyan tree. We also compared dielectric Loss of 100 yrs banyan tree, 50 yrs banyan tree, 25 yrs banyan tree and 10 yrs banyan tree and found that dielectric Loss of 100 yrs banyan tree is less in comparison to 50 yrs banyan tree, 25 yrs banyan tree and 10 yrs banyan tree. It means the 100 yrs Banyan tree has more strength to sense the electromagnetic waves originating during and before the indication of any seismic hazards. We know that if the impedance of the material is decreasing with the increase in frequency, the value of current is increasing at the same frequency calculation that the electromagnetic signals may be propagated to a long distance (>1000 km) in middle layer crust working as a waveguide. The signal (value of current) generated during the seismic activity will affect the tree and hence by measuring the change in dielectric properties we are in a position to give the correct explanation of any seismic hazard. Further, in order to know the dielectric properties of latex from banyan tree, we have measure in dielectric properties and studied the responsible mechanism for relaxation at different frequencies. These A.C. relaxation processes in trees liquid is definitely conducted with change in bio-potential of trees under seismic signals properties. The variation of bio-potential of different trees is originated by seismic signals and then affected the bio-potential of latex. This natural disturbance causes the relaxation process increase and produce the change in bio-potential from time to time in order to develop clear understanding of this process. We have conducted the experiment to measure relaxation process by mean of dielectric properties.

Consequently, we can say both the effects are very similar and follow the same type of relaxation process. We conclude that when the higher magnitude signal or high energy signal reach in contact with latex of banyan tree roots. It absorbed the energy and latex is shrinking during the time of precursory signature. We identify the different parameters which is correlated the mechanism of electric properties of materials i.e. similar to human blood which is clearly explained by Gaur et.al, 2007.

ACKNOWLEDGEMENT

The authors are thankful to Ministry of Earth Science, India Meteorological Department, New Delhi for providing a major research Project. We are also thankful to Director of Hindustan College of Science & Technology for supporting the research activities and also thanks for our research department for co-operate the research work.

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