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Study of Microwave Dielectric Charecteristics of Soil in North East Chattisgarh

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ABSTRACT

In the present paper an attempt has been made to study of microwave dielectric characteristics of soil in north east Chhattisgarh. Soil is a heterogeneous mixture of silicate particles, humus, and a variety of insoluble salts and oxides of metals called the solid phase, a liquid phase and a gaseous phase. Organic matter level and structural improvement of soil can be built up, to a varying degree, and maintained by continuous judicious application of manures, even under tropical conditions prevailing in India. It has been found that the dielectric constant of soil is dependent on the soil texture. The dielectric constant of soil is dependent on the porosity and wilting point of soil.

Keywords: Properties, heterogeneous, humus, organic matter, soil, phase.

INTRODUCTION

Soil is the unconsolidated or loose covering of fine rock particles that covers the surface of the earth. The soil water content is most important physical properties of soil. Soil plays pivotal role in agriculture. As a primary motivation to pursue research on the correlation between dielectric properties, physical, chemical properties; it is essential to determine the quality of agricultural products and food materials so as to meet the consumers' expectations that are growing quickly. The dielectric characterization applications in agriculture have been collected along with their techniques and measurements. Indian agriculture occupies an eminent position in global cultivation of rice, wheat, sugarcane, pulses, and vegetables. There are a lot of parameter to affect agriculture product but physical properties, chemical properties, and electrical properties plays pivotal role. Generally **physical properties** are consist of

following points viz :Sand : %,Silt : %,Clay : %,Bulk density : mgm^{-3},Particle density : mgm^{-3}, Maximum water holding capacity : %,Porosity : %,Wilting point : W_p,Field capacity, Transition moisture.: W_t, **Chemical properties:** Ph,E.C. :(dSm^{-1}),Organic carbon: %, Calcium carbonate :%, Available nitrogen: Kg/ha, Available phosphorus : Kg/ha, Available potassium : Kg/ha, Available iron : ppm, Available manganese : ppm, Available zinc : ppm, Available copper : ppm, **Electrical Properties :**Dielectric constant, Dielectric loss, Tangent loss, Relaxation time, Emissivity, Microwave conductivity.

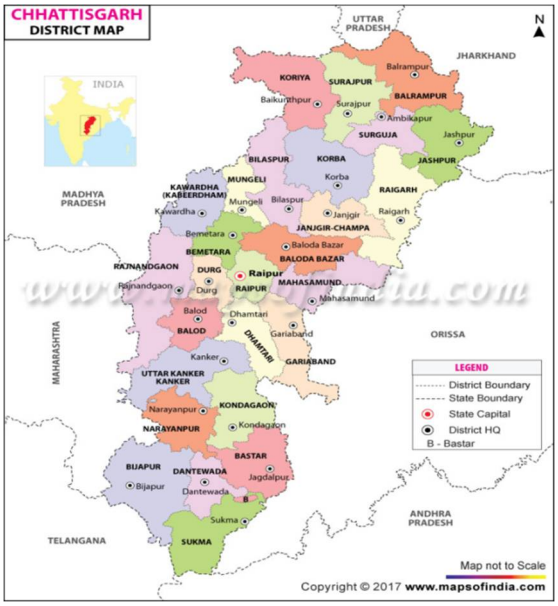
THEORETICAL CONSIDERATION

The dielectric properties of soil are function of its naturally available chemical constituents such as carbon, sodium, potassium, iron, and physical properties such as sand, silt, clay. Soil is a thin layer that covers earth's rocky surface. Soil in an intimate mixture of organic and inorganic materials, water and air. Productive soils are necessary for agriculture to supply the world with sufficient food. Now a day's soil contamination has become a severe environmental problem. It has been seen that soil behavior are affected by physical properties, chemical properties and location. It has been found that dielectric constant increases as moisture content increases at frequency level. The variation of dielectric constant of slightly acidic soil is nonlinear with moisture content. Remote sensing can play a role in the identification, inventory and mapping of soils that are on the surface of the earth. Microwave remote sensing of natural planet earth materials such as soil and water has a very close dependence on their electrical parameters. The most important parameters are the dielectric constant and dielectric loss. The knowledge of dielectric constant loss. The knowledge of dielectric constant and dielectric loss helps in the study of dry and wet contaminated soils using microwave sensor.

Theoretically, dielectric properties of the material depend on the concentration, activity of permanent electric dipole molecules, ionic conduction and degree of dipole alignment with the applied time verging electric field. Therefore, when sample holder is filled with material, the dielectric properties are affected by the composition of the material and temperature, which affects molecular movement. The microwave soil dielectric measurement uses absorption. The microwave soil dielectric measurement uses absorption of microwave energy, corresponding to rotational energy of water molecules. When electromagnetic field is applied to dielectric material, electromagnetic energy is dissipated in dielectric materials as a result of dielectric relaxation process, and the interaction of electromagnetic field depends upon the complex dielectric permittivity relative to the free space. In a non homogeneous medium such as soil the dielectric constant is combination of individual dielectric constant of its physical properties, naturally available macronutrients, micronutrients, minerals, organic and inorganic matter content. Complex dielectric constant has been calculated by following relation:

$\epsilon^* = \epsilon' - j\epsilon''$

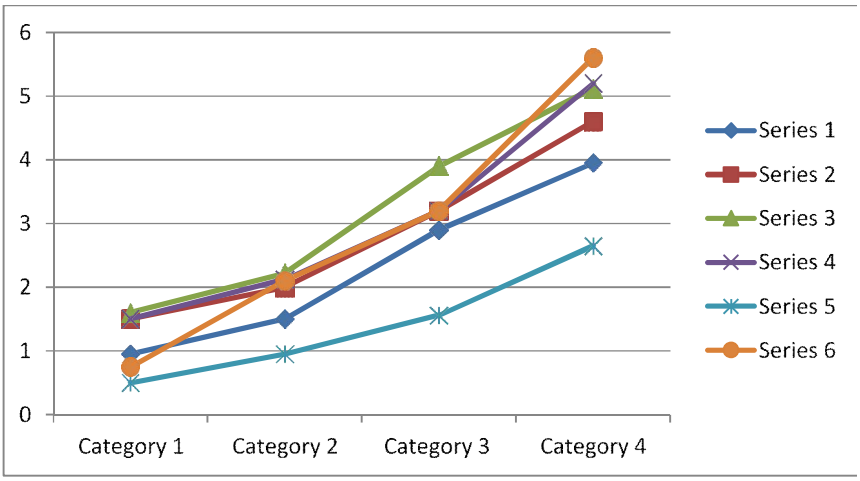
The real part ϵ' is called the dielectric constant and the imaginary part ϵ'' is called the dielectric loss. The dielectric constant describes the ability of a material to store electromagnetic energy, and dielectric loss represents loss of electromagnetic field in the material.



RESULT AND DISCUSION

The dielectric properties of a soil depend on a number of factors including its bulk density, sand, silt, clay, the density of soil particles, the volumetric water content of the soil, the temperature, frequency. It is obvious from the figure that dielectric constant of soil

increases with moisture content. It is found that dielectric constant of the soils increase only slowly with the moisture content initially and after reaching a transition point the permittivity increase rapidly. It is also seem that transition point moisture value (Wt) are higher for soil with high clay content as compared to sandy soils. Emissivity decreases with moisture content of the soil. As moisture content as the soil increases their emissivity values decreases fastly. Emissivity in the very important parameter, which provides information about soil. It has been seen that variation of dialectic constant with increase in moisture contents.



X-axis: moisture content

Y-axis: Dielectric constant

CONCLUSION

Physical and chemical properties show remarkable variation in dielectric properties these dielectric properties can be used to predict the soil fertility and health. Dialectic constant of soil are strongly dependent on soil moisture and soil texture. Moisture is soil significantly affect the dielectric properties of soil. Such study of soil in also useful in microwave remote sensing and agriculture in order to increase its productivity. Physical properties, chemical properties, and electrical properties strongly affect the productivity of agriculture.

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