

The measurement of soil water content on dielectric constant in summer season

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Abstract: The soil water content of soil sample from Shri Kumar swami College AUSA in summer season has been measured by using microwave X- band. The soil water content has been measured at room temperature and fixed frequency at 9 GHz. The water content is measured by the method based on the measurement of dielectric constant of soil. The dielectric constant of water is about 80 and that of most soil material is in between 2 to 5. So that the dielectric constant of moist soil is sensitive measure of the volumetric water content. From the experimental result it is observed that dielectric constant of soil increases with the addition of water content. It has been also observed that the increase in dielectric constant of soil with water content is different for soil sample and its variation is nonlinear.

Introduction:

The measurement of soil water content is fundamental to many agricultural, forestry, hydrological and civil engineering investigations of soils. The requirements vary from the need for occasional determination in the laboratory to continuous field monitoring at several depths. The soil water content is used in widely accepted sense to refer to the water that may be evaporated from soil by heating to between 100 and 110°C until there is no further weight loss. The water is present in soil as water vapor and liquid. In addition water molecules are absorbed on the surface of colloidal materials, particularly clay, and incorporated with hydroxyl groups within clay lattice structure. The water vapor and structural water are disregarded in the conventional definition of soil water content. The structural water is immobilized and is released only upon mineral decomposition, which requires heating to temperature between 400 to 800°C. Absorbed water does have a degree of mobility, which becomes important at low water content and may be exploited by resistance plants. The heating to 110°C is not normally sufficient to remove absorbed water. Water is eliminated from the clay surface at temperature least between 110 to 160°C. The heating is also promotes the oxidation and decomposition of soil organic matter, whereas they occur to some extent to temperature below 110°C, higher temperature enhance it. When dealing with organic soils, some inaccuracy is possible in the traditional determination because part of the weight loss may be due to organic changes. Alternative definition of soil water content should be considered, when working with organic soil content gypsum.[1,2,3,4]

Experimental:

The experimental procedure adopted for measurement of soil water content is the method based on measurement of dielectric constant and loss, i.e. of Roberts and Von Hipp. The dielectric constant and loss of different soil samples are computed by using least square fit technique of Sobhanadri. The apparatus used to measure the dielectric permittivity and loss of soil sample is a X-band microwave bench setup. A microwave signal generator supplies microwave power, i.e. by a Gunn diode or Reflex Klystron oscillator. The signal passes through a cavity frequency meter. As the resonant condition is approached, power is stored in the cavity, and a sharp drop in power passing down the transmission line is observed on the output indicator. The micrometer, which varies the cavity dimensions, may be calibrated to read frequency directly.

The signal continues through flexible X-band waveguide, and through a ferrite isolator, whose magnetic dimension is oriented so as to allow free passage of power only in forward direction but attenuate strongly in reverse direction. The microwave bench set up also consists of a variable calibrated attenuator and a slotted line, i.e. a section of a waveguide with a longitudinal slot along the broader side to accommodate a thin probe to couple the amount of electric field at the location of the probe. The incident wave continues through the solid dielectric cell, through the soil and strikes the short-circuited length of the dielectrics.[5,6,7,8]

The data is recorded with the solid dielectric cell, which is connected to other end of the microwave bench. The microwave source used in this experimental technique is a Gunn diode. Firstly, by energizing the microwave source sufficient output is obtained on the output indicator. Then, tuning of the bench is done so that the probe penetration should be optimum. If insertion of the probe is less then it is difficult to excess it may disturb the standing wave pattern on the guide. After tuning of the bench, the slotted line probe is moved on the slot line, the corresponding distance and the power (current) can be recorded. Fitting the experimental data in least square programmed the dielectric constant and loss can be determined.

Results:**Table 1.1**

Soil Sample: Botanical garden soil (Kumar swami college Ausa) in summer season Variation of dielectric constant of soil sample with increasing volumetric water Content in soil (ml)

Volumetric water content in soil (ml)	Dielectric constant(ϵ')	percentage of water content in soil
0.0	3.2345	10.0000
0.2	3.5634	11.0168
0.4	3.9843	12.3180
0.6	4.4987	13.9084
0.8	4.9876	15.4199
1.0	5.5019	17.0099

Conclusion:

The variations of dielectric constant with water content for soil sample from botanical garden (Shri Kumar swami college Ausa) in summer season are shown in Table 1.1. It is observed that the dielectric constant of soil increases with addition of water content. This is in agreement with the earlier investigation of Topps et al. [9, 10,14].The relation between dielectric constant and volumetric water content is nonlinear. This is because for a composite material such as moist soil, the dielectric constant is not a simple function of the values for the individual components. [13, 15].

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