

# Study on Microwave Free-Space Technique for Moisture Measurement

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This paper describes the study on microwave free-space technique for moisture measurement. The study focuses on the theory and technique using the amplitudes of the transmission and reflection coefficients to determine the moisture in material. Using the result of this study, it is realized to measure the moisture over wide ranges of moisture content and density, and it is possible to apply the result of this study to the on-line measurement.

The first and second chapters describe the background and purpose of this study and the fundamental theory of the microwave free-space technique.

The third chapter describes the moisture measurement method using microwave attenuation. Using the impedance matching technique, the influence of the reflection occurring at the surface of the sample is reduced. The moisture measurement is successfully performed over wide ranges of moisture content and density.

The fourth chapter describes the theory and technique that permit the microwave attenuation measurement to be not affected by the reflection. It is proposed to measure the amplitudes of transmission and reflection coefficients to calculate the attenuation. The measurement using this method is not affected by reflection and it is proved by experiment with sawdust.

The fifth chapter describes the theory and technique on the permittivity determination by measuring the amplitudes of transmission and reflection coefficients. Preparing the sample with such large attenuation that the influence of the multiple reflections between the two surfaces of the sample can be neglected, the permittivity can be calculated uniquely from the measurement values. This theory is verified by experiments using sawdust and green tea.

The sixth chapter describes the study on the density dependence of permittivity and density-independent moisture measurement. According to the study on the density dependence of permittivity, a moisture function independent of the density can be obtained. Using this function, the moisture content can be determined independently of the density. The validity of this method is verified by an accurate measurement result using green tea.

The seventh chapter is the conclusion of this study.