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Nondestructive and noncontact dielectric measurement methods for transformer oil using free-space microwave measurement system in 19 25 GHz frequency range

ABSTRACT

Nondestructive, noncontact and real time evaluation of dielectric properties of low-loss liquids are important for applications such as service-aged transformer oil, biomedical, remote sensing and design of radar absorbing material. Free-space methods were developed to measure dielectric properties of low-loss liquids at microwave frequencies. Metal-back method was developed for Freespace Microwave Measurement system (FSMM). The purpose of this research is to measure the dielectric properties of transformer oil by using free-space microwave measurement system between 18 – 26 GHz (K-band), to compare measured results with published results for transformer oil and to collect the variation values of dielectric properties in microwave frequency between 18GHz to 26GHz (k-band). FSMM system consists of spot focusing horn lens antennas, mode transitions, coaxial cables and vector network analyzer (VNA). Dielectric constants and loss factors were measured for new transformer oil and all results close agreed with published data. It is observed that metalback method is suitable for dielectric measurement of transformer oil.

Keyword: Nondestructive; Noncontact; Metal back; Horn antennas; Coaxial; Microwave; Transformer oil