



Dielectric Properties of EVA Rubber Composites at Microwave Frequencies Theory, Instrumentation and Measurements

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ABSTRACT

This work describes and evaluates a technique for determining the dielectric properties of carbon-black filled Ethylene Vinyl Acetate (EVA) rubber and presents results on the studies of the effect of frequency on the permittivity and microwave conductivity using resonant cavity perturbation method. The measurements are performed with the aid of a Network Analyzer in X-band. The simplicity of this method lies in the fact that the dielectric properties can be obtained directly from the analytical formula without taking recourse to calibration.

KEYWORDS: EVA Polymer, Dielectric Properties, Microwave Frequencies, X-Band, Cavity Perturbation Method.

INTRODUCTION

The dielectric constant (ϵ_r') is the ratio of the capacity of an electric capacitor filled with the substance to that of the same capacitor in vacuum, at a definite external field frequency. Dielectric loss is associated to the part of the energy of an electric field that is dissipated irrecoverably as heat in the dielectric. A molecule possesses a constant dipole moment if the centers of gravity of its positive and negative charges are displaced relatively to each other. In an electric field the dipole molecules orient themselves predominantly in the direction of the field and the total electric moment of all the dipoles differs from zero, resulting in what is known as an orientation moment. The time needed for orientation depends on temperature, which determines the intensity of molecular moment. With increasing temperature the mobility of the molecule increases, and therefore orientation of the polar molecules in the direction of external electric field is faster [Tager, 1978]. In a temperature frequency range there is a phase shift between the voltage applied at any given instant and the orientation moment, or more precisely the electric displacement vector, as the result of which the moment lags somewhat behind the applied voltage. This phase shift is a result of dissipation of part of the energy as heat. It is customary to characterize phase shift by the angle δ . Since the energy dissipated per unit volume of dielectric as heat (dielectric loss) is proportional to the field frequency and to $\tan \delta$, the angle δ is usually called the loss angle. Besides $\tan \delta$, dielectric loss is characterized