QuadTech

Application Note

Measuring the Dielectric Constant of PVC Compounds

Customer Inquiry

One of QuadTech's customers is a manufacturer of PVC compounds, most of which is used by cable manufacturers in the telecommunication industry. An important part of the production process is to ensure that the makeup of the pellets from batch to batch consistently meets customer requirements, which is best done by monitoring the dielectric constant of the material.

QuadTech Solution

One measure of the quality of PVC compound is the surface resistivity. The surface resistivity of the PVC is a measure of the intensity of the current flowing over the sample surface. A voltage is applied to the surface of the PVC sample through two electrodes. The smaller the surface resistivity, the better the antistatic properties of the PVC. Figure 1 illustrates a test circuit for measuring the surface and volume resistivity of a plastic sample. Refer to ASTM D257 for a detailed test method & circuits for measuring DC resistance of insulating materials.

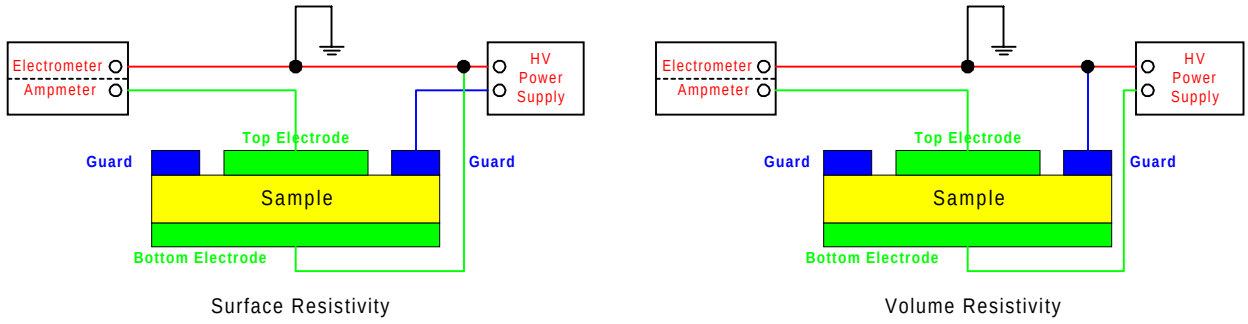

Figure 1: Surface & Volume Resistivity

This particular PVC manufacturer had previously been using a volume resistivity meter, which was insensitive to material changes and thus provided less than adequate information on the material. The 7400 Precision LCR Meter and a dielectric cell have been introduced into this process as a QC tool for monitoring the dielectric constant during manufacturing of the PVC.

Measurement Procedure

A sample of PVC pellets is selected from a production batch and compressed into test slabs 75 mm in thickness. The sample is tested using a dielectric cell as illustrated. The dielectric cell is a test fixture consisting of two parallel plates (with adjustable spacing) between which a material sample (PVC) can be installed for measurement of electrical properties. The measurement parameter of interest is capacitance. The value of C is used to calculate a dielectric constant as reference for ongoing monitoring of the material during the manufacturing process.

What's that look like?

The dielectric constant (k) of the material is a key electro-physical characteristic in determining the fitness of the PVC pellets for specific applications.

$$\text{Dielectric Constant} = \frac{Cx}{Ca}$$

Cx is the capacitance of the PVC sample and Ca the capacitance of air using the same plate spacing. Currently, this company has standardized their test at a frequency of 1kHz while continuing to study measurement results at other frequencies. Figure 2 illustrates the connection of the 7400 Precision LCR Meter to the Dielectric Cell. The PVC pellet test slab is mounted between the plates of the dielectric cell.

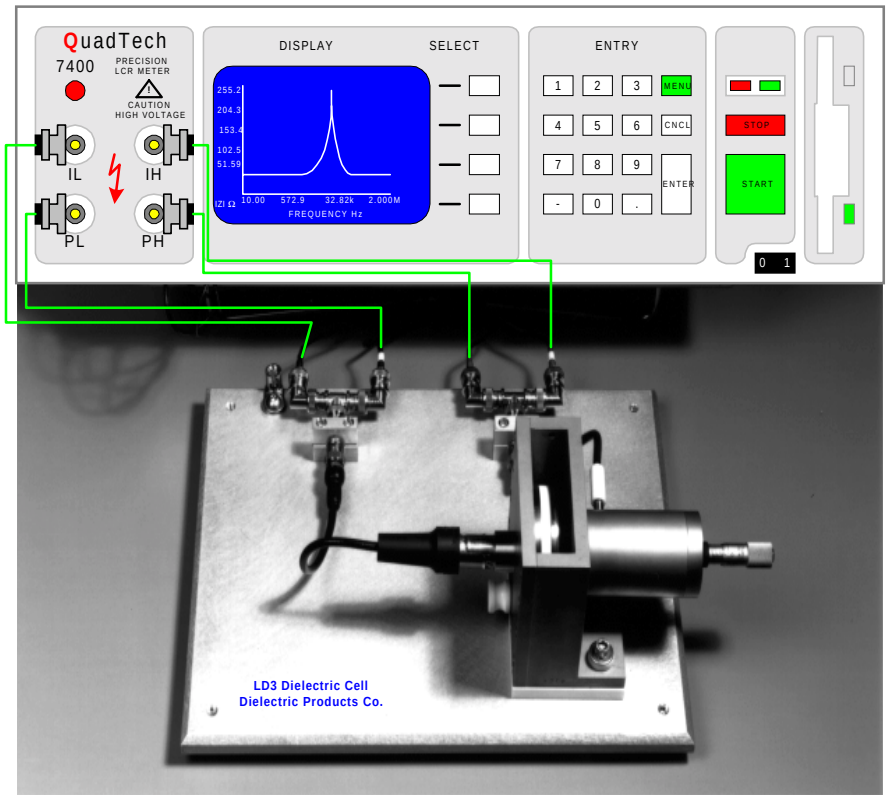

Figure 2: 7400 Precision LCR Meter connected to Dielectric Cell

This manufacturer purchased the 7400 primarily as a quality control tool for monitoring the manufacturing process of PVC compounds based on the dielectric constant. After some experience using the instrument, it appears that the feature most likely to reap new benefits for them is the sweep capability of the instrument. This sweep capability allows the manufacturer to study samples over wider frequency ranges.

For complete product specifications on the 7000 Series Precision LCR meters or any of QuadTech's products, visit us at http://www.quadtech.com/products. Call us at 1-800-253-1230 or email your questions to info@quadtech.com.

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