QuadTech

Application Note

Measuring Electrical Properties of Copier/Printer Toners

One of QuadTech's customers is a manufacturer of toner used in a wide variety of copiers and printers. An important part of the production process is to ensure that the electrical properties from batch to batch remain consistent. This manufacturer has been quite successful in maintaining process control using a QuadTech 1689 Digibridge for measuring the capacitance and dissipation factor of production samples. However, the 7400 Precision LCR Meter has now been introduced into this manufacturer's production line as a QC tool and in process refinement as an R&D tool.

Toner, an electrically charged powder, consists of two main ingredients: pigment and plastic. The pigment provides the color and the plastic particles bind the copied image to the paper when exposed to heat. Toner particles are approximately 5-10 micrometers in diameter and have tightly controlled electrostatic properties. Toner particles are mixed with magnetized particles and become charged. The charged toner adheres to the image due to the electric field produced by the opposite charge pattern of the image. For a full explanation on how a photocopier works, visit Scientific American. Black & white toner consists of black pigment. Color toner consists of cyan, magenta, yellow and black pigment.

Toner cartridges come in different shapes, sizes and composition (ink or powder). No matter what the size or shape of the cartridge, the toner powder is still made up of pigment and plastic. And it's that ability of the toner compound to hold a charge that makes the process of photocopying work: charge – expose – develop – transfer – and finally fuse the image to the paper. Figure 1 illustrates this process and the chemical makeup of 4 toner cartridges.

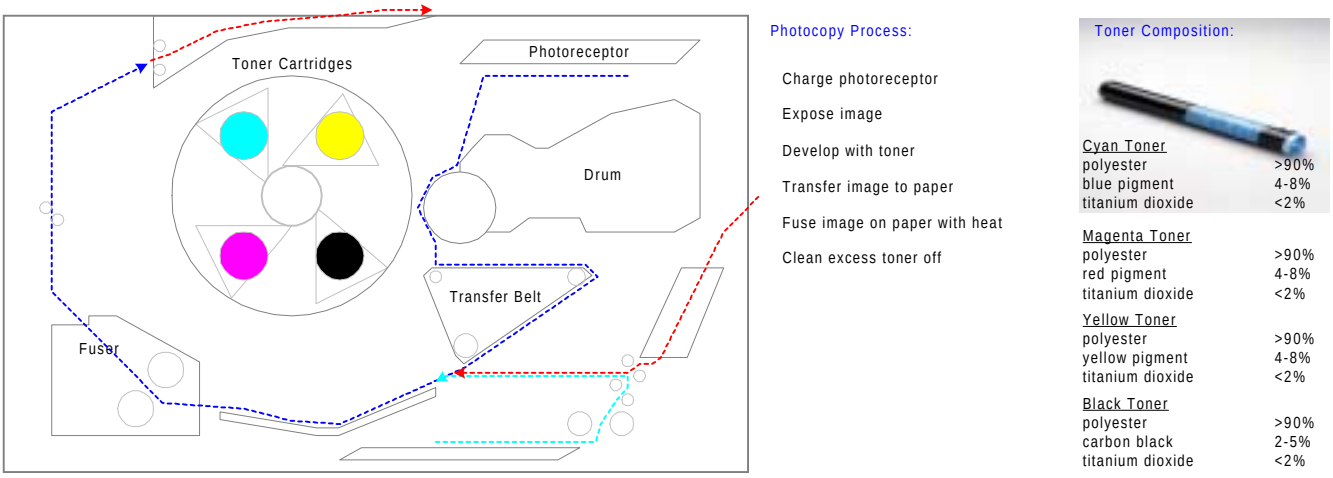

Figure 1: Photocopy Process & Toner Composition

Measurement Procedure

Manufacturer's Measurement Procedure

To check the toner a powder sample from a production batch is selected and then compressed into a hard disk sample, 1 1/2 to 2 1/2 inches in diameter and about 3mm in thickness. In this particular application the sample is tested using a dielectric cell as illustrated in Figure 2. In simplest terms a dielectric cell can be thought of as a test fixture consisting of two parallel plates (with adjustable spacing) between which a material can be installed for measurement of electrical properties.

Figure 2: 7000 Series Precision LCR Meter connected to a Dielectric Cell

The measurement parameters of interest are C and D. The C measurement is used to calculate a dielectric constant or K factor and the D measurement is used directly for sample comparisons. The dielectric constant or K factor is defined as:

$$K = \frac{Cx}{Ca}$$

Cx is the capacitance of the toner sample and Ca the capacitance of air using the same plate spacing. Currently, this manufacturer has standardized their test at a frequency of 1kHz while studying measurement results at other frequencies.

It should be noted that often the D and K factors values may not be that meaningful, but what's most important and the main reason for making these measurements, is a uniform comparison of these numbers between different batches of mix or comparison to a known or "standard" sample of toner.

This toner manufacturer purchased the 7400 for two primary reasons, first as a backup system to the existing monitoring process and secondly, but more importantly for the wide frequency capability so they can study measurement samples over wider frequencies ranges which they believe will eventually lead to better process control, increased efficiency, and superior product.

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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