



Questioned Documents Section – 2008

J16 The Correlation of Photoreceptor Defects to Electrophotographic (Toner Based) Documents

Tobin A. Tanaka, BSc, Canada Border Services Agency, 79 Bentley Avenue, Ottawa, Ontario K2E 6T7, CANADA*

The goal of this presentation is to offer an overview of equipment not previously used for the purpose of forensic document examination.

The widespread use of low cost laser printers and multi-function devices utilizing toner has increased the volumes of documents produced by an electrophotographic (EP) process. Of these documents questions regarding the device that produced them arise. Common questions include whether or not questioned documents were printed by a suspect printer or copied by a multi-function device which can perform scan, copy, print and fax functions. In order to answer such questions the forensic examination of the components in a suspect EP device may be required.

Traditionally such examinations were limited to forensic work that could be done with; the optical comparison of specimen test prints made from the device and/or from test prints from different time periods, and the chemical analysis of the toner with its related constituent materials.

Examination of the questioned documents may disclose the presence of individual defects commonly referred to as "trash marks". Some of these marks may be observed to have a periodic pattern on the page. It is known that individual identifying features in the components of the EP device such as the photoreceptor, transfer roller, and the related roller components causes these periodic marks. Of these components the defects on the photoreceptor are probably the easiest to view and correlate as repeating defects on the printed page. When the coating of the photoreceptive material has worn down to the underlying metallic surface a repeating spot of toner that is not part of the image to be copied/printed appears on the document. Although direct physical examination of the photoreceptor may reveal the larger defects by visual inspection the electrical properties of the photoreceptor cannot be determined in this manner.

Automated equipment for testing the electrical properties of photoreceptors in the electrophotographic industry has been in use since the mid 1990s. The focus of such testing has been for the quality control of photoreceptors, in particular the recycling/refill industry where used photoreceptors get recoated with photoreceptive materials. The potential use of such equipment in forensic document examination has several benefits:

- (1) the quantification of the overall voltage properties of the photoreceptor,
- (2) the detection of small scale defects sometimes referred to as "pinhole" defects on the photoreceptor surface not visible to the unaided eye, and
- (3) the possibility of detection of non-homogeneous voltage distributions on the photoreceptor allowing for the possible correlation to the production of a questioned document having a similar non-homogeneous deposition of toner.

In this feasibility study points (1) and (2) described above were addressed.

Different printed pages were made on the same laser printer but with different cartridges (photoreceptors). After the documents were printed the cartridges were disassembled and the photoreceptors tested for their electrical properties in order to locate defective areas. Defective areas on the photoreceptor where the photoreceptive material was worn right to the supporting roller will not retain charge and will print onto the document a repeating "trash mark". The shape of such "trash marks" is dependent on the shape of the photoreceptor defect that may be individual features. Additional individual features may also be present in the geometric patterns that multiple "trash marks" will have with each other. The location of such defective areas on the photoreceptors was visualized by plotting the voltage data for the entire circumference and length of the photoreceptor. These defective areas were then compared to individual defects on the printed pages to determine whether a correlation between them was possible.

Document Examination, Electrophotography, Laser Printer