J12 Investigating the Interlaboratory Reproducibility of Magnetic Flux Measurements of Toners

Carrie Polston, BA, Sam Houston State University, Huntsville, TX 77341; Williams Mazzella, PhD, University of Lausanne, Lausanne-Dorigny, 0 CH-1015, SWITZERLAND; Patrick Buzzini, PhD, Sam Houston State University, Huntsville, TX 77340*

Learning Overview: After attending this presentation, attendees will better understand the potential for use of a quantitative magnetic flux measuring device to differentiate between black and white toner-printed documents from different sources. Attendees will gain an understanding of the magnetic characteristics exhibited by toner-printed documents and how to employ magnetic flux measurement techniques during comparative examinations between questioned and reference printed texts.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a method for rapidly screening black and white toner-printed documents, offering the opportunity to evaluate the subsequent need for more time-consuming or destructive methods.

This study was conducted to address questions raised by previous research into the magnetic properties of toner and the use of magnetic flux measurement devices. Specifically, this research addresses questions related to the reproducibility of numeric magnetic flux measurement results between different analysts from different laboratories using similar instrumentation. The hypotheses advanced were that the difference in magnetic flux measurement values produced by different devices is not significant, or alternatively significant, when applied to the same sample.

To test the hypothesis of interest, samples were prepared that contained a standardized test site with a grid of squares of known area and controlled properties to minimize the chance of hysteresis and other induction current spatial effects. The study sample set consisted of three toner samples for each participating laboratory as well as a standardized negative quality control sample. These samples were analyzed by the issuing laboratory and three participating laboratories using a standardized methodology guide optimized to control for hysteresis and to minimize operator-introduced random error. Following this methodology guide, each laboratory conducted testing on positive and negative quality control samples at instrument startup before collecting 28 replicate measurements on each toner sample. The toner samples were measured by the originating laboratory prior to issuance to the participating labs to facilitate the direct comparison with the results of the participating laboratories. The values obtained for each toner sample by each participating lab were then compared with the values obtained for that same sample by the issuing lab via a paired *t*-test to check for significant variation in the results before and after performing comparisons between the results of all of the laboratories and using Analysis Of Variance (ANOVA).

It was found that there was a significant difference in magnetic flux measurement capability between similar devices, and the values produced for the same sample were significantly different. Some of the participating laboratories were not initially able to follow the standardized methodology guide when it was presented, as the software and sensor versions for their instruments were significantly different and not originally set to conduct the requested measurements. These investigations have found differences in the instrument serial number to be a significant source of variability in magnetic flux measurement data. For effective implementation of magnetic flux measurements in forensic laboratory settings, it is advisable to ensure that measurements are conducted using the same device when their numeric results will be the basis for comparisons. Numeric measurements of the magnetic flux of toners can be of value for questioned document examiners due to their non-destructive nature and their rapid collection; however, it is important to ensure that the methodology used controls for sources of variation, including differences in the device and software design.

Questioned Documents, Toner, Magnetic Flux

*Presenting Author