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The Analysis of Printer Ink Over Time Using Infrared Spectroscopy

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SURF was an unforgettable experience that has taught me lifelong skills that I am very grateful for. The goal of my project was to investigate how printer ink ages over time on different types of paper and when exposed to different environmental conditions. The overall goal was to determine if there is an evident change in the chemical compounds within printer ink over time to create a timeline for dating documents. Past research conducted on printer ink focused on other aspects of the analysis. For example, Braz et al. analyzed how to connect a document back to the printer itself through the use of Raman spectroscopy to analyze the chemical makeup of the ink, but no aging studies had been conducted. To investigate the aging of printer ink over time, Infrared Spectroscopy was utilized because it is an easy, fast and non-destructive method that provides information about the bonds in a chemical sample. The percent transmittance from an infrared spectrum corresponds to the light absorbance by bonds within a sample and can indicate chemical changes when monitored. The ink samples were prepared by printing bullet points consecutively onto different types of paper. To analyze the ink, three bullet points were cut out and individually ran three times each at nine different time points over forty days using Infrared Spectroscopy. Five peaks from the spectra that corresponded to bonds in the ink were chosen to monitor for all paper types. The percent transmittances of the respective peaks were plotted against time and compared for each paper type.

We believed that the chemical components of the ink would change over time as the ink aged, which was observed in the form of changing percent transmittance values that correspond to bond in the ink. One of the most evident changes was between days one and five, during which the percent transmittances for all peaks of all the papers increased very quickly, likely due to the solvent evaporating. As for the rest of the time points, the percent transmittances all followed the same pattern of increasing and decreasing slightly, likely caused by the breaking of bonds as the ink decomposed. It was also observed that the percent transmittances of the ink peaks on paper aged in direct sunlight were higher than those aged on a lab bench. We speculate that the difference is due to sunlight breaking the ink compounds down at an increased rate. In the future, I would hope to expand upon the realm of this project by investigating shorter time points to fill in the "gaps" from this project. Also, it would be useful to use other analytical methods, such as mass spectrometry and Raman spectroscopy, to further investigate exactly what is happening to the ink over time. These techniques could provide further insight into exactly what chemical compounds in the ink are changing, assisting in the formation of a timeline to date documents.

Works Cited

Braz, A., López-López, M., Montalvo, G., & Ruiz, C. G. (2014). Forensic discrimination of inkjet-printed lines by Raman spectroscopy and surface-enhanced Raman spectroscopy. Australian Journal of Forensic Sciences, 47(4), 411-420. doi:10.1080/00450618.2014.982179