



Questioned Documents Section – 2010

J10 The Quantitative Analysis of Ballpoint Pen Inks Solvents on Paper

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After attending this presentation, attendees will learn ink dating methodologies.

This presentation will impact the forensic community by alerting them to new changes in ink dating methodology.

In the field of forensic document examination, forensic ink chemists face the task of classification and discrimination between the different brands of inks and accurate dating of ink entries. For characteristic profiles of inks, non-destructive methods such as physical and optical, as well as microscopic and spectroscopic techniques, are primarily applied. These methods provide color, infrared reflectance, luminescence, absorption of radiation, and Raman scattering characterization. But it is necessary to determine sample kinds and components using chemical methods. Chemical examinations of an ink used are the solubility test, thin-layer chromatography (TLC), ultraviolet fluorescence, high-pressure liquid chromatography (HPLC), and gas chromatography/mass spectrometry (GC/MS). Forensic document examiners have been focusing on the aging processes of the components in ink such as dyes (colorants), solvents (vehicles), and resins. Aging processes have been recently influenced by environmental conditions and effective abstraction of ink components. Ballpoint pen inks are mainly composed of dye, organic solvents, resin, and additives. Among these components, organic solvents are 50-95% by weight based on the weight of the ink such as benzyl alcohol, phenoxyethanol, phenoxyethoxyethanol, ethoxyethoxyethanol, 2-ethylhexanol, *N*-methylpyrrolidone, dipropylene glycol, propylene glycol, monophenyl ether, polyoxypropyltrial, triethylene glycol mono butyl ether, triethylene glycol monoethyl ether, 1-octanol, and/or 2-octanol.

The aim of this study was to investigate the aging process of ballpoint pen inks, determined by the disappearance of solvents from the stroke after deposition on paper. The components present in black ballpoint pen by GC-FID were evaluated. Examinations were performed for fifty-nine samples of black ballpoint pen with various brands and manufacturers, commonly available in South Korea. Ballpoint pen entries drawn on office copy paper (80 g/cm²) with a writing force of 300 - 400 kgf using load cell with a ruler and stored at room condition (darkness, 25, 50 % relative humidity). Small paper disks were cut from ink entries with a micro-punch (plug size about 0.5 mm in diameter). To determine calibration curves, reference solvents were pure ethoxyethoxyethanol, 2-phenoxy ethanol and dipropylene glycol and etc. Extraction of solvents from ink entries was made using dichloromethane. Changes in quantity of solvent were investigated for entries over 1-year-old. It was detected that in some ink a significant decrease of solvent was noticed within several hours and up to several months. This research could aid the forensic document field by providing an alternative to current ink analysis techniques

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