



### **A72 Analysis of Pigmented Inks by Pyrolysis Gas Chromatography - Mass Spectrometry**

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After attending this presentation, attendees will understand the nature of pigmented inks, their role in criminal activity, and how pyrolysis gas chromatography can be used to differentiate pigmented inks by manufacturer and type.

This presentation will impact the forensic community by showing how pigmented inks on questioned documents can be analyzed and by providing a new analytical tool in questioned document analysis.

Personal computers and associated printers are used in a variety of crimes today. These include counterfeiting (money and identification documents such as drivers licenses, passports, and birth certificates), child pornography, threatening letters (including chemical and biological threatening hoax letters), financial contracts, wills, and criminal record keeping (drug dealers and terrorists). Many of these have increased greatly owing to heightened terrorism activities. Because of all of this illegal activity it becomes increasingly important for law enforcement and antiterrorism agents to have the most modern tools for combating these threats. These tools include state of the art capabilities in forensic science laboratories for characterizing and associating items of physical and scientific evidence. As the examples above show, the analysis of inks used in writing instruments and computer printers is of paramount importance.

Pigmented inks are among the most popular inks used in ink jet printers today. They have also been extensively used in some types of writing instruments including certain gel pens. Ink jet printers are inexpensive and produce high quality photographs as well as documents. They are the most popular printers used today on personal computers in homes and offices. As a result, documents and photos produced by these printers are becoming common types of evidence in cases involving document fraud including photos, art works and other documents. Pigmented inks consist of tiny particles of colorant suspended in a vehicle (solvent plus additives), which are then sprayed onto a paper surface. Almost no research has been done to characterize pigmented inks in a systematic way. In this research a battery of instrumental techniques will be used to characterize these inks. The techniques will include pyrolysis gas chromatography/mass spectrometry, matrix assisted laser desorption mass spectrometry, thermogravimetry and differential scanning calorimetry. A collection of 150-200 specimens provided by the US Secret Service Laboratory (who suggested part of the proposed research) will be used in this research. These techniques will also be used to explore how solvent content in the ink on a paper plug can be used to determine the age of the ink. A website will be developed that will make the searchable library and all of the mass spectral and thermal data available to the forensic science community. Pigmented inks solubility in water and organic solvents makes them difficult to analyze using routine methods. These inks are resistant to water and mechanical abrasion and tend to fade more slowly than dye-based inks. For all these reasons pigmented inks are in great demand and are being used frequently in inkjet printers and gel pens. This popularity has resulted in writing instruments using pigmented inks to show up as evidence in questioned documents cases. Pyrolysis-gas chromatography-mass spectrometry (py-GC/MS) is an analytical technique that allows the analysis of insoluble, non-volatile solid materials that are difficult to analyze by routine methods such as thin layer chromatography (TLC). The problem addressed here is whether or not py-GC/MS could be used to distinguish among various specimens of pigmented inks on paper. Ninety-three pigmented inks have been analyzed by py-GC/MS. The resulting chromatograms were analyzed applying multivariate chemometrics. After pretreatment, hierarchical clustering analysis, principal components, and discriminant analysis were applied. These techniques were used successively so that an objective and reproducible discriminant model was calculated in the final step.

#### **Pigmented Inks, Questioned Documents, Pyrolysis Gas Chromatography**