B98 Differentiation of Gel Pen Inks by Thin Layer Chromatography, Fourier Transform Infrared Spectroscopy, and Energy Dispersive X-Ray Spectrometry

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The goals of this presentation are to illustrate an examination methodology for the differentiation of gel inks.

The analysis of writing inks has been an integral part of the field of Questioned Document examination for many years. Early attempts to differentiate writing inks relied upon either physical methods such as microscopic examination or the use of filters and various light sources, or the use of chemical spot tests, requiring application of the appropriate chemicals directly to the document. In the early 1970's extensive work was done by governmental laboratories in both the U.S. and Switzerland in the use of thin layer chromatography as a method to differentiate writing inks. These studies led to the approval of 2 ASTM standards for the examination of commonly found writing inks for the purpose of either differentiation or identification by comparison with a standard collection of ink formulations. In the late 1980's, a new class of writing inks was introduced: gel inks. These inks were applied to the paper surface by a ball mechanism similar to ballpoint pens, but the ink was not the "oil" based ink commonly found in ballpoint pens. Gel ink is a mixture of colorant, dyes, or pigments, and water based gel or carrier. Due to these differences, water gel vs. solvent and containing pigments and dyes vs. dyes alone, a different examination methodology is required to differentiate adequately gel inks.

In this work, a collection of 43 different gel ink samples was examined using thin layer chromatography, Fourier Transform Infrared Spectroscopy (FTIR) and Energy Dispersive X-Ray Spectrometry. The physical characteristics of the inks were noted, including color, reaction to ultraviolet light, and solubility in several common solvents. Thin layer chromatographic analysis was conducted using a variety of solvent systems and the color and placement (Rf) of components were noted. The solubility characteristics and TLC results allowed for differentiation of many samples of similar color and different manufacture. Due to the presence of some pigment only based ink systems, there remained a segment of the collection that could not be differentiated by TLC. The use of both FTIR and X-Ray spectrometry allowed for further differentiation through the identification of elemental composition due to the pigments present or by the presence of different spectroscopic results due to the use of different gels from one manufacture to another. A correlation could be made in some instances between elemental content and ink color or appearance, as well as between molecular structure and ink manufacture.

Future work will include the incorporation of a larger collection of gel inks from additional manufactures, as well as the use of Raman Spectroscopy to investigate further the molecular structure of the gel.

Questioned Documents, Gel Inks, Ink Analysis

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