B141 Analysis and Discrimination of Electrical Tape Adhesives by Fourier Transform Infrared Spectroscopy (FTIR) and Pyrolysis-Gas Chromatography-Mass Spectrometry (py-GC/MS)

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After attending this presentation, the audience will be aware of current FBI protocols for analysis of electrical tapes and the common chemical compositions thereof.

This presentation will impact the forensic community by providing a better understanding of the relative discrimination powers of forensic analyses of electrical tape adhesives using Fourier transform infrared spectroscopy (FTIR) and pyrolysis-gas chromatography-mass spectrometry (py-GC/MS).

Electrical tapes are often submitted to crime laboratories as evidence associated with improvised explosive devices or other violent crimes. The FBI Laboratory performs comparative electrical tape examinations to explore the possibility of an evidentiary link between a suspect and a crime or between different crime scenes.

Submitted samples are first evaluated by visual and microscopic means to evaluate physical characteristics such as backing color, adhesive color, width, degree of gloss, surface texture, and thickness.

If the samples are consistent following visual and microscopic examinations, chemical composition of each of the tapes' components (backing and adhesive) is evaluated. Current FBI protocol calls first for chemical analysis via FTIR with a microscope attachment. FTIR analysis can provide information regarding the rubber and polymeric materials used to formulate tape's adhesive and backing as well as some information for the plasticizers and flame retardants that are present. However, typically a significant amount of peak overlap occurs, making spectral interpretation difficult. This is further complicated by the spectral scatter encountered when analyzing black adhesives. Therefore, in most instances the individual chemical constituents are categorized into general classes rather than identified. For samples that cannot be differentiated by FTIR examination, scanning electron microscopy / energy dispersive spectroscopy (SEM/EDS) is then performed to compare elemental composition. Finally, py-GC/MS is performed on each component if samples have yet to be discriminated. This technique breaks the organic components down, separates them, and provides more conclusive information as to the identity of the chemical constituents. As a result, py-GC/MS is particularly useful in identifying the rubber component(s), the type(s) of plasticizers, and any other organic additives present.

This study involved the analysis of ninety electrical tape samples utilizing the current FBI Laboratory protocol. Most of the tapes were purchased by FBI Laboratory personnel at discount stores or home-improvement retailers, are marketed as general purpose or economy grade, and cover a variety of U.S. and foreign manufacturers. Therefore, the sample set represents tapes that could be easily obtained by consumers and would be comparable to casework evidence submitted to the FBI Laboratory.

This project was designed with a number of objectives in mind. They include: (1) determination of the range of physical characteristics and chemical compositions of electrical tapes, (2) evaluation of the ability of the individual techniques to discriminate samples, and (3) assessment of the ability of the overall analytical scheme to distinguish between samples. The subject of this presentation will be the composition of the electrical tapes' adhesives as determined by FTIR and py-GC/MS. Furthermore, a comparison of the two techniques' discrimination ability will be discussed.

Electrical Tape, Fourier Transform Infrared Spectroscopy, Pyrolysis - Gas Chromatography - Mass Spectrometry

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