B94 The Development of a Comprehensive Scheme for the Analysis of Electrical Tape Using Instrumental and Chemometric Methods

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After attending this presentation, attendees will gain an understanding of the capabilities and limitations of some of the techniques available for the forensic analysis of electrical tape. Furthermore, this research will provide the forensic science community with an effective analytical scheme for examining and comparing questioned and known samples of electrical tape.

Polyvinyl chloride (PVC) tape, more commonly known as electrical tape, is often encountered during explosive investigations. Electrical tape may be used in the construction of improvised explosive devices (IEDs) for wire insulation, for sealing openings, and for securing fuses and other components onto a device. If tape is recovered and submitted as evidence, an analyst may be asked to compare the questioned tape with a known source, often a roll of tape obtained from a suspect. On rare occasions a physical match of the tape ends can positively identify the questioned tape fragment as having originated from the known source. However, when such individual characteristics are not present, the analyst must resort to comparisons of class characteristics for association or elimination. Most often these include physical dimensions, surface texture, and chemical composition.

Before carrying out any research study of the class characteristics of electrical tape, a number of challenges must be overcome. First, a detailed understanding of the inherent heterogeneity of the sample population, arising from both chemical composition and product distribution, is needed. Only then can a representative sample of the population be obtained. However, most formulations of electrical tape are proprietary and the manufacturers will not disclose the identity of some of the raw materials used. This limits what information is known about the composition of the product. With regard to distribution, tape from the same manufacturer may often be marketed under many different brand names. Chemically and physically the tapes are considered to be the same, while commercially they are different. Next, following sampling, the use of multiple analytical methods is necessary in order to fairly evaluate the relative merits of each individual method. Finally, using quantitative methods of analyzing the results allows for more reliable conclusions.

There have been numerous articles published regarding the forensic analysis of adhesives and a few that focus specifically on electrical tape; however, none of these have directly addressed the above-mentioned issues. In this study, discussions and plant tours with tape manufacturers and careful attention to manufacturing/product codes has allowed for a greater understanding of the tape industry. The sampling methodology involved acquisition of known exemplars directly from a manufacturer as well as the traditional route of purchasing tape from commercial sources, but with a better understanding of the true manufacturer of a sample. Specifically, nine rolls of tape, including three rolls from three different batches of three different types of tape, were obtained directly from a manufacturer, 3M. Also, 32 other samples from 18 other brands representing a total of 10 manufacturers were obtained. All the samples were analyzed by the following methods: Attenuated Total Reflectance (ATR) Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy with Energy Dispersive Spectrometry (SEM-EDS), Pyrolysis-Gas Chromatography-Mass Spectrometry (Py-GC-MS), and High Temperature GC-MS. The results from each of the techniques were evaluated individually and in various combinations, via principal components analysis (PCA) to determine their relative ability to distinguish between the rolls of tape. With this information, an analytical scheme for electrical tape was developed.

Preliminary results demonstrated that between the three brands of 3M tape obtained directly from the manufacturer, elemental composition alone can discriminate between the general-purpose brand and the professionalgrade brands. Initial experiments with chemical extraction of the plasticizer have shown that High Temperature GC-MS may be able to elucidate more information about this particular component of electrical tape than traditional methods have previously allowed (e.g. FTIR and Py-GC-MS). Also in this study, FTIR methods examined in previous work were employed to screen the samples and subsequent separations/extractions provided further discrimination.

Electrical (PVC) Tape, Improvised Explosive Devices (IEDs), Chemometrics

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