## B21 Analysis of Black Electrical Tapes by Direct Thermal Extraction-Gas Chromatography/Mass Spectrometry (TE-GC/MS)

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After attending this presentation, attendees will have a better understanding of how TE-GC/MS can be used to analyze volatiles thermally extracted from electrical tapes.

This presentation will impact the forensic science community by providing an alternative method to analyze and compare electrical tapes that may be submitted as trace evidence to crime laboratories.

Black Polyvinyl Chloride (PVC) electrical tape is often used in the construction of Improvised Explosive Devices (IEDs) as a means of securing their components. Consequently, black electrical tape is often submitted as evidence to crime laboratories. IEDs often incorporate PVC tape for sealing, insulating, or securing parts to the device; therefore, important information can be gained from the analysis of the components of IEDs, either intact or fragmented. Most of the methods that have been developed for the forensic analysis of black electrical tape have used a combination of microscopy, Infrared (IR) and/or Raman spectroscopy, Scanning Electron Microscopy/Energy Dispersive Spectroscopy (SEM/EDS), or Pyrolysis Gas Chromatography (PyGC). New alternative methods to compare and differentiate black electrical tapes are needed.

For this reason, Direct Thermal Extraction-Gas Chromatography/Mass Spectrometry (DTE-GC/MS) was explored as an analysis technique for black electrical tapes. Thermal sampling techniques generally require no sample preparation and can replace more complex and time consuming analytical procedures such as solvent extraction. DTE is a thermal desorption method used to extract Volatile Organic Compounds (VOCs) and semivolatile compounds directly to the gas chromatographic column for analysis. DTE-GC/MS can differentiate and identify volatiles thermally extracted off of polymers such as PVC tapes. This thermal extraction technique is a dynamic process that can be used to analyze both solid and liquid samples. Under a continuous flow of inert gas and heat, volatile and semi-volatile organics are thermally extracted from the sample matrix into the gas stream and transferred to the vapor phase and then into the carrier gas of a gas chromatograph. DTE-GC/MS was used in this experiment to examine black electrical PVC tape samples purchased from various commercial sources. DTE was performed using an SIS AutoDesorb™ system. The AutoDesorb™ tower, containing the sample analysis hardware, sits over the gas chromatographic injection port and communicates with the PC software through the electronics console. Trace amounts (<30mg) of samples were thermally desorbed at 150°C with a purge and flow of helium gas for one minute. Desorption time for all samples was set to ten minutes with an initial column trap temperature at 30°C to focus the volatiles onto the gas chromatographic column.

GC was performed using a 5890 Agilent® gas chromatogaph. A Zebron™ ZB-5HT capillary column (30m+5m Guardian x .25mm i.d. x .10µm) was used for all analyses. A helium carrier gas with a flow rate of 1.0mL/min was used with a 10:1 split. The injector temperature was set to 225°C. The initial column temperature was held at 30°C for two minutes, followed by its first ramp to 150°C increasing 10°C/minute. The second ramp was to 240°C increasing 2°C/minute, finishing with a final ramp to 280°C increasing 10°C/minute. The oven was held at 280°C for five minutes. A post-run program returned the oven temperature to 30°C and lasted ten minutes. MS was carried out on a 5973 Agilent® Mass Selective Detector with a scan range of 40m/z-500m/z and auxiliary temperature of 250°C.

All the black electrical tapes studied produced different chromatograms with peaks of varied intensity. All samples were run in triplicate with excellent reproducibility. The compounds identified originated from volatiles thermally extracted from the tape film and adhesive. Phthalate plasticizers from the tape film were among these peaks. In conclusion, this study provides an innovative and semi-destructive technique to examine trace amounts of polymeric materials, specifically PVC electrical tape that may be submitted to crime laboratories.

**Electrical Tape, Direct Thermal Extraction, GC/MS**

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