ELEMENTAL EXAMINATION OF SILVER DUCT TAPE USING ENERGY DISPERSIVE X-RAY SPECTROMETRY

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Silver duct tape is commonly submitted to crime laboratories for analysis when used in such cases as homicides, kidnappings, burglaries, etc. Historically, analysis has relied on jigsaw matches and basic macroscopic, microscopic and chemical evaluations which often dismantle, alter or destroy the tape. Since a primary objective of evidence technicians and the law enforcement community is the preservation of evidence, it is recommended that a non-destructive elemental evaluation technique such as energy dispersive X-ray spectrometry (EDS) be a primary consideration in the initial analysis of duct tape.

This elemental technique can be applied to intact samples of tape. The cleanest section of tape should be examined. To ensure the cleanest section of tape, the duct tape was placed adhesive side down with Teflon-coated forceps and affixed on a section of Mylar film (E. I. duPont de Nemours & Co., Inc., Wilmington, DE). A Tracor-Northern energy dispersive X-ray spectrometer (Middleton, WI) was used. The sample was scanned for 150 seconds, at a KEV of 0.02 with an approximate dead time of 50 percent with no filtration. The X-ray tube anode current setting was at .03 with the voltage level on high. The results were plotted on a Tracor-Northern spectral plotter.

This elemental technique involved the identification of seven elements found in duct tape: titanium, calcium, zinc, iron, copper, lead and chlorine. It is important to note that not all of these elements were found in any one brand of tape. The elemental composition can vary from as few as three identified elements to a maximum of five, with the majority of samples examined (over 65) averaging four elements. The elements are routinely identified in varying concentrations.

It is the identification of these elements and the comparison of their varying concentrations that allows duct tape to be classified according to manufacturer. For example, several tape samples from different distributors (Figures 1 and 2) reveal the same elemental composition; but differences in their quantities are apparent. The quantities or ratios of all elements concerned must be considered when identifying a manufacturer. Numerous brands of duct tape contain the four most commonly identified elements: zinc, calcium, titanium and iron. These various brands can easily be distinguished by examining the varying concentrations of each element.

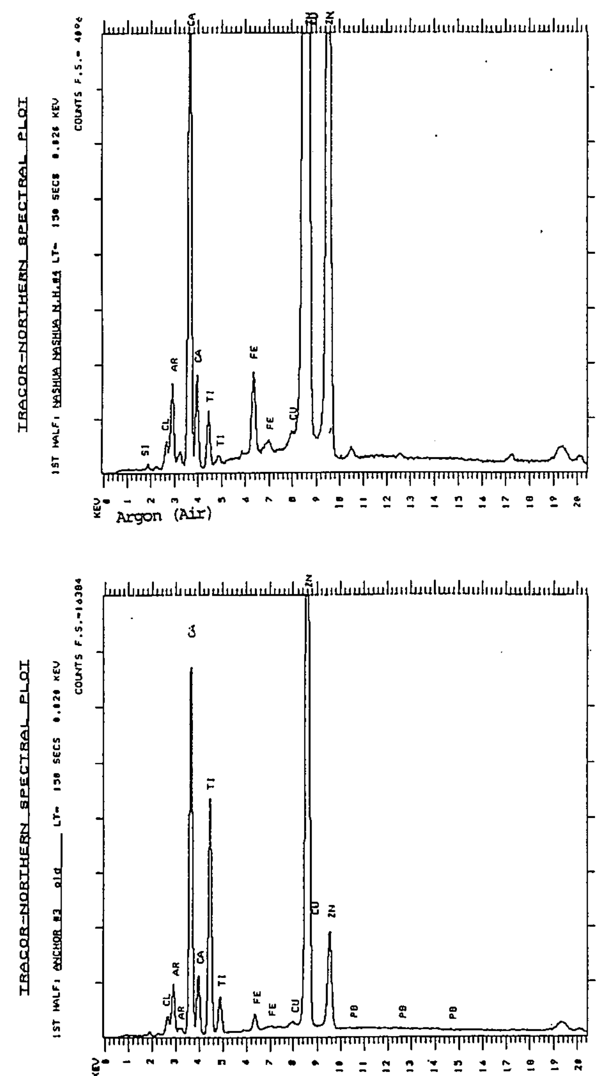

Figure 1. Energy dispersive X-ray spectra of Nashau (top) and Anchor (bottom) tapes.

To date, only three brands of duct tape (Aron, Superior and Mystik) have been found to contain titanium as the element of greatest concentration (Figures 3 and 4). In each case, titanium far overshadows the second element of lesser concentration by 3 to 1.

Chlorine has been detected as the element of greatest concentration in only two brands (Sekisui and Westape) (Figure 5). Both of these brands are manufactured in Japan; however, only one brand contains lead (Westape), creating a quick and easy method for brand identification.

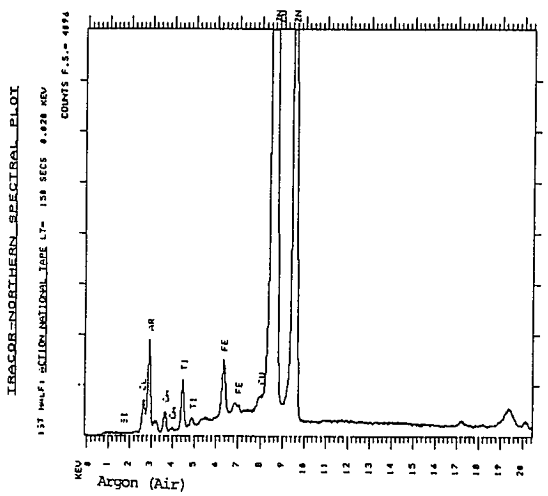

Figure 2. Energy dispersive X-ray spectrum of Action National tape.

The elements of greatest concentrations have proven to be zinc, titanium, calcium and chlorine. These elements are a direct result of fillers used in the manufacturing process. For example: TiO_2, $CaCO_3$ and ZnO are fillers and Cl_2 is used in the tape.

Elemental examination has not shown any significant differences among samples removed from the beginning, middle and end of a roll of tape, thus indicating the elements and their concentrations are homogeneous throughout the roll.

Energy dispersive X-ray spectrometry is an easy, reliable and non-destructive method of duct tape analysis. It provides vital investigative information in the identification of brands of duct tape involved in criminal cases. Its simple comparison of elemental spectra makes interpretation fast and easy, thus allowing duct tape to be classified according to manufacturer. By using this technique to determine the basic manufacturer identification, it may be possible to compile the other trace evidence techniques, such as color, texture, surface design, weave pattern, weave count, fiber identification, adhesive properties and pyrolysis to make a positive batch lot identification.

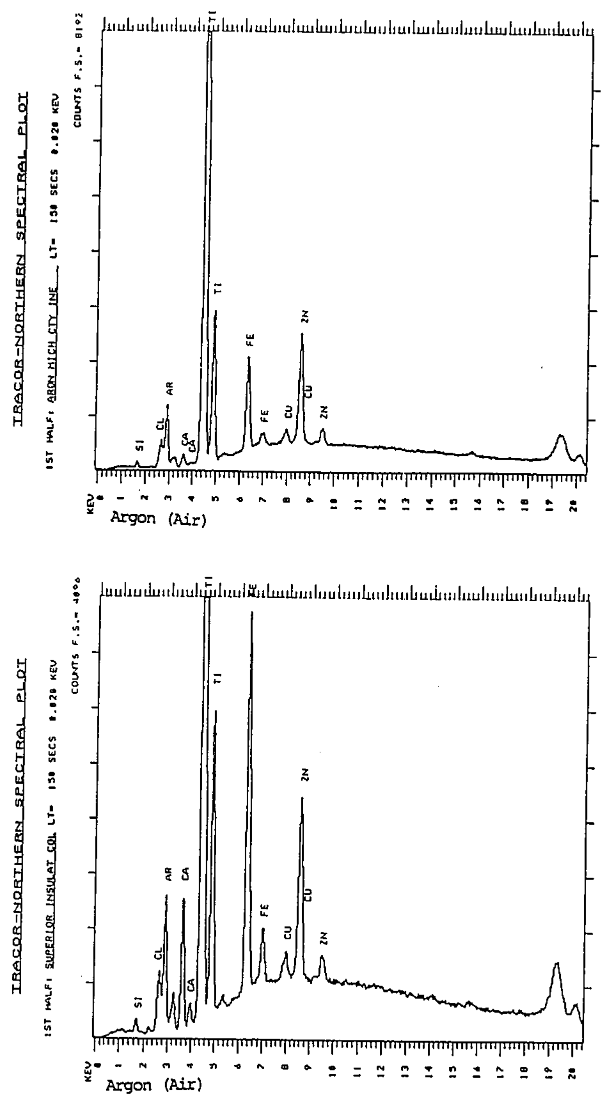

Figure 3. Energy dispersive X-ray spectra of Aron (top) and Superior (bottom) tapes.

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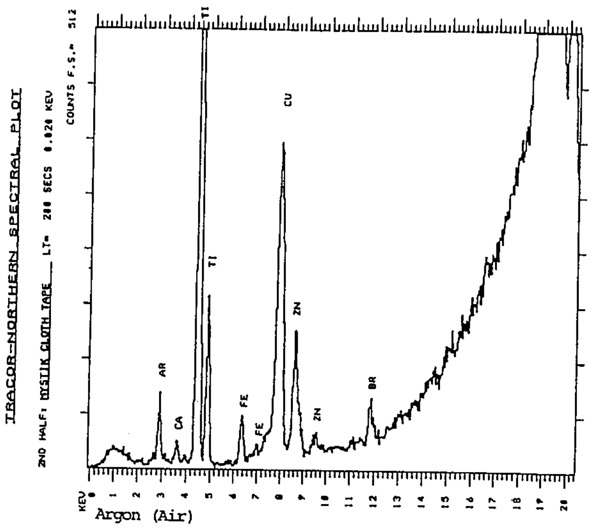

Figure 4. Energy dispersive X-ray spectrum of Mystik tape.

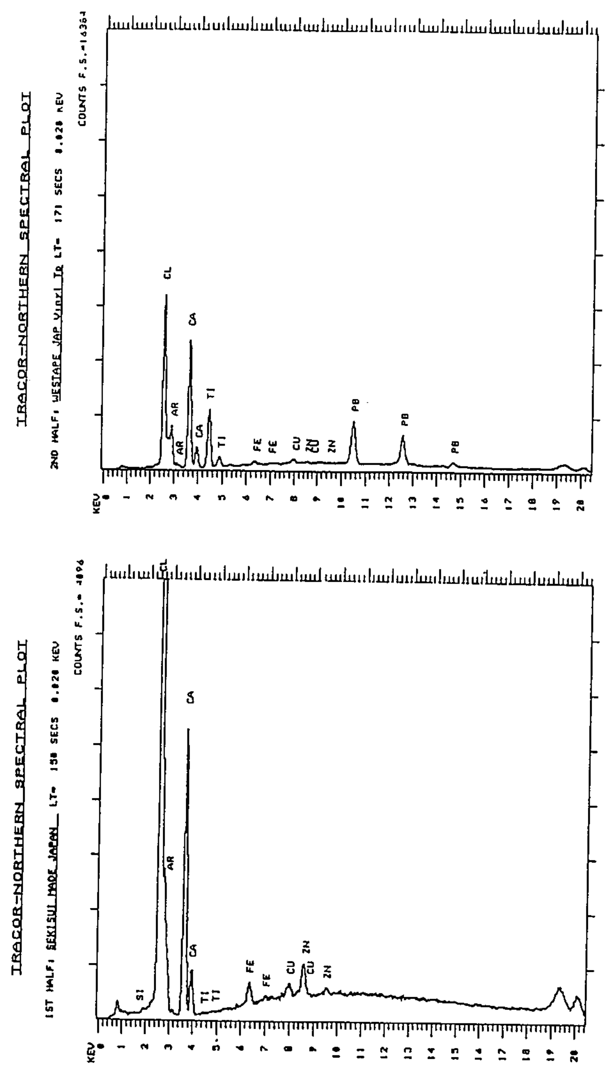

Figure 5. Energy dispersive X-ray spectra of Westape (top) and Sekisui (bottom) tape.