A181 Liquid Chromatography/Mass Spectrometry Investigations of Dye and Fiber Degradation Resulting From Environmental Exposure

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The goal of this presentation is to describe characterization changes that occur in textile fibers as a result of exposure to environmental conditions including laundering and outdoor exposure to sunlight, heat, and moisture.

This presentation will impact the forensic science community by providing trace evidence examiners a better understanding of textile physical and chemical changes and by accounting for these effects through laboratory comparisons of fibers.

Textile fibers have become an important aspect of forensic science due to their abundance at crime scenes. However, fibers are rarely found in pristine condition. The degradation of fibers and dyes can complicate the forensic comparison between questioned and known fiber samples, particularly if only one sample has been weathered. Although ultraviolet (UV)/visible and fluorescence microspectrophotometry allow direct and nondestructive analysis of a fiber of a few millimeters in length, a more selective and sensitive technique, such as liquid chromatography/mass spectrometry (LC-MS), is required to characterize diminutive amounts of dye (2-200 ng) present on forensically relevant analytes.

In this study, dyed fabric samples of the most commonly used fiber types (cotton, polyester, nylon, and acrylic) were used with the most commonly used dyes (reactive, disperse, acid, and basic) and subjected to a variety of environmental conditions (washing, bleaching, sunlight, heat, accelerated weathering, and natural weathering). Fabric samples were exposed to outdoor weathering (Arizona and Florida) and accelerated outdoor weathering (EMMA and EMMAQUA equivalent to three, six, nine, and twelve-months in hot-dry and hot-wet environments). Samples were also laundered with various commercial detergents, each alone; with chlorine bleach; and with peroxide bleach. Textile samples were retired from exposure at predetermined time intervals of exposure and screened by UV/visible and fluorescence microspectrophotometry for degrading effects. Microextractions of dyes and fluorescent brighteners (FBs) from fibers were subsequently performed on small scale threads and single fibers (1 mm-5 cm) followed by reconstitution of the dyes in liquid chromatography-compatible solvents. Fiber extracts were then analyzed using an Agilent 1100 Series LC system interfaced to an AB SCIEX 3200 Q-Trap mass spectrometer. The dyes and other traces associated with the manufacturer and/or weathering conditions present in the fibers were qualitatively identified and their relative quantitative composition was estimated.

The analysis of environmentally exposed samples by LC/MS allows investigators to examine the loss of dyes from textiles and the addition of extraneous contaminants from the environment, as well as to profile degradation products from both fibers and dyes. Finally, the experimental design approach used in these studies permits assess of the nature of changes in those profiles that occur as a function of time. This wealth of information could contribute to the interpretation of environmental effects on fiber evidence and determination of their forensic relevance. **Textile Fibers, LC/MS, Dyes**

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