B76 Environmental Effects on Textile Fibers

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After attending this presentation, attendees will learn about the changes that occur in textile fibers as a result of exposure to environmental conditions.

This presentation will impact the forensic community and/or humanity by demonstrating the improvements in fiber examinations.

This research addresses the need of forensic fiber examiners to under- stand changes that occur in textile fibers as a result of exposure to environ- mental conditions. Fabric samples of the most commonly used fiber types, containing commonly used dyes, were subjected to a variety of environ- mental conditions and subsequently analyzed to determine the effects of these treatments. Environmental conditions explored include washing, bleaching, sunlight, heat, accelerated weathering, and exposure to natural weather conditions. Samples of acrylic (dyed with basic dyes), cotton (dyed with reactive dyes), nylon (dyed with acid dyes), and polyester (dyed with disperse dyes) will be employed. Analyses at selected time intervals of exposure to environmental conditions were performed using fluorescence microscopy, UV/visible and fluorescence microspectrophotometry, and infrared microspectroscopy. Chemical changes in a representative sampling of the environmentally exposed samples were also assessed using extraction, capillary electrophoresis, and mass spectrometry to elucidate the chemical changes observed after environmental exposure. For example, experiments were performed to address whether fibers from the same source, which have been treated differently through laundering, can be dis- criminated based on fluorescent brighteners from detergents. Detergent manufacturers add fluorescence brighteners to improve "whiteness" by masking yellowness. During the wash cycle, fibers pick up the fluorescent brighteners. The presence of additional fluorescent brightener alters the flu- orescence from the brighteners applied by textile dyers.

Items of clothing, bedding, curtains, upholstery, carpets, and auto inte- riors are typically comprised of dyed and finished textile fibers. These items are subjected to a broad array of environmental conditions during use. For instance, auto interiors may become extremely hot in the summer and very cold in the winter, while the environment may range from arid to humid. Auto interiors, curtains, carpeting, and items of apparel are exposed to sunlight throughout their useful lives. All items within about five miles of the coastline are exposed to ozone. Carpets and upholstery get spot- cleaned, while items of apparel are laundered or dry-cleaned many times. During these exposures and cleaning cycles, collectively termed 'environ- mental exposures,' dyes and finishes may be degraded or otherwise changed in chemical form, or they may be partially or completely removed. The items may also pick up various contaminants, such as soils and body fluids, and deposition of refurbishment chemicals may occur during the cleaning process (soaps, fabric softeners, and fluorescent brighteners). As a result of these environmental exposures, fibers from the same source may, over time, show differences that the forensic trace evidence examiners may need to explain.

The designed experiments performed in this project, combined with analytical characterization of chemical changes, may suggest improve- ments in fiber examinations for casework. Explanations by trace evidence examiners for observed differences in textile fibers as a result of environ- mental exposure will be more convincing if accompanied by insight into possible chemical or physical mechanisms. Using these techniques, the sci- entist are not only able to assess the level of changes induced by environ- mental exposure, but also gain insight into the chemical natures of the degradation and deposition products. This chemical understanding will also assist in interpretation of spectral data and enhance the forensic significance of the results.

Forensic Fiber Examination, Environmental Effects, Fiber Dyes

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