B63 The Characterization of Nylon Fiber Color by Ultra High-Performance Liquid Chromatography-Mass Spectrometry (UHPLC-MS)

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After attending this presentation, attendees will recognize the merits of using UHPLC coupled with Time-Of-Flight/Mass Spectrometry (TOF/MS) in the analysis of nylon fiber dyes.

This presentation will impact the forensic science community by demonstrating that UHPLC-TOF/MS is suitable for the analysis of dyes in nylon fibers.

Nylon is a synthetic polyamide with repeating units made of hydrocarbons linked by highly polar amide groups. Acidic dyes are commonly used to color nylon fibers, where the dye molecules interact with the amide groups via hydrogen bonding. Current techniques for analyzing dyes in nylon fibers include microspectrophotometry, thin-layer chromatography, high-performance liquid chromatography, and capillary electrophoresis.

There are advantages to using UHPLC-MS to analyze nylon fiber dyes. The results provide chemical-level information about the dyes that would not be available via analysis by microspectrophotometry or thin-layer chromatography. Besides molecular mass information, partial structural information may be accessible if a fragmentation technique is available. On the downside, the method is destructive and other analyses, such as microspectrophotometry, would need to precede it.

Depending on the type of dye used to color the fiber, extraction can be difficult. A solvent for extracting the dye from the nylon fiber must be capable of solvating the dye molecules by reducing their affinity for the nylon fiber. Equal parts deionized water, pyridine, and ammonium hydroxide were mixed and used as extraction solvent. The fiber and solvent were heated at 100°C for one hour to achieve optimum dye extraction. Then various nylon fibers of different colors from several manufacturers were subjected to this dye extraction protocol followed by analysis of the extracted dyes via UHPLC-MS. Each sample was run under both positive and negative ion modes. The UHPLC column used was a Brownlee SPP by Perkin Elmer® (2.7µm:C18 2.1x30mm) with a method run time of four minutes.

The method yielded signals in both positive and negative ion modes for the dyes extracted from samples of different colors. Manufacturers typically use a proprietary blend to obtain different dye colors by mixing dyes in different ratios. Consequently, different colors from the same manufacturer display signals corresponding to the same dye components, in different ratios. Some dyes were present in all colors, while others were only present in certain colors. The data generated from UHPLC-MS analysis yielded a fingerprint for each sample that could be used to improve the confidence in the forensic examination of nylon fibers.

Nylon Fiber, Dye, UHPLC-MS

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