A153 Characterization of Vectran LCP Fibers

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After attending this presentation, attendees will have information for the characterization and identification of Vectran LCP fibers.

This presentation will impact the forensic science community by expanding the knowledge and data on forensic fiber identification.

Vectran liquid crystal polymer (LCP) fibers are a relatively new commercially produced aromatic polyester fiber that was first developed by Celanese Acetate LLC in the 1990s and is now manufactured by the Kuraray Co., Ltd. Liquid crystals (LCs) are a state of matter that have properties between those of a crystalline solid and those of a conventional liquid. Like LCs the LCPs in the liquid state, either dissolved in a solvent or melted, have highly oriented anisotropic-molecular domains like a crystal but they flow like a liquid. A para-substituted aromatic polyamide, is a LCP fiber in the solid state and is wet spun from dissolved polymer in a liquid (lyotropic liquid-crystal polymer). Unlike conventional polyester that is melt spun from randomly oriented and fixable molecules, Vectran fibers are LCPs in the solid state and are the only LCP fibers being produced today that are melt spun from a highly ordered liquid crystal phase (thermotropic liquid-crystal polymer). Since Vectran fibers, like Kevlar fibers, are spun from a LCP it locks in the oriented crystalline nature and provides the exceptional high performance characteristics of strength, rigidity, and chemical resistance.

Both Kevlar and Vectran LCP fibers, as well as several other fibers, fall into the class of "High Performance Fibers." High performance fibers, as compared to commodity fibers, are "fibers that fall into special technical functions that require special properties unique to these fibers." These special functions may include chemical resistance, tensile strength, operating temperature, limiting oxygen index, and a modulus value. It should be noted that all high performance fibers are not classified as "High Temperature Resistant Fibers." A good example of this is high density polyethylene Spectra® fiber that is gel extruded and classified as a high performance fiber but not high temperature resistant fiber due to its low melting point of 250° F (121° C). A general definition of high temperature resistant fiber is "a synthetic fiber with a continuous operating temperature ranging from 375° F to 600° F (190° C to 316° C)" but this definition may vary depending on the end use of the fiber. Three types of Vectran fibers are being commercially produced by Kuraray Co, Ltd.: Vectran HT; Vectran NT; and, Vectran UM. Airbags made with Vectran woven fabric were used by NASA on the Mars Pathfinder spacecraft. A more down to earth use of Vectran fibers in everyday products include rope/cordage made of Vectran HT fiber or Vectran NT fiber; protective clothing made from Vectran NT fiber which is sometimes blended with another type of fiber; and fiber optic cables reinforced with Vectran UM fibers.

Therefore, Vectran fibers, especially HT and NT, may be encountered in forensic fiber evidence in casework. A review of literature commonly relied on by forensic fiber analysts failed to find identification characteristics for Vectran fibers. To fill this void, the microscopic optical properties, physical characteristics, as well as infrared and Raman data will be presented for the characterization and identification of Vectran fibers. Various equipment was used to determine this data.

Vectran LCP Fibers, Liquid Crystal Polymers, High Performance Fibers

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