63. Hazardous Occupational Exposure and Lung Disease Among Nylon Flock Workers

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NIOSH became involved in clinical, industrial hygiene, epidemiological and toxicological investigations following recognition of a cluster of work-related interstitual lung disease among workers at a plant that produces nylon flocked upholstery fabric. At the plant, nylon flock is made by cutting bundles of continuous nylon filaments ("tow") into very short segments. Flock finish (to impart electrostatic properties) is applied before cutting, as are any desired dyes. Nylon-flocked fabric is made by applying flock to adhesive-coated backing fabric in an electrical field, which aligns the flock fibers perpendicular to the fabric. The flocked fabric is printed, embossed, or otherwise finished.

Environmental sampling was conducted at worksites throughout the plant. Endotoxin ranged from 1 to 219 EU/m^3 based on area total dust samples. Viable bacteria ranged from 140 to 6080 CFU/m^3. Viable fungi ranged from 129 to 1201 CFU/m^3. Formaldehyde concentrations were measured up to 0.44 ppm. Given the physical diameter of nylon tow processed at this plant (approx. 10–15 microns), the flock fibers are not themselves respirable, but substantial airborne respirable dust is generated during processing. Respirable dust concentrations were particularly high in the flocking rooms (up to 39.9 mg/m^3) and screening rooms (up to 5.02 mg/m^3), and use of compressed air for "blowdowns" resulted in extremely high dust concentrations. Microscopic analysis of this dust revealed fibers visually similar to the much larger nylon flock. Additionally, the melting point of these elongated respirable particles was consistent with that of nylon. Scanning electron microscopy examination of the ends of flock fibers showed evidence of nylon shredding during the cutting process.

A medical survey of current employees revealed highly prevalent work-related symptoms that were significantly associated with work on the flocking ranges, hours worked per week, and participation in the very dusty "blowdown" process to remove loose flock from equipment, but not with smoking. Airborne dust from the plant caused marked acute lung inflammation following intratracheal instillation into rats. The water-soluble fraction of airborne dust retained some inflammatory potency, but water-washed airborne dust and milled nylon particulate (without flock finish) were each highly inflammatory.

NIOSH also convened a workshop to review all 20 human cases of work-related interstitial lung disease known to have been diagnosed by January 1998 among

nylon flock workers, including 9 from the study plant, 9 from a similar plant in Canada, and two sporadic cases from other plants in the U.S. Based on review of all available lung biopsies (15 cases from four plants), expert pulmonary pathologists noted a characteristic lesion that was distinctive in these cases compared to other lung conditions.

NIOSH concluded that a health hazard exists from occupational exposure to flock-associated dust. Reduction of worker exposures to airborne dust by means of process changes, engineering and administrative controls, and personal respiratory protection, together with implementation of a medical screening and surveillance program, is recommended to protect the health of the workers at this plant.

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