

Investigation of Lead in Hosiery Products

The Hosiery Technology Center
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Consumer Product and Safety Commission



Hosiery Technology Center

- 19 year history of training, R&D, prototyping and testing
- 18 full time and 10 part time employees
- Lab also houses knitting, seaming, dyeing and finishing processes for socks and sheer hosiery
- Industry resource for entire value chain (manufacturers, suppliers and retailers worldwide)
- Key partner of The Hosiery Association (THA)
- No memberships or dues



Investigation of Lead in Hosiery: Industry Survey

- Searched for lead in textile fibers, waxes, oils, dyes and finish chemicals used in hosiery processing.
- Contacted entire supply chain.
- Surveyed the industry – 2,509 Material Safety Data Sheets and Zero products with lead were identified. EPA Wastewater Inspections – 149 tests with Zero lead content. 359 sock tests for lead and Zero test positive for lead.

Bottom Line - No commercial products in the supply chain contained lead.



Leaded Fiber Test Sample Preparation

- All samples were prepared using an industry standard multi-fiber strip consisting of acetate, cotton, nylon, polyester, acrylic and wool.
- One set was prepared with dye and lead nitrate mordant.
- One set was prepared with dye only and no lead nitrate.
- Samples were air dried to maximize lead exposure on the fabric.
- Half of the dyed with lead samples were home laundered once with AATCC laundry detergent at 120°F.



Testing for Lead

- Multi-fiber strips were agitated vigorously in a solution of 2% nitric acid for 2 hours.
- The extract was then analyzed using atomic absorption spectrometry (AAS).
- Same tests performed using commercially available socks with different fiber contents to determine any lead levels present.

Rinsed Lead Levels vs. Un-Rinsed

	Un-rinsed	Rinsed
Fiber Strips	Lead Nitrate and Dye	Lead Nitrate and Dye
Filament Acetate	2,910	2,810
Cotton	15,200	10,800
Nylon	5,410	1,950
Spun Polyester	2,390	586
Spun Acrylic	2,520	1,650
Wool	10,900	9,860

Note - Control Samples measured less than 63 ppm.

Effectiveness of Lead as a Mordant

Un-rinsed Lead Nitrate & Dye



Rinsed Lead Nitrate and Dye



Dye only – No Lead Nitrate
(un-rinsed)



Lead Content – Commercial Socks

Commercial Socks	
Coolmax Polyester/A.M.Y/Spandex	< 63 ppm
Polyester/Nylon/Silver/Spandex	< 63 ppm
Rayon/Cotton/Nylon/Spandex	< 63 ppm
Wool/Nylon/Spandex	< 63 ppm
Cotton/Nylon/Spandex	<63 ppm
Cotton/Acrylic/Nylon/Spandex	< 63 ppm

Using AAS and based on 5 ppm limit of detection, approximately 2 gram sock sample digested in 25 ml of 2% nitric acid.



Potential Everyday Lead Exposure

- EPA action level for drinking water consumed is 0.015 milligrams/liter. Assume a child drinks 1 liter of water daily.
- Federal EPA inhalation action level is 0.00015 milligrams of lead per cubic meter. Based on California EPA research a child sitting inhales approximately 10 cubic meters of air per day.
- FDA levels for food consumption is 0.006 milligrams per day.
- TOTAL = 0.0225 milligrams of lead per day.
- A 2 gram sample of sock (<63 ppm Pb) contains less than 0.125 milligrams of lead.
- Equivalent to consuming 2 grams of socks every 5-6 days.



Conclusions

1. Comprehensive hosiery industry survey results indicate **no lead** in the supply chain.
2. “Leaded fabric” can be created; however, **NOT** with commercially available dyes and finishes.
3. The leaded fabrics would not be commercially acceptable for colorfastness.
4. Leaded fabrics would require more expensive dyes and yield poorer dyeing quality verses industry standard (lead free) commercially available dyes and finishes.



For Further Information

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