U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service
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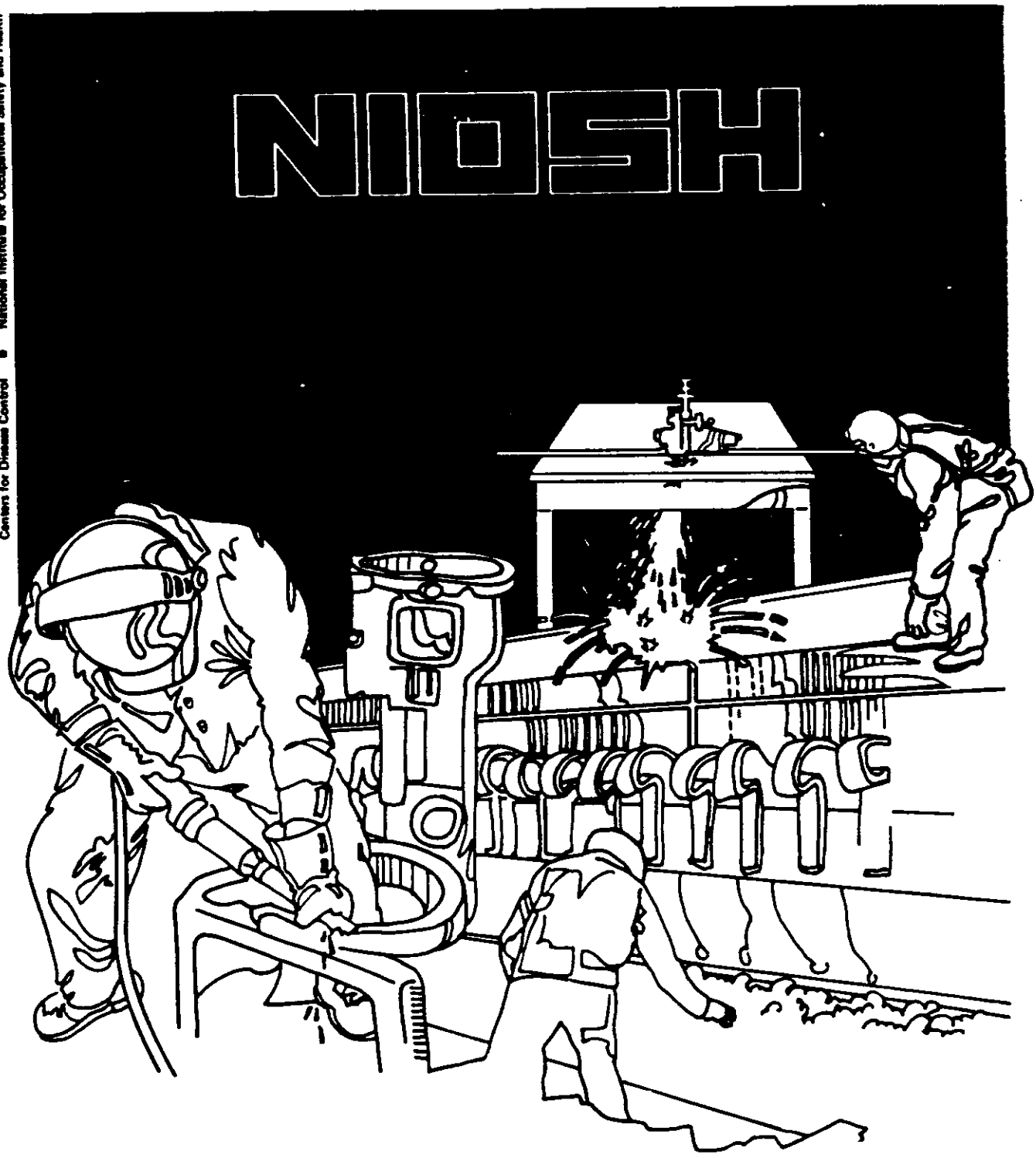
NIOSH



Health Hazard Evaluation Report

HETA 87-370-1973
NATIVE TEXTILES
GLENN FALLS, NEW YORK

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 87-370-1973
JULY 1989
NATIVE TEXTILES
GLENS FALLS, NEW YORK

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I. SUMMARY

On July 28, 1987, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Communication Workers of America Local 1139 to assess irritative effects to the skin, eyes, and upper respiratory tract from exposures in the finishing areas of Native Textiles, Glens Falls, New York.

NIOSH investigators conducted initial and follow-up surveys at Native Textiles on August 26, 1987 and May 25, 1988. During the initial and follow-up industrial hygiene surveys, area air sampling for formaldehyde, total nuisance dust, hydrocarbons, and personal breathing zone air sampling for respirable dust, were performed in the ARTOS frame, thread drawing, and spooling areas. The medical survey consisted of confidential interviews with employees from the finishing areas.

From the area air sampling, 10 of 17 formaldehyde samples were above 0.1 parts per million (ppm) and the total and respirable dust levels were between 0.1 and 0.2 milligrams per cubic meter (mg/m^3). Low levels of 1,1,1-trichloroethane and trace levels of toluene, xylene, and various alkyl-substituted benzenes were measured in the finishing areas. Medical survey results indicated that employees in the thread drawing and spooling areas were experiencing symptoms consistent with exposure to low levels of formaldehyde.

Anecdotal reports from employees indicated that certain lace patterns may be more irritating than others. In response to these reports, the NIOSH investigators examined the chemical and physical characteristics of fabric lots from two one-week periods. In addition, we compared industrial hygiene sampling data from thread drawing machines, and obtained bulk samples of the lace for qualitative and quantitative analyses. No distinguishing characteristics were identified which would substantiate one pattern of lace being more irritating than others. However, the laboratory analyses did indicate that the lace off-gassed formaldehyde at room temperature, with the formaldehyde source being the melamine/formaldehyde resin used to impart durability and body to the fabric. During thread drawing and spooling operations, an inspirable dust is generated, which consists of the melamine-formaldehyde resin. Upon coming in contact with the body (moist tissues and skin), this resin dust can off-gas formaldehyde, resulting in irritaion of the upper respiratory tract, skin, and eyes.

On the basis of these results, the NIOSH investigators concluded a health hazard exists from exposure to dust generated from thread drawing and spooling the resin coated lace. In addition to this, the irritative effects from exposure to this dust are exacerbated by the workplace formaldehyde levels above 0.1 ppm. Recommendations are made in Section VII aimed at reducing the effects of these exposures.

KEYWORDS: SIC 2241 (Narrow Fabrics and Other Smallwares Mills: Cotton, Wool, Silk, and Man-Made Fiber), Lace, Formaldehyde, Nuisance Dust, Irritative Effects.

II. INTRODUCTION

In July of 1987, NIOSH received a request for a health hazard evaluation at Native Textiles in Glens Falls, New York. The request was submitted by an authorized representative of the Communications Workers of America, Local 1139 and concerned the evaluation of irritative effects to the skin, eyes, and upper respiratory tract from exposures in the finishing areas. An initial site visit was performed on August 26, 1987; it included a medical survey and a limited industrial hygiene survey. The NIOSH industrial hygienists conducted a follow-up survey on May 25, 1988. Results from the initial medical and industrial hygiene surveys were forwarded to plant and union officials on December 21, 1987. At that time, a recommendation was made concerning the company's use of a disposable respirator which was not NIOSH/MSHA-approved.

III. BACKGROUND

Native Textiles is a manufacturer of lace, tricot, and specialty fabrics, employing approximately 400 people at its Glens Falls, New York facility. Lace is knitted from man-made fibers, i.e. nylon, acrylics, polyester, etc. Each type of lace is characterized by lot, pattern, color, finish, resin type, and dye time. Lace is produced in large rolls which consist of repetitive strands of a specific pattern, held together by a lockstitch. In the finishing process, an ARTOS frame runs the lace through a melamine/formaldehyde resin, which coats the lace, giving it durability and body. The melamine/formaldehyde resin typically contains less than 1% formaldehyde and 0.5-3.5% melamine. The lace is conveyed through a dryer which accelerates polymerization. Next, the roll of lace is divided into individual strands by using a thread drawing machine to rip out the lockstitches. In the final step, a spooling machine is used to wind individual strands of lace around a spool. Both the thread drawing and spooling operations are performed in the same room.

The mechanical action of thread drawing generates a fine dust that contains the polymerized melamine/formaldehyde resin. Workers operating the thread drawing machines reported that this dust covers their arms and clothing and that certain patterns seemed to be more irritating than others.

IV. EVALUATION DESIGN AND METHODS

A. Industrial Hygiene

On August 26, 1987, an initial survey was performed in the finishing areas. This survey consisted of area air sampling for formaldehyde, and the collection of bulk samples of lace to

deterimine if they off-gassed aldehydes. Area air sampling was performed in the thread drawing and spinning room, in the ARTOS frame room, and on the building rooftop (used as an indicator of ambient formaldehyde levels). Based on the data collected during this initial survey, a follow-up survey was scheduled to better evaluate exposures in the thread drawing and spooling areas. On May 25, 1988, area air sampling was performed for formaldehyde, aliphatic and aromatic hydrocarbons, and total dust at specific thread drawing and spooling work stations. Air samples for respirable dust were obtained from the breathing zone of selected thread drawing operators. It should be noted that some of the thread drawers and spoolers worked lace which was from the suspected irritant patterns. Finally, bulk samples of the lace were obtained for latent formaldehyde analysis. The specific methods used in this sampling and analysis are presented below.

Formaldehyde

Performance of area air sampling for formaldehyde was according to NIOSH Method 3500,[1] which utilizes a midget impinger containing 20 milliliters (mL) of 1% sodium bisulfite solution. Air was sampled at a nominal flowrate of 1.0 liter per minute (Lpm) through a calibrated, battery-powered sampling pump. After sampling, each impingers, sample volume was measured and a 4 mL aliquot taken for analysis. Each samples' color was developed by adding 0.1 mL of 1% chromotropic acid and 6 mL of concentrated sulfuric acid, and the samples were analyzed by visible spectroscopy. The limit of detection (LOD) was 3 micrograms per sample (ug/sample); the limit of quantitation (LOQ) was 7.7 ug/sample. Values falling between these limits are considered to be semi-quantitative data.

Hydrocarbons

Aliphatic and aromatic hydrocarbons were measured using NIOSH Methods 1003, 1500, and 1501.[1] In these methods, sample air is drawn through a standard charcoal tube at a nominal flowrate of 1.0 Lpm, using a calibrated, battery-powered pump. After sampling, the charcoal was removed from the tube and desorbed with 1 mL of carbon disulfide and screened by gas chromatography with a flame ioniztion detector (GC-FID), using a 30 meter DB-1 fused silica capillary column in the splitless mode. The LODs and LOQs for these methods are dependent on the specific hydrocarbon being measured.

Total And Respirable Dust

Total and respirable dust were measured using NIOSH Methods 0500 and 0600, respectively.[1] In both methods, sample air is drawn through a tared polyvinyl chloride (PVC) filter [37-millimeter (mm)

diameter, 5-micron (um) pore size] at a nominal flowrate of 1.5-2.0 Lpm using a calibrated, battery powered sampling pump. The difference between the total dust and the respirable dust methods is that the latter utillizes a two stage collector. The first stage is a 10-mm Dorr-Oliver cyclone which removes particles with an aerodynamic diameter larger than 10 um from sample air. The second stage is the filter assembly which now collects only dust particles with an aerodynamic diameter of 10 um or smaller. A determination of the weight of dust deposited on each sample was made by weighing the samples on an electrobalance and subtracting the previously determined tare weights. The instrumental precision of these methods is 0.01 milligrams (mg) per weighing.

Qualitative Aldehyde Analysis

Two bulk samples of lace were submitted for a qualitative aldehyde screen according to NIOSH Method 2539 (May 15, 1989).[1] The bulk materials were warmed in a tube furnace operating at 80-100°C and the effluent sampled over a two hour period at 60 cubic centimeters per minute (cc/min) using a critical orifice. Sample air was drawn through an Orbo-23 tube (manufactured by Supelco, Inc.) containing XAD-2 coated with 10% hydroxymethyl piperazine. After sampling, the sorbent was desorbed with 1 mL of toluene in an ultrasonic bath for 60 minutes. Aliquots of the toluene solution were then qualitatively screened for aldehydes by gas chromatography with a flame ionization detector (GC-FID) using a 30 meter DB-WAX fused silica capillary column.

Latent Formaldehyde

Six bulk samples of lace, three of suspected irritant patterns and three other patterns, were obtained for latent formaldehyde analysis.[2] In the laboratory, a weighed portion of each sample was suspended in a wire mesh basket over 50 mL of distilled water in a reaction vessel. The vessels were capped and incubated at 50°C for 20 hours. In addition to this, a portion of each sample was incubated at room temperature prior to analysis. An aliqout of the water was analyzed for latent formaldehyde according to the previously discussed NIOSH Method 3500. The LOD for this method was 15 ug of formaldehyde per gram of fabric; the LOQ was 45 ug per gram of fabric. Values falling between these limits should be considered semi-quantitative data.

B. Medical

During the initial survey, the NIOSH medical officer conducted confidential interviews with employees to ascertain the types and severity of symptoms and conditions responsible for these

symptoms. These interviews were conducted on the day shift and concentrated on workers in two job classifications: thread drawers and spoolers. During these interviews, some of the workers identified seven lace patterns which they believed were more irritating than others. Because of this, the NIOSH investigators compared the chemical and physical characteristics of suspected irritant patterns with all lace patterns for two randomly selected one-week periods of production from 1987 records. Laces were compared to determine if any characteristics could be identified which would account for the workers' perceptions that certain patterns were more irritating than others.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of air contamination criteria generally consulted include: (1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), (2) the American Conference of Governmental Industrial Hygienist's (ACGIH) Threshold Limit Values (TLVs), and (3) the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limits (PELs). Often, the NIOSH recommendations and ACGIH TLVs are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLVs usually

are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 (29USC 651, et seq.) to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Formaldehyde

Formaldehyde and other aldehydes may be released from foam plastics, carbonless paper, particle board, plywood and textile fabrics. Symptoms of exposure to low concentrations of formaldehyde include irritation of the eyes, throat and nose, headaches, nausea, congestion, asthma, and skin rashes. It is difficult to ascribe specific health effects to specific concentrations of formaldehyde to which people are exposed, because they vary in their subjective responses and complaints. Irritative symptoms may occur in people exposed to formaldehyde at concentrations as low as 0.1 parts per million (ppm), but more frequently in exposures of 1.0 ppm and greater. Some sensitive children or elderly, those with preexisting allergies or respiratory diseases, and persons who have become sensitized from prior exposure may have symptoms from exposure to concentrations of formaldehyde between 0.05 and 0.10 ppm. However, cases of formaldehyde-induced asthma and bronchial hyperreactivity developed specifically to formaldehyde are rare.[3]

In the past, formaldehyde vapor has been found to cause a rare form of nasal cancer in Fischer 344 rats exposed to a 15 ppm concentration for 6 hours per day, 5 days per week, for 24 months. Whether these results can be extrapolated to human exposure is the subject of considerable speculation in the scientific literature. Conclusions cannot be drawn with sufficient confidence from published mortality studies of occupationally exposed adults as to whether or not formaldehyde is a carcinogen. Studies of long term human occupational exposure to formaldehyde have not detected an increase in nasal cancer. Never-the-less, the animal results have

prompted NIOSH to recommend that formaldehyde be considered a potential occupational carcinogen.[4] Because of this, NIOSH recommends that workplace exposures be reduced to the lowest feasible level.[5] ACGIH considers formaldehyde to be a suspected human carcinogen and recommends an exposure level (TLV) of 1 ppm.[6] OSHA has recently reduced its occupational exposure limit (PEL) for formaldehyde to 1 ppm and considers it to be an occupational carcinogen.[7]

C. Total and Respirable Dusts

A chemical and/or substance may be present in inhaled air in a solid or liquid particle form, thus constituting an aerosol. The potential of a particle for becoming a health hazard depends on its composition and ability to penetrate to target regions within the respiratory tract. The property of any particle which determines its ability to reach the lower, alveolar regions of the lung, is aerodynamic diameter, which is measured in microns (0.000001 meters). Respirable dust is that portion of particulate matter in inhaled air that has an aerodynamic diameter which allows the particle to descend to the lower portions of a person's lungs. Traditionally, all particles with an aerodynamic diameter of 10 um or less have been considered respirable. The ACGIH has further defined this by dividing respirable dust into "particle size-selective sampling criteria for airborne particulate matter" based on aerodynamic diameter and area of particle deposition in the respiratory tract.[6] The ACGIH's criteria[6] are as follows:

a. Inspirable Particle Mass-those materials which are hazardous when deposited anywhere in the respiratory tract. These are typically particles with an aerodynamic diameter less than 100 um.

b. Thoracic Particle Mass-those materials which are hazardous when deposited in the lung airways and the alveolar region. These are particles with an aerodynamic diameter of 10 um or less.

c. Respirable Particle Mass-those materials which are hazardous when deposited in the alveolar region. These are particles with an aerodyanamic diameter of 3.5 um or less.

OSHA's occupational exposure limit (PEL) for total dust is 15 milligrams per cubic meter (mg/m^3) and for respirable dust is 5 mg/m^3.[7] The ACGIH recommended exposure limit (TLV) for total nuisance dust is 10 mg/m^3.[6] These standards are for dust which contains no asbestos and less than 1% free silica.

VI. RESULTS AND DISCUSSION

A. Air Sampling

The data from the area and personal breathing zone air sampling can be found in Tables 1, 2, 3, and 4. From Table 1, 10 of 17 (59%) area air samples had formaldehyde concentrations above 0.1 ppm, with all of these levels being found in the threader and spooling areas. The formaldehyde levels within these areas are 8 to 30 times higher than outside ambient levels, but are still below the corresponding OSHA PEL and ACGIH TLV. Typically, these formaldehyde concentrations are at levels which may produce symptoms of irritation in some workers.

Data from the respirable and total resin dust sampling are presented in Tables 2 and 3. The total dust samples were area air samples taken at the work stations for various thread drawers and spoolers. The respirable dust samples were taken in the personal breathing zone of selected thread drawers and spoolers. The total and respirable dust levels were very low, with the respirable dust levels about 50 times lower than the OSHA PEL. All but one of the breathing zone respirable dust samples had levels of 0.1 mg/m^3, with the exception one level of 0.2 mg/m^3.

Four area air samples (three in the thread drawing area and one in the spooling area) were taken to identify hydrocarbons in the workroom air. As shown in Table 4, very low levels (between 0.17 and 0.18 ppm) of 1,1,1-trichloroethane, trace amounts of toluene, xylene, and various alkyl-substituted benzenes, were found in the samples. The 1,1,1-trichloroethane levels are over 1900 times lower than established exposure limits.

B. Medical

Fourteen employees were selected randomly from a company supplied list of the 39 workers employed as spoolers and thread drawers. Workers interviewed were asked to describe the symptoms they experienced while working or handling lace and tricot products. Symptoms reported include sore itchy nose (46% of those interviewed); itchy skin (38%); cracked, dry skin (23%); and headaches (23%). Thirteen of the interviewed workers (93%) described a persistent presence of fabric dust in their nasal passages and nasal secretions.

C. Suspected Irritant Lace Versus Other Lace

In order to determine if the chemical treatment and/or physical characteristics of the lace products were responsible for an

increase in upper airway irritation, the NIOSH investigators first compared suspected irritant laces to the entire production runs from two, one week periods (June 8-12, 1987 and August 3-7, 1987). The following parameters of each lace product were compared: lot number, pattern number, color, dye formulation, number of bands, finish number, melamine-formaldehyde concentration, and processing time. No distinguishing physical or chemical characteristic was observed in suspected irritant laces. Furthermore, laces identified as being irritating by employees, as well as other laces, varied with respect to many or all parameters reviewed. No distinguishing characteristic was observed that could account for the employees' perception that certain laces were more irritating than others.

Next, the NIOSH investigators compared the results from area air sampling performed at thread drawing machines working suspected irritant lace to those from thread drawing machines working other lace. During NIOSH's follow-up survey on May 25, 1988, thread drawing machines numbered 004, 005, and 007, worked lace from the suspected irritant patterns. The formaldehyde levels at these three work stations were 0.09, 0.14, and 0.15 ppm (Table 1), with a mean level of 0.13 ppm. The mean formaldehyde level for the thread drawing machines working other lace was 0.09 ppm. These means are not significantly different ($p=0.08$). Respirable resin dust exposures and total dust levels can be compared in a similar manner using Tables 2 and 3. For air samples taken from thread drawing machines 004, 005, and 007 or employees at these workstations, the personal exposure levels to respirable dust and the total dust levels were all 0.1 mg/m^3.

Although the review of quality control data and the industrial hygiene sampling found no evidence that would indicate an increased irritative potential for any of the fabric patterns examined, chemical analysis did show that all the laces tested released formaldehyde at room temperature. The levels of latent formaldehyde off-gassing from bulk samples of the lace are shown in Figures 1 and 2. The formaldehyde levels from suspected irritant patterns fall within the range of levels observed in other patterns. Although different laces may give off different amounts of formaldehyde, the distribution of levels did not correspond to the employees' impressions of which laces were irritating.

The mechanical agitation of the fabrics during thread drawing and lace spooling generates an inspirable dust. This dust, particulate forms of the treated fabric, will release formaldehyde at the same rate as the intact fabrics, and perhaps at a greater rate because of increased surface area. Because of the presence of inspirable dust and the release of formaldehyde from the fabrics tested, we

believe that the irritative effects experienced by the thread drawers and spoolers could be the result of exposure to formaldehyde released from the dust. Previous research has demonstrated this phenomenon.[8] Dusts generated during the production of melamine-formaldehyde resin, and in the manufacturing of dishwares and decorative laminates from the same resin, was found to contain free formaldehyde which off-gassed from the particles. Treated fabric particulates are aerosolized and then deposited on the skin and in the respiratory system where, because of direct contact with moist skin and mucous, formaldehyde can elicit irritant effects.

VII. RECOMMENDATIONS

The following recommendations are made per the conditions encountered and the data collected during the NIOSH surveys:

1. The ventilation in the thread drawing and spooling room should be upgraded by increasing the amount of mechanical dilution ventilation to reduce formaldehyde levels to the lowest feasible level.

2. Native Textiles should investigate the possibility using a resin system that either contains less formaldehyde, or is less likely release formaldehyde upon application to the lace.

3. All workers operating thread drawing and spooling machines should be provided with and wear NIOSH-approved respirators suitable for removing dust from inhaled air.

4. All exposed skin surfaces on workers' arms and hands should be covered to prevent skin contact with the resin dust.

5. Workers who are sensitive to formaldehyde should be given the option of reassignment to other areas with reduced formaldehyde levels.

6. Workers in the ARTOS frame area who handle the melamine-formaldehyde resin should use appropriate personal protective equipment. This can include respirators, faceshields, goggles, gloves, and impervious clothing.

VIII. REFERENCES

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

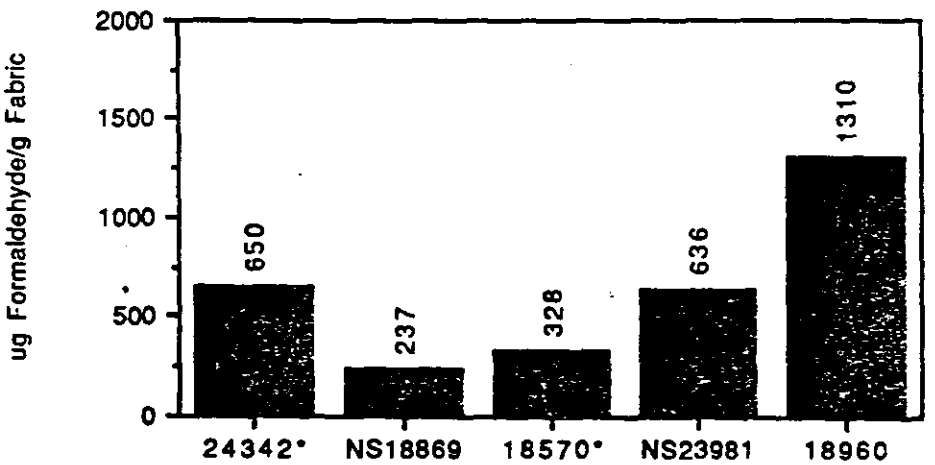
1. Plant Manager, Native Textiles.
2. Technical Director, Native Textiles.
3. President, Communication Workers of America Local 1139.
4. Safety and Health Officer, Communication Workers of America Local 1139.
5. NIOSH Boston Region.
6. OSHA Region II.

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days

Figure 1

Latent Formaldehyde Off-gassing From Lace

Native Textiles
HETA 87-370
May 25, 1988



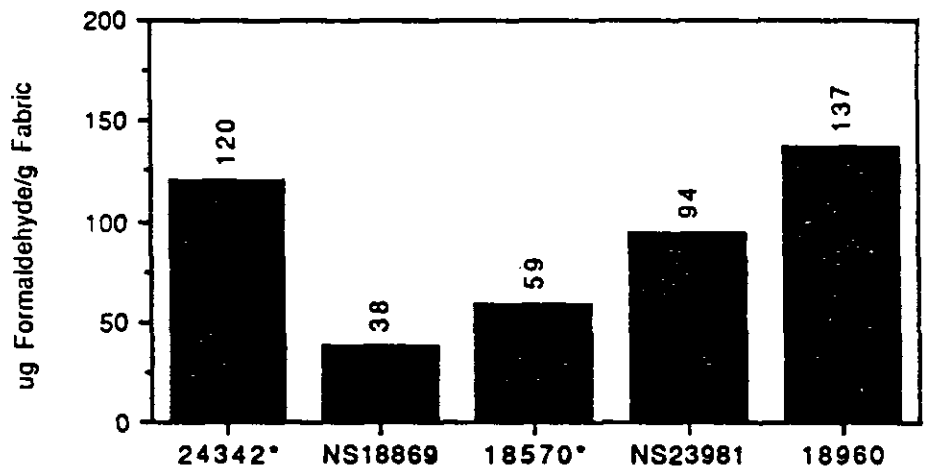
Lace Heated to 50 Degrees Centigrade

*-Indicates Suspected Irritant Pattern

Figure 2

Latent Formaldehyde Off-gassing From Lace

Native Textiles
HETA 87-370
May 25, 1988



Lace Not Heated

*-Indicates Suspected Irritant Pattern

Table 1

Results of Area Air Sampling for Formaldehyde

Native Textiles
HETA 87-370

August 26, 1987 & May 25, 1987

Sample Location	Sample Time	Sample Volume[1]	Concentration[2]
Threader 004[3]	0841-1154	129	0.28
Threader 015[3]	0900-1149	102	0.26
ARTOS Frame[3]	0958-1159	104	0.06
Outside Air[3]	0905-1156	104	0.008
Threader 008	0854-1358	295	0.11
Threader 009	0856-1356	250	0.11
Threader 010	0858-1400	291	0.12
Threader 003	0859-1033	94	0.09
Threader 001	0859-1425	305	0.07
Threader 015	0901-1418	312	0.08
Threader 013	0902-1415	310	0.08
Threader 004[4]	0739-1410	385	0.09
Threader 007[4]	0752-1353	279	0.15
Threader 005[4]	0704-1351	352	0.14
Spooler 030	1112-1405	170	0.12
Spooler 028	1113-1402	158	0.11
Spooler 022	1107-1402	173	0.13
OSHA PEL			1.0
ACGIH TLV			1.0
NIOSH REL			LFL
LOD			3.0 ug/sample
LOQ			7.7 ug/sample

[1] Sample volumes expressed in liters of air.

[2] Concentrations expressed in parts per million of formaldehyde.
LFL-Lowest Feasible Limit

[3] These samples were obtained on August 26, 1987; the remaining samples were obtained on May 25, 1988.

[4] This threader worked a pattern of lace which was of the suspected irritant patterns.

Table 2

Results of Area Air Sampling for Dust

Native Textiles
HETA 87-370

May 25, 1988

Sample Location	Sample Time	Sample Volume[1]	Concentration[2]
Threader 003	0825-1033	253	0.2
Threader 001	0827-1556	880	0.2
Threader 015	0829-1554	881	0.2
Threader 002	0830-1552	871	0.1
Threader 009	0836-1544	841	0.1
Threader 008	0837-1542	850	0.1
Threader 010	0838-1545	837	0.1
Threader 004[3]	0739-1559	978	0.1
Threader 007[3]	0752-1559	974	0.1
Threader 005[3]	0704-1539	1012	0.1
Spooler 022	0905-1548	796	0.3
Spooler 030	0906-1550	800	0.2
Spooler 034	0909-1605	817	0.2
Spooler 028	0910-1602	799	0.04
Spooler 025	0912-1604	816	0.3
OSHA PEL			15.0

[1] Sample volumes expressed in liters of air.

[2] Concentrations expressed in milligrams of dust per cubic meter of air.

[3] This threader worked a pattern of lace which was of the suspected irritant patterns.

Table 3

Results of Personal Sampling for Respirable Dust

Native Textiles
HETA 87-370

May 25, 1988

Sample Location	Sample Time	Sample Volume[1]	Concentration[2]
Threader 013	0801-1507	724	0.1
Threader 004[3]	0803-1508	723	0.1
Threader 001	0854-1033	168	0.2
Threader 003	0745-1029	277	0.1
Threader 014	0742-1511	763	0.1
Threader 007[3]	0730-1459	763	0.1
Threader 010	0731-1505	772	0.1
Threader 008	0725-1529	813	0.1
Threader 009	0723-1458	774	0.1
Threader 005[3]	0705-1529	839	0.1
Spooler 022	0917-1529	614	0.1
Spooler 030	0926-1529	597	0.1
Spooler 034	0923-1529	606	0.1
Spooler 028	0920-1529	609	0.1
Spooler 025	0919-1529	586	0.1
OSHA PEL			5.0

[1] Sample volumes expressed in liters of air.

[2] Concentrations expressed in milligrams of respirable dust per cubic meter of air.

[3] This threader worked a pattern of lace which was of the suspected irritant patterns.

Table 4

Results of Area Sampling For Hydrocarbons

Native Textiles
HETA 87-370

May 25, 1988

Sample Location	Sample Time	Sample Volume[1]	Concentration[2]
Spooler 032	0900-1437	329	0.17
Threader 013	0900-1437	326	0.17
Threader 007	0900-1437	332	0.18
Threader 003	0900-1431	323	0.17
OSHA PEL			350
NIOSH REL			350
ACGIH TLV			350

[1] Sample volumes expressed in liters of sample air.

[2] Concentrations expressed in parts per million of 1,1,1-trichloroethane.

Other hydrocarbons identified in trace amounts:

Toluene
Xylene
Various alkyl substituted benzenes; such as trimethylbenzenes, methylethylbenzene, etc.