HETA 97-0219-2708
Active Industries, Inc.
Clifton Park, New York

David C. Sylvain, CIH

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.

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by David C. Sylvain, CIH, of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Desktop publishing by Nichole Herbert and Pat Lovell. Review and preparation for printing was performed by Penny Arthur.

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Health Hazard Evaluation Report 97-0219-2708
Active Industries, Inc.
Clifton Park, New York
September 1998

David C. Sylvain, CIH

SUMMARY

In May 1997, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from an employee of Active Industries, Clifton Park, New York. The HHE request stated that employees in the Specialized Machine Operations (SMO) area were experiencing sore throats, rashes, eye irritation, and upper respiratory congestion. The request indicated that the source of the health problems was mica, fiberglass, and Kevlar® dust, released during the manufacture of electrical insulation products. On November 11 - 12, 1997, a NIOSH investigator conducted a site visit which included an opening conference, records review, walk-through inspection, informal discussions with employees, and air sampling.

Total particulate concentrations in SMO, measured in personal breathing zone (PBZ) and area samples during shearing and chopping, were 0.23 milligrams per cubic meter (mg/m^3) and 0.15 mg/m^3 respectively. The total airborne fiber concentration during this period in SMO was 0.095 fibers per cubic centimeter (f/cc) (measured in a single area sample). Sampling, which was conducted in SMO when the only operation was the shearing of top ripple spring, found total particulate to be below the minimum detectable concentration (MDC) of 0.006 mg/m^3, and the fiber concentration to be 0.095 f/cc. Total particulate and fiber sampling in the Tool Room found 0.21 mg/m^3 and 0.040 f/cc respectively. These samples were collected while top ripple spring was being cut on a bench saw equipped with local exhaust ventilation.

Examination of fiber air samples by phase contrast microscopy at a magnification of 400X, revealed fibers and nonfibrous particulates. Fiber lengths ranged from 5 to 200 micrometer (µm), and diameters ranged from 0.25 to 15 µm. The exception was a single blue, synthetic fiber, which was 20 µm in diameter and >500 µm in length. The diameters of nonfibrous particulates ranged from submicron to 60 µm. The approximate average particulate diameter in the three air samples was 3 to 7 µm with larger agglomerates. Nonfibrous particle morphology was variable, ranging from rounded to angular.

All of the results from samples collected on this date revealed particulate and fiber concentrations which were well below the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs), and other recommended exposure limits for these air contaminants. Based on sample results and observation of work processes, it does not appear that significant concentrations of particulates or fibers are generated in SMO during the processing of ripple spring and epoxy-coated Kevlar. Nevertheless, reports of a cough while chopping epoxy-coated Kevlar, and a rash while handling mica tape, indicate that routine processing of insulation materials may be affecting some workers.

Keywords: SIC 3644 (noncurrent-carrying wiring devices), electrical insulation products, particulates not otherwise classified, PNOC, PNOR, fibers, upper respiratory congestion, dermatitis.

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INTRODUCTION

In May 1997, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from an employee of Active Industries, Clifton Park, New York. The HHE request stated that employees in the Specialized Machine Operations (SMO) area were experiencing sore throats, rashes, eye irritation, and upper respiratory congestion. The request indicated that the source of the health problems was mica, fiberglass, and Kevlar® dust, released during the manufacture of electrical insulation products. The request also indicated that there was "poor air quality" due to inadequate ventilation.

On November 11-12, 1997, a site visit was conducted which included an opening conference, records review, walk-through inspection, informal discussions with employees, and air sampling.

BACKGROUND

Approximately 50 workers were employed at Active Industries' Clifton Park plant at the time of this evaluation. Of these, eight worked in SMO, where various electrical insulation materials are laminated cut, chopped, slit, and/or sheared. Insulation materials, which are received as sheets or rolls, typically consist of various resin-impregnated substrates, and two types of mica sheets (i.e., "flexible" and epoxy-bonded mica). Constituents of the resin-impregnated materials include fully-cured epoxy, polyurethane, polyester, and alkyd resins; and paper, polyester mat, fiberglass cloth, cotton cloth, polyimide film, and Kevlar substrates. One specific type of electrical insulation material is known as "ripple spring." The material safety data sheet (MSDS) for ripple spring describes it as glass-fabric substrate with fully-cured polyimide resin.

The vast majority of operations in SMO consist of the mechanical operations, which are performed on a shear, chopper, and three slitters. Two laminators are used to bond materials using pressure-sensitive acrylic adhesive. Sawing occurs in another room, where sheets of insulating materials are cut on a bench saw. Airborne contaminants in SMO consist of particulates from the various mechanical operations, and vapors from occasional use of solvents and adhesive. The two solvents were identified as "No. 106 Flash Right" (petroleum distillates and 18-22% methylene chloride), and "Safety Solvent Degreaser II" (trichloroethylene and perchloroethylene). Small amounts of these solvents are used by some workers for incidental tasks such as wiping dust off ripple spring, or cleaning the cutting blade on the chopper. A rubber adhesive is used for approximately one-hour per week when droplets of adhesive are applied to 30± strips of Nomex.

The HHE request identified five insulation materials as sources of dust. Information provided by management indicated that these materials were processed as follows:

Side ripple spring: sheets are sheared to length and width (two passes through the shear) – 10-hours/week;

Epoxy-coated Kevlar: fabric is received as a roll which is sheared into 36" x 36" sections, cut to width, and chopped – 10-hours/week;

Epoxy-bonded press-cured flexible mica: sheets are not processed every week – 30-hours/month (8-hours/week when processed);

Manniglass: fabric is slit and chopped;

Fiberglass roving: roving is wound onto spool, bagged, and boxed, – 3-hours/week.

Personal protective equipment (PPE) available in SMO includes Tyvek® suits (for cutting manniglass), respirators, hearing protection, and safety glasses. Respirator training is provided by the department supervisor.

METHODS

The HHE consisted of a review of the Occupational Safety and Health Administration (OSHA) Log and Summary of Occupational Injuries and Illnesses (OSHA-200 Log) and MSDSs, and observation of work practices, engineering controls, and PPE. On November 13, 1997, air samples were collected to evaluate employee exposure to total airborne particulate and fibers.

Four total particulate samples were collected using a battery-powered sampling pump to draw air through a tared 37-millimeter (mm) diameter Polyvinyl chloride (PVC) membrane filter mounted in a closed-face cassette. The pumps were operated at a nominal flow rate of 2.0 liters per minute (lpm), and were calibrated before and after sampling to ensure that the desired flow rate was maintained throughout the sampling period. The samples were analyzed for total weight according to NIOSH Method 0500 (NIOSH Manual of Analytic Methods, Fourth Edition, 8/15/94) with the following modifications: (1) filters and backup pads were stored in an environmentally controlled room (21±3°C, 50±5% RH) for at least two-hours prior to weighing; (2) tare and gross weights were determined by weighing the filter twice, and using the average of these weighings to calculate total sample weight.

Three airborne fiber samples were collected using a battery-powered sampling pump to draw air through a 25-mm diameter cellulose ester membrane filter mounted in an open-face conductive cowl cassette. The pumps were operated at a nominal flow rate of 2.0 lpm, and were calibrated before and after sampling. Air samples were analyzed for total fiber count according to NIOSH Method 7400 (NIOSH Manual of Analytic Methods, Fourth Edition, 8/15/94). In addition, the size and morphology of fibers and particulates were noted.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the 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 even though 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 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 environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs™)[2]. and (3) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs).[3] In July 1992, the 11th Circuit Court of Appeals vacated the 1989 OSHA PEL Air Contaminants Standard. OSHA is currently enforcing the 1971 standards which are listed as transitional values in the current Code of Federal Regulations; however, some states operating their own OSHA approved job safety and health programs continue to enforce the 1989 limits. NIOSH encourages employers to follow the 1989

OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever is the more protective criterion. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard and that the OSHA PELs included in this report reflect the 1971 values.

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 (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Mica

Mica is a nonfibrous, water-insoluble silicate containing less than 1 percent quartz, which occurs inplate form.[4,5,6] Of the nine species of mica, muscovite (white mica), and phlogopite (amber mica) are the types that are most commonly used for commercial purposes.[5,6] The insulating and thermal properties of mica have resulted in its use in the electronic and electric products industries. Mica is also used in the manufacture of roofing shingles, wallpaper, and rubber.[4,5]

Studies of pneumoconiosis among workers exposed to mica dust indicate a dose-related association between mica dust and pneumoconiosis.[4,6] Other symptoms include chronic cough and dyspnea; and, less frequently, weakness and weight loss.[4]

The NIOSH REL and ACGIH TLV for mica containing <1 percent quartz is an 8-hour TWA of 3 milligrams of mica per cubic meter of air (mg/m^3) (respirable fraction). The OSHA PEL is an 8-hour TWA of 20 million particles per cubic foot (mppcf), which is equivalent to 3 mg/m^3.

Fibrous Glass

Fibrous glass is a skin, eye, and respiratory tract irritant. Skin contact commonly results in transitory mechanical skin irritation which is characterized by itching or prickling, especially in skin folds.[7,8,9,10,11] The biological effects of exposure to fibrous glass vary according to fiber dimensions. Large diameter fibers (>3.5 micrometer [µm]) are responsible for irritation of skin, eyes, and the upper respiratory tract irritation, whereas smaller diameter fibers (<3.5 µm) can enter gas exchange regions of the lung. Experimental studies have indicated fibrogenic and carcinogenic effects when long (>10 µm length) and thin (< l µm diameter) fibers were implanted in the pleural or peritoneal cavities of animals; however, the biological effects from this type of exposure are difficult to interpret, since they cannot be extrapolated to conditions of human exposure.[8,11]

The NIOSH REL for fibrous glass is 5 mg/m^3 (total particulate) as an 8-hour TWA, with a limit of 3 fibers per cubic centimeter of air (f/cc) for fibers $\leq$3.5 µm in diameter, and $\geq$10 µm in length. The REL is based on increased health concern of fibrosis and respiratory tract irritation in longer, small diameter fibers.[8]

The OSHA PEL for fibrous glass dust is 15 mg/m^3 (total particulate) and 5 mg/m^3 for the respirable fraction, determined as 8-hour averages. The ACGIH TLV for exposure to continuous-filament glass fibers, glass wool fibers, and special purpose glass fibers, is 1 f/cc for fibers > 5 µm in length and < 3 µm in diameter, with an aspect ratio > 5:1 (length to width). In addition, the ACGIH recommends that exposure to the inhalable fraction of continuous filament glass fibers not exceed 5 mg/m^3. The critical effect, which is the basis for the TLV, is irritation.

Particulates, not otherwise classified

Often the chemical composition of airborne particulates does not have an established occupational health exposure criterion. In such cases, it has been the convention to apply generic criteria which are based on the conclusion that these particulates do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. More recent studies, however, indicate that exposure to sufficiently high concentrations of airborne particulates can cause irreversible airway changes.[12]

Formerly referred to as “nuisance dust,” the preferred terminology for the ACGIH TLV criterion is now "particulates (insoluble), not otherwise classified," (PNOC).[13] The current terminology used by OSHA is “particulates, not otherwise regulated,” (PNOR). The OSHA PEL for total PNOR is an 8-hour TWA of 15 mg/m^3; for the respirable fraction, the PEL is an 8-hour TWA of 5 mg/m^3. The OSHA PEL was established to protect workers against significant eye, skin, and other physical irritation. The ACGIH TLV for total PNOC is an 8-hour TWA of 10 mg/m^3; for the respirable fraction, the TLV is an 8-hour TWA of 3 mg/m^3. The TLV is based on toxicological information regarding pulmonary particulate overload of macrophages, and impairment of pulmonary clearance mechanisms.[13] NIOSH has not established a REL for PNOC. After a limited review of the literature, NIOSH concluded that the documentation cited by OSHA was inadequate to support the PEL.[14]

RESULTS

The results of air sampling conducted on November 13, 1997, are presented in Tables 1 and 2. Total particulate concentrations in SMO, measured in personal breathing zone (PBZ) and area samples during shearing and chopping, were 0.23 mg/m^3 and 0.15 mg/m^3 respectively. The worker, who wore the PBZ sample cassette, sheared and then chopped epoxy-coated Kevlar. Another worker sheared top ripple spring while the coated Kevlar was being chopped nearby, thus particulates from both of these operations are likely to have been collected in the area sample. (The chopper and the shear are located within a few feet of each other.) The total airborne fiber concentration during this period in SMO was 0.095 f/cc (measured in a single area sample).

During the afternoon, sampling was conducted in SMO when the only operation was the shearing of top ripple spring. Two concurrent one-hour samples found total particulate to be below the minimum detectable concentration (MDC) of 0.006 mg/m^3, and the fiber concentration to be 0.095 f/cc.

Total particulate and fiber sampling in the Tool Room found 0.21 mg/m^3 and 0.040 f/cc respectively. These samples were collected while top ripple spring was being cut on a bench saw equipped with local exhaust ventilation.

Examination of fiber air samples, by phase contrast microscopy at a magnification of 400X, revealed nonfibrous particulates with diameters ranging from submicron to 60 µm. The approximate average particulate diameter in the three air samples was 3 to 7 µm with larger agglomerates. Nonfibrous particle morphology was variable, ranging from rounded to angular. Fiber lengths ranged from 5 to 200 µm, and diameters ranged from 0.25 to 15 µm. The exception was a single blue, synthetic fiber, which was 20 µm in diameter and >500 µm in length.

DISCUSSION

All air samples collected on this date revealed particulate and fiber concentrations well below the PELs and RELs for the measured air contaminants. Based on sample results and observation of work processes, it does not appear that significant concentrations of particulates or fibers are generated in SMO during the processing of ripple spring and epoxy-coated Kevlar.

Even though it appears that only low levels of airborne contaminants are present in SMO, health effects were reported among SMO employees. One person reported a cough that he believed was caused by epoxy-Kevlar dust which was generated while chopping this material. The cough was reported to have subsided with use of a respirator.

The chopper was not equipped with local exhaust ventilation (LEV); however very little, if any, dust was visible during chopping. Upon examination of dust that had accumulated on the chopper, the dust was found to be somewhat "sticky." Because of the sticky nature of the epoxy-Kevlar dust, it appeared that the dust would adhere to LEV ductwork and fan blades, which would preclude the use of LEV to control airborne dust.

Another individual reported that he had experienced a rash while working with mica tape. This individual had worked with mica tape for approximately one year prior to the appearance of the rash. After that time, a rash appeared around his neck and on his arms, which reportedly spread to other parts of his body. He reported that the rash appeared during the work week, and disappeared over the weekend. (A rash was not present at the time of the site visit, nor was the tape being used.) Other work activities which may have been occurring concurrently with use of mica tape are not known.

Rolls of cellophane-wrapped tape are received and stored in sealed five-gallon pails. Inspection of an unwrapped roll of mica tape revealed a mild odor of methyl ethyl ketone (MEK). Although it seems unlikely that use of the tape would result in a significant airborne solvent exposure, it is conceivable that skin contact with solvent in the tape, perhaps in combination with exposure to airborne particulates or fibers, might contribute to, or exacerbate, dermatitis. The role that MEK and the mica tape might have in the reported rash is unclear, as the rash was described as occurring on parts of the body which would not be expected to be in contact with the tape.

No illnesses were reported in the OSHA-200 Log for 1994 - 1997. Informal discussions with workers did not indicate any health concerns other than those involving the cough and rash. It was not determined if either of these conditions had been brought to the attention of the employer.

It was not possible to assess exposure to mica dust, as mica was not processed at the time of the site visit. However, based on observations, sampling data for other materials, and information provided by management and employees, it appears that exposures to mica dust may be similar to those resulting from the processing of other materials. Assuming this to be true, exposure to mica dust could be expected to be below the PEL and RELs. Nevertheless, air sampling for mica dust would provide a much more reliable estimate of worker exposure than an assessment based on the preceding information and data.

In addition to materials listed in the HHE request, insulation materials are sometimes received from customers which are processed in SMO, and then returned to the customer. It was reported that some customers have not provided MSDSs for insulation materials that are processed in SMO. Although no "unusual" materials were reported, an MSDS should be provided for all materials to ensure that employees know exactly what they are working with. Customers should be reminded that they are required to provided MSDSs per the OSHA Hazard Communication Standard, 29 CFR 1910.1200 so that the information can be made available to all employees who work with these materials.

CONCLUSIONS

Air sampling and workplace observations indicate that overexposure to airborne contaminants is unlikely in SMO during the observed operations. Nevertheless, reports of a cough while chopping epoxy-coated Kevlar, and a rash while handling mica tape, indicate that routine processing of insulation materials may be affecting some workers.

RECOMMENDATIONS

The following recommendations are based on observations made during this survey, and are intended to ensure the health of workers in SMO.

1. MSDSs should be available for all customer-supplied materials, as well as for Active Industries'

own insulation materials. Customers should be reminded that the OSHA Hazard Communication Standard, 29 CFR 1910.1200, requires that a MSDS be provided for each customer-supplied material so that chemical hazard information can be provided to Active Industries' employees.

2. Although it appears that airborne mica concentrations are not likely to present a health hazard, PBZ air samples should be collected to assess exposure to airborne mica dust during processing of mica-containing insulation materials. The New York State OSHA Consultation Program could be contacted for further assistance in assessing exposure to mica dust, and compliance with OSHA regulations.

3. Workers should be encouraged to report all possible work-related skin problems. These problems should be investigated on an individual basis by the company in consultation with a health care provider. Because the work-relatedness of skin diseases may be difficult to prove, each person with possible work-related skin problems should be evaluated by a physician, preferably one with expertise in occupational/dermatological conditions.

4. When feasible, skin contact with irritant chemicals should be controlled by substituting less irritating materials, and/or through use of engineering controls. Where substitution and engineering controls cannot be used, skin should be protected by using appropriate PPE, such as clean gloves, protective coveralls, and sleeve protectors; however, the introduction of PPE must be considered carefully, since PPE may actually create problems if it becomes contaminated with skin irritants, or if the PPE itself irritates the wearer's skin. The effectiveness of PPE depends on the specific exposure, and the types of PPE used. PPE selection should be based on information in the specific MSDSs for the materials being processed. For protection against MEK, appropriate PPE materials include butyl rubber, and 4H™.[15]

5. Skin that has come in contact with irritants should be washed with soap and water as soon as possible, and any residual soap should also be rinsed from the skin. Special attention should be directed toward soaps and skin cleansers, since they themselves can serve as irritants. Certain components of soaps and moisturizers (e.g., lanolin and fragrances) are known allergens, and may cause contact dermatitis in sensitive individuals.

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Table 1. Air Sampling, Total Particulate. Active Industries (HETA 97-0219)

Sample Type	Location/Operation	Sample No.	Time	Period (minutes)	Volume (liters)	Total Particulate (mg/m³)[1]
PBZ	SMO/Shearing & chopping epoxy-coated Kevlar	3580	0815-1055	160	323	0.23
	Tool Room/Sawing top ripple spring	3592	0820-1134	194	389	0.21
Area	SMO/Shearing top ripple spring; Chopping epoxy-coated Kevlar	3583	0918-1150	152	306	0.15
	SMO/Shearing top ripple spring	3577	1238-1338	60	121	<0.066

1. Average total particulate concentration during sample period.
mg/m^3 = Milligrams of particulate per cubic meter of air.
< = Less than.
PBZ = Personal breathing zone.

Table 2. Air Sampling, Fibers . Active Industries (HETA 97-0219)

Sample Type	Location/Operation	Sample No.	Time	Period (minutes)	Volume (liters)	Fibers (f/cc)[1]
PBZ	SMO/Shearing top ripple spring	1	0935-1140	125	315	0.095
	SMO/Shearing top ripple spring	3	1236-1314	38	95.8	0.16
Area	Tool Room/Sawing top ripple spring	2	0829-1135	186	465	0.040

1. Average fiber concentration during sample period.
f/cc = Number of fibers per cubic centimeter of air.
PBZ = Personal breathing zone.

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