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SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a Health Hazard Evaluation (HHE) dated June 10, 1991, from employees of U.S. Shoe in Cincinnati, Ohio. The request concerned the occurrence of cancers in the Cobblershop area of the Service Department in the Finished Goods Warehouse.

NIOSH investigators visited the facility on October 8 and November 7, 1991. During the initial visit, a walk-through survey, a review of company records, and medical interviews were conducted. NIOSH industrial hygienists evaluated exposures to methyl ethyl ketone (MEK), acetone, naphtha, and benzene in the Finished Goods Warehouse. Noise exposures in the Service, Boxing, and Stock Departments of the warehouse also were evaluated.

Personal breathing zone and general area air samples for MEK and napthas were collected using ORBO™ 90 molecular sieve and activated charcoal sorbent tubes, respectively. Airborne concentrations of MEK ranged from 1.4 to 24.0 parts per million (ppm) over a full shift. The airborne naphtha concentrations ranged between 9.5 and 97.3 milligrams per cubic meter (mg/m^3) of air. Both types of sorbent tube samples were also used to determine airborne acetone concentrations. The airborne acetone concentrations ranged from 1.6 to 30.0 ppm on samples collected with ORBO™ 90 molecular sieve sorbent tubes, and from 1.8 to 41.0 ppm on samples collected with charcoal sorbent tubes. All MEK, acetone, and naphtha concentrations were below their individual evaluation criteria, as well as the criterion for mixtures with similar toxicologic effects. Eight-hour employee noise exposures, expressed as time-weighted averages (TWA), ranged between 77.8 and 86.9 decibels on the A-weighted scale [dB(A)]. These noise levels do not exceed the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit (PEL) of 90 dB(A); however, two did exceed the NIOSH REL and OSHA Action Level of 85 dB(A) for the implementation of hearing conservation requirements.

Private medical interviews were conducted with 11 of the 17 current Cobblershop employees. Additionally, five employees that had previously worked in the Cobblershop were interviewed. The symptoms that employees most commonly associated with working in the area were: (1) headaches; (2) dizziness; (3) eye, nose, and throat irritation; and (4) skin dryness/irritation of the hands. Employees symptoms were predominantly associated with exposure in the work area to cleaning solvent "690," which contains MEK, acetone, and toluene.

Among the 34 women that worked in this area over the last ten years, the company and union representatives identified three cases of breast cancer, one case of renal cell carcinoma, one case of lung cancer, and two cancer cases of unknown primary etiology. Among the five men that worked in this area, one case of prostate cancer was reported. This distribution of cancer is not suggestive of any single occupational cause.

The environmental sampling results from a typical work day indicated that the solvent exposures in the Cobblershop area were all below the relevant evaluation criteria. However, the medical investigation determined that a number of employees were experiencing symptoms consistent with periods of exposure to volatile organic chemicals. The results from two noise dosimeters indicated that the NIOSH REL and OSHA action level of 85 dB(A) were exceeded. The pattern of cancers reported among workers in this facility were neither unusual nor suggestive of any specific cancer-causing agent. Specific information concerning the reduction of worker noise and chemical exposures are given in the "Recommendations" section of this report.

KEYWORDS: SIC 5139 (footwear), cancer, methyl ethyl ketone, acetone, naphtha, benzene, noise.

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a confidential Health Hazard Evaluation (HHE) request dated June 10, 1991, from employees of U.S. Shoe in Cincinnati, Ohio. The request concerned the occurrence of cancer in the Cobblershop area of the Service Department in the Finished Goods Warehouse. The requestor and an employees' union representative subsequently indicated that the employees also were concerned about other potential health effects of the various chemicals with which they worked. On October 8, 1991, NIOSH investigators conducted an initial site visit that included a meeting with employees, management, and union representatives; a walk-through survey of the Cobblershop area; employee medical interviews; and a review of company records.

On November 7, 1991, NIOSH industrial hygienists evaluated exposures to methyl ethyl ketone (MEK), acetone, naphtha, and benzene in the warehouse Service Department and noise exposures in the Service, Boxing, and Stock Departments.

BACKGROUND

The U.S. Shoe Finished Goods Warehouse opened in 1981. It is approximately a 250,000 square foot facility employing 138 workers. Manufacturers send finished shoes to the warehouse for distribution to retailers. Retail stores also send the warehouse returned and damaged shoes for repair and reconditioning. Returned shoes are routed to the Cobblershop area, where they are inspected, cleaned, and reboxed. Fifteen workers are employed in the Cobblershop area. These employees process 100 to 400 pairs of shoes over an 8-hour period, depending on the condition of the shoes. Workers in the Cobblershop area inspect each pair of shoes for residual price stickers, marks, or scuffs, which are cleaned off the shoes with a rag dipped in cleaning solvent. The workers use two solvents in this area, Product "690," which is comprised of 45% MEK, 45% acetone, and 10% toluene, and Product "622," which is comprised of 90% naphtha and 10% heptane, according to the producers' Material Safety Data Sheets.

METHODS

A. Environmental

Personal breathing zone and general area air samples for the chemical constituents of both solvents "690" and "622" were collected in the Cobblershop area. The personal breathing zone samples were collected from eight employees. Each of the employees was asked to wear two Gilian®, Model No. LFS 113 DC, low-flow personal sampling pumps attached to solid sorbent tubes via flexible tubing. One of the two pumps was calibrated at a flow rate of 50 milliliters per minute (mL/min) of air and attached to an activated charcoal sorbent tube, while the other pump was calibrated at 75 mL/min and attached to an Orbo™ 90 molecular sieve sorbent tube. General area air samples were collected from two locations in the Cobblershop using similar methods.

The charcoal sorbent tubes were desorbed for 30 minutes in 1 milliliter (mL) of carbon disulfide. Aliquots of the resulting solutions were then analyzed by a Hewlett-Packard Model 5890A gas chromatograph equipped with a flame ionization detector (GC/FID) for naphtha, acetone, and benzene using variations of NIOSH Methods 1300, 1501, and 1550.[1] The charcoal tube samples were analyzed for the presence of benzene as a possible contaminant in the solvents. The Orbo™ 90 tubes also were desorbed in 1 mL of carbon disulfide and analyzed for MEK and

acetone by GC/FID. NIOSH Method 2500[1] was followed for the Orbo™ tube analysis.

Noise dosimetry was conducted on eight employees who worked at the boxing machine, under conveyors, or at other locations in the warehouse. Area noise samples were also collected with dosimeters at two areas under conveyor belts, including an area in the Stock department and an area which was at a convergence of the conveyors where the noise levels were perceived by employees as being the highest. These noise exposure measurements were taken with Metrosonic Model 301-dB Metrologger dosimeters with 1/4 inch remote microphones clipped to the shirt collars of the workers. General area samples were collected approximately five feet above ground at both locations under the conveyor belts. The Metrologger data were stored in a Metrosonics Model dt-390 Metroreader/Data Collector for later computer analyses of the data. Each dosimeter was calibrated before and after sampling, according to the manufacturer's instructions, with a traceable calibration source from the National Institute of Standards and Technology.

B. Medical

NIOSH medical officers conducted private interviews with 11 of the 17 current Cobblershop employees. Interviewed workers were randomly selected from a list of all Cobblershop employees. Additionally, five workers with previous work experience in the Cobblershop area also were interviewed. Concerns about excess cancer cases occurring among employees in the Cobblershop were addressed by evaluating available medical records, OSHA 200 Logs, and employment records over the last ten years. Accumulated information was then reviewed to determine the number of workers employed in the Cobblershop, the types and number of reported cancer cases, and workplace exposures over this ten year time period.

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 ten 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),[2] 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),(3), and 3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[4] The OSHA PELs may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH RELs, 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 the report, it should be noted that the most stringent standard was used; however, industry is legally required to meet those levels specified by the OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a chemical 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 high short-term exposures.

A. Acetone and MEK

Acetone and MEK are organic solvents classified as ketones.[5] Acetone is a highly volatile and flammable liquid which has been widely used in commercial applications (e.g., nail polish remover, varnishes, glues) for many years.[6] Acetone is considered to be of low risk to human health, because few adverse health effects have been reported despite its widespread use.[7] In the workplace setting acetone is primarily absorbed through inhalation and to a much lesser degree through skin absorption.[6] Symptoms associated with acetone exposure include eye and mucous membrane irritation at concentrations greater than 1000 parts per million (ppm). At higher acetone exposures headaches and lightheadedness have been reported, and at exposures greater than 12,000 ppm central nervous system depression (CNS), dizziness, weakness, and loss of consciousness have been reported.[7] In one case report, ingestion of 200 to 400 mL of acetone caused CNS depression but no long-term health effects. Chronic skin contact to acetone produces a dry, scaly, dermatitis through the removal of natural skin oils.[6]

MEK, similarly to acetone, is absorbed primarily through inhalation and causes irritation of the eyes, mucous membranes, and skin; and at high concentrations may cause CNS depression. In humans, exposure to 100 ppm of MEK caused mild nose and throat irritation; 200 ppm caused mild eye irritation; and 300 ppm was associated with headaches.[7] Exposure of laboratory animals to 10,000 ppm produced CNS depression after five hours.[7] Additionally, studies indicate that MEK by itself does not cause neurologic toxicity of the extremities (peripheral neuropathy), but rather, may potentiate the toxic effects of substances known to cause peripheral neuropathy, such as *n*-hexane.[6]

The National Toxicology Program, in conjunction with other governmental agencies, has found no evidence supporting an association between acetone or MEK exposure and the development of cancer in humans or experimental animals.[16]

The relevant evaluation criteria for acetone and MEK are listed below in ppm.

Compound	NIOSH REL	OSHA PEL	ACGIH TLV
Acetone			
TWA	250	750	750
STEL		1000	1000
Methyl Ethyl Ketone			
TWA	200	200	200
STEL	300	300	300

B. Naphthas

Petroleum naphtha is comprised mainly of aliphatic hydrocarbons.[8] Effects from exposure to these solvents are primarily acute, unless significant amounts of substances that have chronic toxicity are present, such as benzene or glycol ethers. Epidemiologic studies have shown that exposure to similarly refined petroleum solvents (i.e., mineral spirits, Stoddard solvent) can cause dry throat, burning or tearing of the eyes, mild headaches, dizziness, respiratory irritation, and dermatitis.[9] The petroleum naphtha in solvent "622" used at U.S. Shoe contains *n*-hexane. Prolonged and repeated exposure to *n*-hexane may damage peripheral nerve tissue and result in muscular weakness and loss of sensation in the extremities. Studies indicate that MEK may potentiate peripheral neuropathy caused by *n*-hexane.[6]

Since naphthas are mixtures of aliphatic hydrocarbons, the evaluation criteria are based upon the most commonly available varieties (petroleum ether, rubber solvent, varnish makers' and painters' naphtha, mineral spirits, and stoddard solvents). The NIOSH REL for petroleum distillates (naphtha) is 350 milligrams per cubic meter (mg/m^3) of air as a TWA exposure. In addition, a ceiling concentration limit (15 minutes duration) of 1800 mg/m^3 is stipulated. The OSHA PEL for petroleum distillates (naphtha) is 1600 mg/m^3 TWA, while the PEL for stoddard solvents is 525 mg/m^3. The ACGIH has also established a TLV of 525 mg/m^3 for stoddard solvents. NIOSH, OSHA, and the ACGIH have established evaluation criteria for *n*-hexane of 180 mg/m^3 TWA.

Petroleum naphtha appears to have weak skin cancer causing potential in laboratory mice.[17] The International Agency for Research on Cancer (IARC) has determined that there is only limited evidence implicating petroleum naphtha as a carcinogen in animals and insufficient evidence associating exposure to petroleum naphtha and the development of cancer in humans.[18] However, depending upon the manufacturing process, petroleum naphtha may sometimes contain varying amounts of aromatic hydrocarbons such as benzene. Benzene is classified by IARC as a known human carcinogen and has been associated with the development of leukemia and some lymphomas in humans.[16] The NIOSH REL is 0.1 ppm and classifies benzene as a human carcinogen, the OSHA PEL is 1 ppm, the current ACGIH TLV® is 10 ppm as a suspected human carcinogen. ACGIH has proposed to lower the TLV® to 0.1 ppm and classify it as a proven human carcinogen.[3]

C. Threshold Limit Values for Mixtures

When two or more hazardous substances which act upon the same organ system are present, their combined effect, rather than that of either individually, should be given primary consideration. In the absence of information to the contrary, the effects of the different hazards should be considered as additive. That is, if the sum of the following fractions,

$$C_1/T_1 + C_2/T_2 + \cdots C_n/T_n$$

exceeds unity, then the threshold limit of the mixture should be considered as being exceeded. C_n indicates the observed atmospheric concentration and T_n the corresponding threshold limits.[3]

Synergistic action or potentiation may occur with some combinations of atmospheric contaminants. Such cases at present must be determined individually. Potentiating

or synergistic agents are not necessarily harmful by themselves. Potentiating effects of exposure to such agents by routes other than that of inhalation are also possible, e.g., imbibed alcohol and inhaled narcotic (trichloroethylene). Potentiating effects are characteristically seen at higher exposure concentrations.[3]

D. Noise

Occupational deafness was first documented among metalworkers in the sixteenth century.[10] Since then, it has been shown that workers in many occupations associated with noise have experienced excessive hearing loss. Noise-induced loss of hearing is an irreversible, sensorineural condition that progresses with exposure. Although hearing ability declines with age (presbycusis) in all populations, exposure to noise produces hearing loss greater than that resulting from the natural aging process. This noise-induced loss is caused by damage to nerve cells of the inner ear (cochlea) and, unlike some conductive hearing disorders, cannot be treated medically.[11]

While loss of hearing may result from a single exposure to a very brief impulse noise or explosion, such traumatic losses are rare. In most cases, noise-induced hearing loss is insidious. Typically, it begins to develop at 4000 or 6000 hertz (Hz) (the hearing range is 20 Hz to 20000 Hz) and spreads to lower and higher frequencies. Often, material impairment has occurred before the condition is clearly recognized. Such impairment is usually severe enough to permanently affect a person's ability to hear and understand speech under everyday conditions. Although the primary frequencies of human speech range from 200 Hz to 2000 Hz, research has shown that the consonant sounds, which enable people to distinguish words such as "fish" from "fist," have still higher frequency components.[12]

The OSHA standard for occupational exposure to noise (29 CFR 1910.95)[13] specifies a maximum PEL of 90 dB(A)-slow response for a duration of eight hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship. This means that in order for a person to be exposed to noise levels of 95 dB(A), the amount of time allowed at this exposure level must be cut in half in order to be within OSHA's PEL. Conversely, a person exposed to 85 dB(A) is allowed twice as much time at this level (16 hours) and is within his daily PEL. Both NIOSH, in its Criteria for a Recommended Standard,[14] and the ACGIH, in their TLVs,[3] propose an exposure limit of 85 dB(A) for 8 hours, 5 dB less than the OSHA standard. Both of these latter two criteria also use a 5 dB time/intensity trading relationship in calculating exposure limits.

TWA noise limits as a function of exposure duration are shown as follows:

Duration of Exposure (hrs/day)	Sound Level (dB[A])	
	NIOSH/ACGIH	OSHA
16	80	85
8	85	90
4	90	95
2	95	100
1	100	105
1/2	105	100

1/4	110	115*
1/8	115*	**

* No exposure to continuous or intermittent noise in excess of 115 dB(A).

** Exposure to impulsive or impact noise should not exceed 140 dB(A) peak soundpressure level.

The OSHA regulation has an additional action level (AL) of 85 dB(A) which stipulates that an employer shall administer a continuing, effective hearing conservation program when the TWA value exceeds the AL. The program must include monitoring, employee notification, observation, an audiometric testing program, hearing protectors, training programs, and recordkeeping requirements. All of these stipulations are included in 29 CFR 1910.95, paragraphs (c) through (o).

The OSHA noise standard also states that when workers are exposed to noise levels in excess of the OSHA PEL of 90 dB(A), feasible engineering or administrative controls shall be implemented to reduce the workers' exposure levels. Also, a continuing, effective hearing conservation program shall be implemented.

RESULTS AND DISCUSSION

A. Environmental

The results of exposure monitoring performed in the Cobblershop area for acetone, MEK, and naphtha are presented in Table I. Since acetone was collected and analyzed using both the ORBO™ molecular sieve and charcoal sorbent tubes, two air concentrations were determined for each employee or area. Both of these air concentrations for acetone are included in Table I. The samples were collected over a full shift; the actual duration of the sampling, in minutes, can be calculated by dividing the air volume by 0.075 and 0.05 for the ORBO™ molecular sieve and charcoal sorbent tubes, respectively.

TABLE I
AIRBORNE SOLVENT CONCENTRATIONS
COBBLERSHOP AREA

Sample Description	Air Volume (liters)	ORBO™ Sorbent Tubes		Charcoal Sorbent Tubes	
		MEK (ppm)	Acetone (ppm)	Acetone (ppm)	Naphtha (mg/m^3)
Employee #1	21.5	1.5	2.1	1.9	24.9
Employee #2	22.7	1.4	1.6	1.9	25.9
Employee #3	22.7	24	30	41	67.7
Employee #4	22.6	20	24	27	97.3
Employee #5	22.5	11	12	12	35.6
Employee #6	22.5	3.3	4.0	3.8	22.9

Employee #7	22.3	10	11	13	147
Employee #8	22.2	10	14	20	108
Cleaning Station Area	21.8	14	15	17	61.3
Area between Cleaning Stations	21.7	2.0	1.9	1.8	9.5

Full shift TWA air concentrations of MEK ranged from 1.4 to 24 ppm. Acetone concentrations ranged from 1.6 to 30 ppm on the samples collected with the ORBO™ molecular sieve sorbent tubes, and from 1.8 to 41 ppm on the charcoal sorbent tube samples. Using a paired t-test, the differences between the acetone concentrations obtained on the two sampling media were not statistically significant ($p>0.05$). The air naphtha concentrations ranged between 9.5 and 97.3 mg/m^3. A trace amount of benzene (approximately 0.01 ppm), due to solvent contamination, was detected on one sample (Employee #7). This concentration was at the analytical limit of detection of 0.001 mg, which equates to a minimum detectable concentration of 0.01 ppm, assuming a sampling volume of 33.3 liters. All these concentrations were below their relevant evaluation criteria.

The effects of acetone, MEK, and naphthas were also assumed to be additive for the purposes of this investigation. The threshold limit value for mixtures was calculated by incorporating the most stringent evaluation criterion for each of these compounds into the sum of fractions presented previously. Therefore, if the resulting sum of the following fractions,

$$C_a/250 + C_m/200 + C_n/350$$

(where C_a, C_m, and C_n are the airborne concentrations of acetone, MEK, and naphtha, respectively)

exceeded unity (1), then the threshold limit of this mixture would be considered exceeded. The resulting sum of these fractions ranged from 0.04 to 0.52, which meant that none of the samples exceeded the threshold limit for a mixture of acetone, MEK, and naphtha. It should be noted that the average of the acetone airborne concentrations were used in these calculations.

The airborne solvent concentration variability among employees was most likely due to differences in the employees' individual work practices. Such factors as the amount of solvent used, proper use of the solvent dispensers, and work station cleanliness (e.g., location of solvent-soaked cloths) can influence personal exposures to the solvent vapors. The quantity of shoes cleaned by each employee was also a factor; increasing the work load would most likely increase the amount of solvent used, thereby increasing the potential exposure.

The warehouse, including the Cobblershop area, is equipped with general dilution ventilation. Although this system seemed adequate for most operations, the general dilution ventilation does not typically provide adequate ventilation for the continued use of solvents. Normally, local ventilation is used for this type of activity. Depending upon the amount of solvent use and other factors, employees may be exposed to variable concentrations of solvents for variable periods of time. The sampling performed during this investigation may not be representative of all

possible exposures, since these samples were collected during only one shift on one day.

Personal and area noise dosimetry was conducted in the Service, Boxing, and Stock Departments of the Finished Goods Warehouse. The maximum noise levels for a one minute period ranged from 83 to 98 dB(A). Time-weighted average noise levels ranged between 77.8 and 86.9 dB(A). Although these levels do not exceed the OSHA PEL for noise, some exceeded the NIOSH REL and OSHA Action Level of 85 dB(A). Noise dosimeter results are shown in Table II.

TABLE II
NOISE DOSIMETRY RESULTS
COBBLERSHOP AREA

Sample Description	Maximum 1-min Period [dB(A)]	Time-Weighted Average dB(A)
Freight Writer, Service Dept.	92	82.0
Freight Writer, Service Dept.	87	77.8
Conveyor Intersection Area, Service Dept. - GA	87	85.7
Sorting Machine Employees #1 & #2, Stock Dept.*	98	86.9
Sorting Machine Employees #3 & #4, Stock Dept.*	95	84.0
Box Pile Employees #5 & #6 Stock Dept.*	92	83.4
Sorting Machine Area, Stock Dept. - GA	83	79.0
Box Machine Operator, Box Dept.	96	84.4

GA - general area sample

* Noise dosimeters were worn by two employees. Odd-numbered employees wore the noise dosimeter during the end of their shift (approx. 0800-1215). Even-numbered employees relieved these employees at the same work station and wore the noise dosimeter during the beginning of their shift (approx. 1215-1510).

The two TWA noise levels that exceeded the OSHA action level of 85 dB(A) were measured near convergences of the over-head conveyor system. These areas had been identified by employees as being the noisiest. The real-time sound levels from three of the individual dosimeters are included as graphs in the Appendix.

B. Medical

Private medical interviews were conducted with 11 of the 17 current Cobblershop employees. Additionally, five employees that had previously worked in the

Cobblershop were interviewed. During the interviews, information concerning safety training, personal protection, and medical symptoms/diagnoses was elicited from the workers. The symptoms that employees most commonly associated with working in the facility were: (1) headaches (75%); (2) dizziness (44%); (3) eye, nose, and throat irritation (63%); and (4) skin dryness/irritation of the hands (50%). Ten of the sixteen workers interviewed felt their symptoms were predominantly associated with exposure to cleaning solvent "690" in the work area. The most commonly reported issues of concern to workers were: (1) excessive noise in the Cobblershop Area (69%); (2) inadequate ventilation with respect to solvent usage (especially "cleaning solvent 690") (100%); (3) insufficient lighting for job task demands (50%); and (4) inadequate safety training and information with regard to workplace exposures (100%).

At the request of this NIOSH investigator, company and union representatives identified employees known to have been diagnosed with cancer, and provided the names of all 39 workers (34 women and five men) employed in the Service Department over the last ten years. A total of seven workers were identified as having been diagnosed with eight cases of cancer from the list of all 39 Service Department employees. One worker identified had two types of cancer, and thus accounted for two of the eight cases. Among the 34 women, there were three cases of breast cancer, one case of renal cell carcinoma, one case of lung cancer, and two cancer cases of unknown primary etiology. Employment of the six women in the Service Department ranged from six years to 15 years prior to the identification of their cancers. Among the five men there was one case of prostate cancer. The identified male worker, reportedly had been in a management position and had worked in the Service Department for over 25 years.

Cancers are a group of diseases that share a common feature of the uncontrolled growth and spread of abnormal cells. Cancer is common in the United States. About one in three people will eventually develop cancer. One of every five deaths is from cancer. Among adults, cancer occurs more frequently among men than among women, and the rate of occurrence increases with increasing age.[15]

Cancers often appear to occur in clusters. Cases that are close together in time or space may have a common cause or may be the coincidental occurrence of unrelated causes. The number of cases may seem high, particularly among the small group of people who have something in common with the cases, such as working in the same building or department. When a small number of cases occurs, it usually is difficult to determine whether they have a common cause. Most cancers require a period of 20 to 30 years from time of first exposure to a causal agent till clinical detection. In this situation, workers with cancer were generally exposed to chemicals in the Service Department for less than 15 years prior to diagnosis of their cancers.

The distribution of types of cancer reported among Service Department workers is not unusual; breast, lung, and prostate cancer are among the most common types in the United States. The finding that most of the cases of cancer occurred in women is not surprising since about 85% of the workers in this department are women.

The only substance that workers are exposed to (listed in the material safety data sheets) that is a suspect human carcinogen is naphtha, which may contain varying amounts of aromatic hydrocarbons such as benzene. Most cancer-causing substances are known to cause only one or two different types of cancer. For example, benzene is associated with leukemia and lymphomas in humans. The

pattern of cancers reported among the workers is not suggestive of any specific cancer-causing agent. Breast cancer, which represented almost half of the cancers reported by women workers, occurs in about one of every ten women and presently is not known to have any association with environmental or occupational exposures.[19]

CONCLUSIONS

The environmental sampling results indicated that the solvent exposures in the Cobblershop area were all below the relevant evaluation criteria. However, the medical investigation determined that a number of employees were experiencing symptoms consistent with, but not specific for, periods of exposure to solvents used in their immediate work area. Workers symptoms may be due to: 1) varying exposures to solvents with differing work practices and/or work loads (not observed during this investigation), 2) exposures to solvents through other routes (i.e., skin absorption) not evaluated during this investigation, and 3) sensitivity of individual workers to solvent effects below recommended exposure guidelines.

Service Department workers have noted health symptoms associated with the solvent mixtures they are exposed to; however, their current chemical exposures do not appear to have an appreciable cancer causing potential. While no historical observational data is available with respect to past exposure conditions in the Cobblershop area, it is unlikely that these past exposures are associated with the present cases of cancer given the pattern of reported cancer cases, the time period between exposure and diagnosis of cancer, and the types of exposures. Further investigation would only be warranted if there were: 1) multiple cases of an unusual cancer, 2) unusual circumstances (for example, a large number of cases of one type of cancer occurring among a relatively small number of people doing a particular job), or 3) identifiable exposures that might account for the cases. None of these circumstances apply to the suspected cluster of cases among current and former Service Department employees.

The results from two noise dosimeters indicated that the NIOSH REL and OSHA action limit of 85 dB(A) was exceeded and that a hearing conservation program may be needed to protect exposed employees and reduce noise levels.

RECOMMENDATIONS

The following recommendations are made to help reduce the potential for exposure to MEK, acetone, naphtha, benzene, and noise, and to improve general health and safety conditions in the workplace. These recommendations are based on the environmental sampling results and observations made by the NIOSH investigators.

1. No eating or drinking should be allowed at the work stations where any chemicals are used. Eating or drinking should be only be allowed in the break areas. Proper personal hygiene should be stressed (e.g., hand washing) before eating or drinking and other breaks.

2. Gloves coated with ethylene vinyl alcohol will provide the proper protection against solvents "621" and "690." However, since it is necessary to remove the gloves whenever removing and applying the sticker labels, perhaps, the process could be reorganized so that a worker could clean many shoes before working with the labels or another worker could remove and apply the labels. Additionally, use of hand moisturizing creams should be available and encouraged among workers with solvent exposure.

3. Workers should be trained in the proper use of solvents and in methods of reducing the amount necessary to complete the task. Also, efforts to find substitute solvents with less toxic constituents (without MEK or hexane) should be continued.

4. The feasibility of installing a local exhaust ventilation system to control potential solvent exposures should be investigated. A ventilation contractor, who is experienced with local exhaust ventilation systems, should be consulted during this phase to ensure proper selection, design, and operation.

5. Noise assessments should be conducted for employees working near the Sorting Machine in the Stock Department and near the conveyor intersection area in the Service Department. If warranted by the results of these assessments, a continuing and effective hearing conservation program in compliance with OSHA and NIOSH requirements[13,14] must be administrated for exposed workers. A hearing conservation program includes among other things: baseline and yearly audiograms, and providing at least two different types of effective, hearing protection devices (e.g., plugs, muffs). The feasibility of implementing engineering controls to reduce noise levels should also be investigated.

6. To help in the prevention of fires, all solvent containers should be outfitted with spring-loaded valves. Several of the containers seen by NIOSH investigators have traditional twist-open valves which could result in overflow when the containers are tipped. The solvent-soaked rag containers should be emptied and properly disposed of each night to reduce the risk of spontaneous combustion. Flammable liquid cabinets should be electrically grounded, and proper container bonding should be used with all transporting containers to reduce the presence of static electricity which can serve as a source of ignition. Flammable liquid storage cabinets also should be ventilated. Fire protection standards established by the National Fire Protection Association and OSHA should be met.

7. General housekeeping in the Service Department should be improved with regard to cleaning up dust, cardboard, and other debris which can result in respiratory irritation and pose potential fire and injury hazards (i.e.,. slipping on loose debris).

8. Efforts aimed at increasing job-specific training for workers regarding all pertinent hazardous chemical agents, physical agents such as noise, and safe work practices should be improved. A joint management and employee safety committee could focus on these topics.

9. Continued investigation and monitoring of engineering control systems should be undertaken to prevent symptomatic exposure to solvents.

10. Sufficient lighting in the Cobblershop area should be provided to enable workers to properly perform job tasks.

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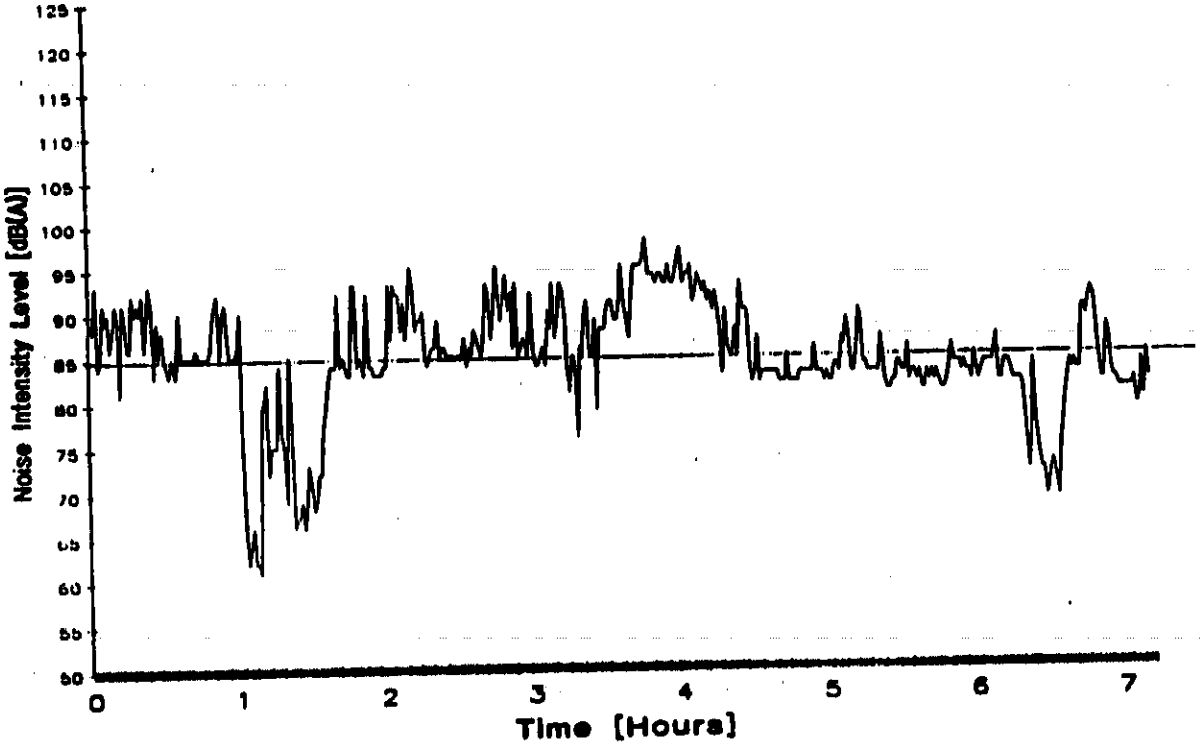
APPENDIX

Noise Dosimeter Real-Time Sound Levels

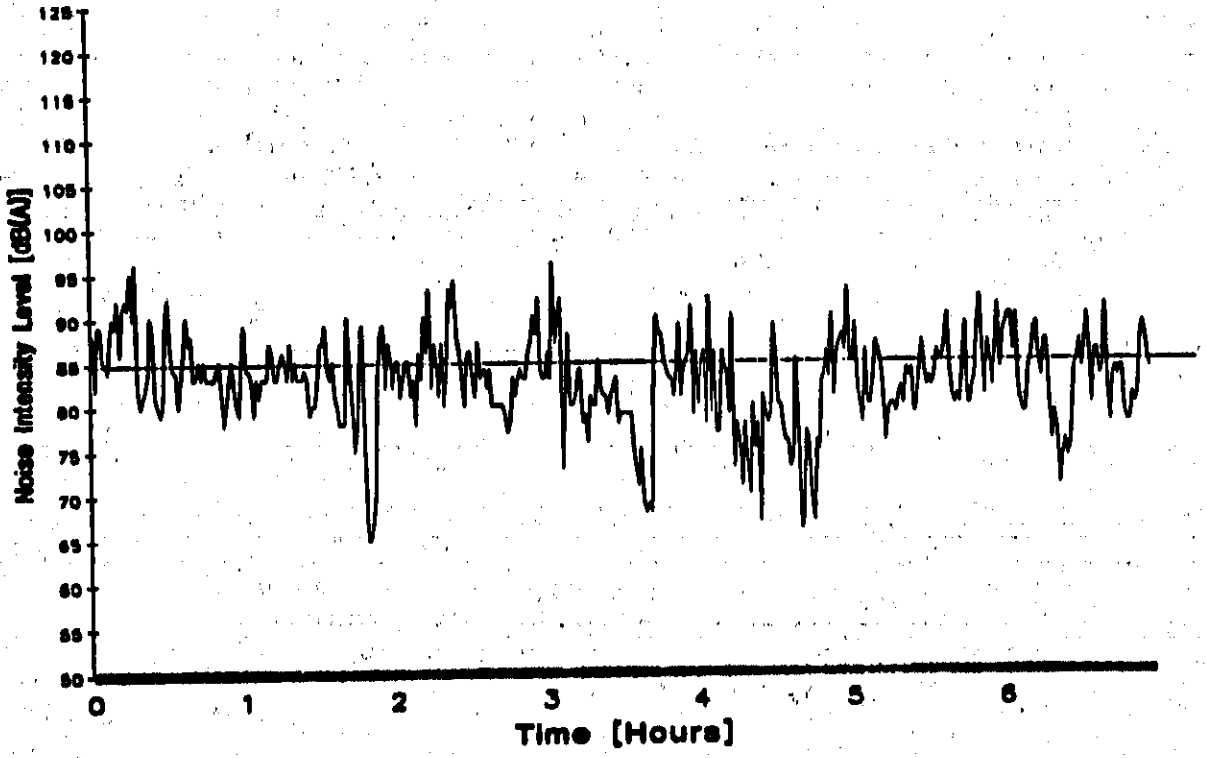
Maximum Average - measured over 1 minute integration period measured by dosimeter

^{L}OSHA - 5 dB exchange rate with a 90 dB(A) criterion sound level as defined by OSHA in 29 CFR 1910.95

U. S. SHOE, HETA 91-270
Cincinnati, Ohio: Nov. 7, 1991
Stock Dept. Employees #1 & #2
Maximum Average (96.0 dB), LOSHA (86.9 dB)



U. S. SHOE, HETA 91-270
Cincinnati, Ohio: Nov. 7, 1991
Box Machine Operator #1
Maximum Average (86.0 dB), LOSHA (84.4 dB)



U.S. SHOE, HETA 91-270
Cincinnati, Ohio: Nov. 7, 1991
Area Sample: Service Dept.
Maximum Average (87.0 dB), LOSHA (85.7 dB)