

HETA 95-0209-2515
Parsons Footwear
Parsons, West Virginia
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I. SUMMARY

On April 7, 1995, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at the Parsons Footwear plant in Parsons, West Virginia. The request stated that employees in the packing department were experiencing sinus problems, headaches, sore throats, hoarseness, dizziness, nausea, lightheadedness, and stomach problems. Employees began experiencing these symptoms in December 1994, after a new formulation of socklining glue was introduced in the packing department.

On May 4, 1995, a site visit was conducted by a NIOSH industrial hygienist and a NIOSH occupational health nurse. Environmental sampling was conducted to determine employee exposure to heptane and toluene from the socklining glue. Employees were interviewed by the occupational health nurse.

Employee exposure to heptane ranged from 41-315 parts per million (ppm). Seven samples were collected from socklining employees and three from production line workers. Exposure was highest for sockliners, with six of the seven (86%) samples having concentrations in excess of the NIOSH Recommended Exposure Limit (REL) of 85 ppm time-weighted average (TWA). Employee exposure to toluene ranged from 20-132 ppm. Exposure to toluene was also highest for sockliners, with three of the seven (43%) having concentrations at or exceeding the NIOSH REL of 100 ppm TWA. Five of the seven (71%) sockliner sample concentrations exceeded the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 50 ppm TWA. No measured exposure exceeded the Occupational Safety and Health (OSHA) Permissible Exposure Limits (PELs) for heptane or toluene. The medical interviews revealed a wide array of health complaints with most pertaining to central nervous system (CNS) effects related to adhesive exposure.

A health hazard exists for socklining employees in the packing department since personal exposures for both heptane and toluene exceeded NIOSH RELs, and toluene exposure exceeded the ACGIH TLV. Employees had health complaints pertaining to CNS effects that were consistent with adhesive exposure. Recommendations are made in Section VIII of this report to reduce adhesive exposure and safeguard the occupational safety and health of packing department employees.

Keywords: SIC 3021 - (rubber and plastics footwear), shoe manufacturing, adhesives, toluene, heptane, CNS effects.

II. INTRODUCTION

On April 7, 1995, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at the Parsons Footwear plant in Parsons, West Virginia. The request stated that employees in the packing department were experiencing sinus problems, headaches, sore throats, hoarseness, dizziness, nausea, lightheadedness, and stomach problems. Employees began experiencing health symptoms in December 1994, after a new formulation of socklining glue was introduced in the packing department.

In response to employee concerns, a joint management and labor safety inspection of the plant was conducted on April 25, 1995. The plant manager, an industrial hygienist with the United Food and Commercial Workers (UFCW) Union International, and the business manager with UFCW Union Local 27, met to discuss employee occupational safety and health issues. Both parties were in agreement that NIOSH should conduct the HHE to determine if a health hazard exists for packing department employees.

On May 4, 1995, a site visit was conducted by a NIOSH industrial hygienist and a NIOSH occupational health nurse. The packing department was examined, and the operations were explained in more detail. Environmental sampling was conducted in the packing department, and employees were interviewed by the occupational health nurse.

III. BACKGROUND

Parsons Footwear, a division of Carter Footwear, Inc., has manufactured shoes in Parsons, West Virginia, since 1973. Major departments in the plant include molding, packing, and shipping. The plant employs approximately 170 workers, represented by UFCW Union Local 27. There are approximately 50 employees working in the packing department of the facility. Employees work from 7:00 a.m. to 3:30 p.m. with a 10-minute break at 9:20 a.m., a 30-minute lunch break at 11:30 a.m., and another 10-minute break at 1:30 p.m. The plant manager is responsible for employee occupational safety and health and the administration of all health and safety programs. Industrial hygiene sampling has been conducted by the plant manager. The plant manager routinely screens for toluene exposure in the packing and glue storage areas using detector tubes. Results have always been less than 10 parts of toluene per million parts of air (ppm), regardless of the particular adhesive in use at the time. This concentration of toluene in air is well below applicable occupational exposure criteria. In addition, the plant manager indicated that the Occupational Safety and Health Administration (OSHA) had conducted environmental air sampling and that the packing department was in compliance.

OSHA sampling data conducted at Parsons Footwear was obtained and reviewed. OSHA had collected four area screening samples for toluene and petroleum distillates on June 9, 1992. Three toluene concentrations in the socklining area were all below 20 ppm. Petroleum distillates were not detected in the single sample collected. No reports of worker overexposure to these contaminants were present in the OSHA record.

Parsons Footwear also has a Safety Committee, which is comprised of a 5-member panel of employees representing all of the plant's departments. The committee meets regularly to discuss health and safety issues and conduct safety inspections of the plant. The safety committee reports their findings directly to the plant manager.

IV. PROCESS DESCRIPTION

Shoe soles are molded to a cloth upper in the molding department. From the molding department, shoes are sent to the packing department. In the packing department the insoles are glued into the shoes by 10 employees called "sockliners." After the insole is installed, the shoes are placed on carts that hold 48 pairs of shoes, the carts are transported to the production line, and the shoes proceed down two conveyor belts. There are seven to nine employees working on each of the four production lines where laces are installed, quality control inspections performed, and the shoes are packaged and boxed for shipment. At the end of the production line is the repair area, where shoes that are pulled from the production line are "touched up" to meet quality control standards.

Adhesives are automatically metered from twin 55-gallon drums (contained in a safety cabinet) to each socklining workstation. Each socklining workstation has a local exhaust ventilation system behind the glue applicator. Sockliners are not required to wear any protective equipment (i.e., safety glasses or gloves) during work but are provided a lanolin-based, solvent-repellent barrier cream (ZEP®Glove™). The barrier cream is applied by sockliners before starting work, and is washed off before lunch. It is reapplied after lunch and washed off before leaving work. At the end of the workshift, sockliners clean their equipment with a citrus-based solvent. Safety glasses and chemical-resistant gloves are provided for clean-up at the end of the workshift and their use is mandatory. An emergency eye wash station is located in the packing department in front of the socklining workstations. The only health and safety program in the packing department of the plant is a hazard communication training program.

The packing department uses the following adhesives: an Adhesives and Chemicals, Inc. product named K-12-LV-2W; an Acxion, Inc. product called C5-C8 Kraton Cement; and a Worthen Industries Inc. hot melt adhesive #9637-4. The plant uses similar adhesives from several different suppliers to prevent dependence on a single product that could cause work stoppages if it were unavailable.

K-12-LV-2W (more commonly referred to as K-12), the adhesive that prompted employee

complaints, was first used in December 1994. K-12 was used by the sockliners during the NIOSH environmental survey on May 4, 1995. The material safety data sheet (MSDS) for K-12 indicates that it is heptane- and toluene-based. The MSDS also states that general mechanical ventilation is usually sufficient to keep product vapor concentrations below occupational exposure criteria and that local exhaust ventilation would be desirable.

V. ENVIRONMENTAL METHODS

The environmental evaluation included collection of 10 full-shift personal breathing zone (PBZ) air samples to evaluate employee exposures to toluene and heptane. Five area samples were also collected at four different locations in the packing department and outside. Bulk samples of the K-12 adhesive were collected for qualitative analysis.

Air samples were collected by drawing air through 150-milligram charcoal tubes at a sampling rate of 20 cubic centimeters per minute (cc/min) for a period of approximately 8.5 hours. Bulk air samples were collected on charcoal tubes at a sampling rate of 200 cc/min for 8 hours. Quantitative analyses of the compounds identified from the bulk analysis were performed on the PBZ and area samples. The charcoal tube samples were prepared and analyzed using a combination of NIOSH Methods 1500 and 1501.^(1,2) Gas chromatography with mass spectrometry detection (GC/MSD) was used for qualitative identification analysis, and a flame ionization detector (GC/FID) was used for quantitative measurement analysis.

The analytical limit of detection (LOD) for both the toluene and heptane analysis was 0.0007 mg/sample, which equates to a minimum detectable concentration (MDC) of 0.04 ppm for toluene and 0.03 ppm for heptane, assuming a sampling volume of 5 liters.

VI. EVALUATION CRITERIA and TOXICOLOGY

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 include the following: (1) NIOSH Recommended Exposure Limits (RELs),⁽³⁾ (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),⁽⁴⁾ and (3) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs).⁽⁵⁾ 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 1989 Code of Federal Regulations (CFR); however, some states operating their own OSHA approved job safety and health programs continue to enforce the 1989 limits which are listed as final rule limits in the 1989 CFR. NIOSH encourages employers to follow the 1989 OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are 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. 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.

Volatile Organic Compounds

Volatile organic compounds describe a large class of chemicals which are organic (i.e., contain carbon) and have a sufficiently high vapor pressure to allow some of the compound to exist in the gaseous state at room temperature. These compounds are typically emitted from adhesives and glues, such as those used in the packing department. Two volatile organic compounds, heptane and toluene, are the major constituents of these adhesives. Below are the occupational exposure criteria for heptane and toluene.

Heptane

Heptane (C₇H₁₆) is an aliphatic hydrocarbon, classified as an alkane, containing seven carbon atoms in a straight chain and is a volatile, flammable liquid. To emphasize that heptane is a straight chain hydrocarbon, a prefix n- (for normal-) is often used. The industrial uses of n-heptane include serving as a fuel and solvent, as a raw material in organic chemical synthesis, and as a component in gasoline and some refined petroleum distillate fractions.⁽⁶⁾

Inhalation of n-heptane can cause loss of appetite, nausea, vertigo, incoordination, giddiness, and other symptoms of central nervous system (CNS) depression.⁽⁷⁾ Skin contact can result in immediate irritation leading to redness and swelling.⁽⁷⁾ The symptoms associated with n-heptane-induced CNS depression appear to be reversible acute effects as opposed to chronic neurotoxic

effects. The NIOSH criteria document for this class of alkanes (which includes pentane, hexane, heptane, and octane) suggests these hydrocarbons have the potential for producing polyneuropathy.⁽⁸⁾ However, the ACGIH TLV committee believes only n-hexane (C₆H₁₄) produces this neurotoxicity.⁽⁶⁾

The OSHA PEL for n-heptane is 500 parts per million (ppm) TWA over an 8-hour workshift. The ACGIH TLV is 400 ppm for an 8-hour TWA, with a corresponding STEL of 500 ppm averaged over 15 minutes. The NIOSH REL for n-heptane is 85 ppm TWA for up to 10-hours and the NIOSH STEL is 440 ppm for a 15-minute duration.

Toluene

Toluene (C₇H₈) is a colorless, aromatic organic liquid containing a six-carbon ring (a benzene ring) with a methyl group (-CH₃). It is a typical solvent found in paints and other coatings, and it is used as a raw material in the synthesis of organic chemicals, dyes, detergents, and pharmaceuticals. It is also an ingredient of gasoline, ranging from 5% to 22%.^(9,10)

Inhalation and skin absorption are the major occupational routes of entry. Toluene can cause acute irritation of the eyes, respiratory tract, and skin. Since it is a defatting solvent, repeated or prolonged skin contact will remove the natural lipids from the skin, which can cause drying, fissuring, and dermatitis.^(7,11) The main effects reported with excessive (inhalation) exposure to toluene are CNS depression and neurotoxicity.⁽⁷⁾ Studies have shown that subjects exposed to 100 ppm of toluene for 6 hours complained of eye and nose irritation, and in some cases, headache, dizziness, and a feeling of intoxication (narcosis).⁽¹²⁻¹⁴⁾ No symptoms were noted below 100 ppm in these studies.

There are a number of reports of neurological damage due to deliberate sniffing of toluene-based glues resulting in motor (muscle) weakness, intention tremor, ataxia (incoordination), as well as brain atrophy.⁽¹⁵⁾ Recovery is complete following infrequent episodes; however, permanent impairment may occur after repeated and prolonged glue-sniffing abuse. Exposure to extremely high concentrations of toluene may cause mental confusion, loss of coordination, and unconsciousness.^(16,17)

The OSHA PEL for toluene is an 8-hour TWA of 200 ppm for an and a 300 ppm ceiling limit. The ACGIH TLV is an 8-hour TWA of 50 ppm for an 8-hour exposure level. This ACGIH TLV carries a skin notation, indicating that cutaneous exposure contributes to the inhalation dose and potential systemic effects. The NIOSH REL for toluene is 100 ppm for up to a 10-hour TWA. NIOSH has also set a recommended STEL of 150 ppm for a 15-minute sampling period.

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,

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

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.⁽⁴⁾ Synergistic action or potentiation may occur with some combinations of atmospheric contaminants. Such cases at present must be determined individually. Potentiating agents are not necessarily harmful by themselves. Potentiating effects of exposure to such agents by routes other than inhalation are also possible. Potentiating effects are characteristically seen at higher exposure concentrations.⁽⁴⁾

VII. RESULTS and DISCUSSION

A. Employee Interviews

On the day of the site visit, the NIOSH occupational health nurse made an attempt to speak to all employees working in the packing department. Thirty-seven of the 48 employees (77%) were interviewed, 10 sockliners and 27 production line workers. All 37 employees surveyed (100%) were female. Questions were asked about tenure with the company and whether or not they had symptoms they felt were work-related. A brief smoking history was also included. Each individual was given the opportunity to submit complaints and suggestions to improve the work environment.

Employee tenure ranged from 3 months to 22 years for employees interviewed in the packing department. The average tenure was 10 years. Eight of the 37 interviewed (22%) were smokers and seven (19%) had smoked previously. Twenty-two (59%) reported to have never smoked. Parsons Footwear is a smoke-free work environment. A designated smoking area is provided for employees outside the main entrance of the facility.

No severe or unusual medical problems were revealed by the interviews. Employees had a wide array of complaints, with most pertaining to central nervous system (CNS) effects related to adhesive exposure. The most frequent health complaints included the following: headache, which was experienced by 35% (13/37) of participants; lightheadedness, 24% (9/37); and dizziness, 24% (9/37). Fewer employees reported sinusitis, nasal irritation, loss of balance,

numbness in the extremities, throat dryness, watering eyes, and cumulative trauma disorders (see Table 1). Fifteen of the 37 interviewed employees (41%) had no complaints.

Employees had several suggestions for improving occupational safety and health at Parsons Footwear (see Table 2). The majority of employees interviewed (43%) felt that increasing the general ventilation in the packing department would solve the problem of adhesive odors. Other suggestions to improve the work environment included the following: installing softer floor mats at each workstation (11%), improving the local exhaust ventilation for sockliner workstations (5%), installing air-conditioning in the plant (5%), increasing ventilation in the restrooms (5%), and improving the hazard communication program by making it easier for employees to obtain MSDSs (1%). Fourteen of the 37 interviewed employees (38%) did not offer any suggestions to improve the work environment.

B. Environmental

At the time of the NIOSH survey the plant was operating at full production. The plant manager indicated that windows in the packing area are normally open and the exhaust and make-up air window fans operating. On the day environmental sampling was conducted most windows were closed and only one window fan was operating. The plant manager expressed concern that employees created "worst-case conditions" for the NIOSH HHE.

The MSDS for K-12 indicated it is composed of 63% heptane, 19% styrene-isoprene copolymer, 10% styrene-butadiene copolymer, and 7% toluene. Qualitative analysis of the bulk sample of K-12 adhesive identified the major components as various C₇-C₈ alkanes (i.e., heptane, octane), toluene, and methyl ethyl ketone (MEK). MEK was not identified in the MSDS for K12.

Table 3 displays worker exposures to heptane and toluene for 10 samples. Seven samples were collected from sockliners and three from production line workers. Employee exposure to heptane ranged from 41-315 ppm. Exposure was highest for the sockliners, with six of the seven (86%) heptane concentrations exceeding the NIOSH REL of 85 ppm TWA. All of the results were below the ACGIH TLV of 400 ppm and the OSHA PEL of 500 ppm TWA.

Employee exposure to toluene ranged from 20-132 ppm. Exposure to toluene was again highest for sockliners, with three of the seven (43%) toluene concentrations at or exceeding the NIOSH REL of 100 ppm TWA. Five of the seven (71%) sockliner results exceeded the ACGIH TLV of 50 ppm TWA. Toluene concentrations for production line worker samples were below all occupational exposure criteria.

The five employee exposures that did not exceed the ACGIH TLV for either heptane or toluene were considered as a mixture. The sockliner exposed to 119 ppm heptane and 47 ppm toluene, while not exceeding either TLV, exceeded the TLV for the mixture. Thus, 6 of the 10 (60%) PBZ air sample results exceeded ACGIH TLVs, and all 6 were from sockliners.

Table 4 displays the area concentrations of toluene and heptane. In the four samples collected in the packing department heptane ranged from 10-37 ppm and toluene concentrations ranged from 6-30 ppm. In a sample collected outside on the front loading dock (negative control), the concentration of heptane was 0.2 ppm, and that of toluene was 0.1 ppm. All area sample results were below occupational exposure criteria. The area samples were relatively low when compared with personal exposures. The personal samples are more representative of employee exposures since area samplers were further away from adhesive application and the workers' breathing zone.

VIII. CONCLUSION and RECOMMENDATIONS

A health hazard exists for socklining employees in the packing department since personal exposures for both toluene and heptane exceeded NIOSH RELs and toluene exposures exceeded the ACGIH TLV. Employees reported CNS effects that were consistent with solvent exposure. The health and safety recommendations of the adhesive manufacture contained in the MSDS were not followed (i.e., adequate ventilation, and eye and dermal protection).

The following recommendations are offered to reduce adhesive exposure and safeguard the occupational safety and health of packing department employees:

- (1) The packing area should be provided with adequate ventilation from the facility's window fans (both exhaust and makeup air) for dilution ventilation. Adequate ventilation is necessary, as stated in the adhesive manufacturer's MSDSs. In addition, a ventilation engineer should be consulted to provide more effective local exhaust ventilation for the sockliner workstations.
- (2) All socklining employees should wear safety glasses during the entire workshift since both the adhesives and barrier cream are eye irritants. The adhesive manufacturer's MSDS recommends "safety glasses, chemical goggles and/or face shields be utilized to safeguard against potential eye contact, irritation, or injury." Although no previous eye injuries have been reported, occupational eye injuries are easily preventable with safety glasses, and their use should be made mandatory.
- (3) The MSDS for K-12 recommends that "the use of gloves which are impermeable to the specific material handled is advised to prevent skin irritation and adsorption." Gloves and protective clothing should be selected based on their permeation and degradation resistance to the adhesives being used by the worker. Employees wore a barrier cream, which is not as effective as gloves. Gloves which offer the best protection against dermal exposure are made from a multiple laminate (composed of polyethylene + ethylene vinyl alcohol + polyethylene).⁽¹⁸⁾ This material has excellent chemical resistance against both hydrocarbons and aromatic hydrocarbons and is currently available in aprons, sleeves, and gloves. For hand protection, the material is only available as a 2-dimensional glove.

The physical properties of these gloves might be inadequate; that is, they are thin with a smooth feeling. Tear or rip, fit, decreased manual dexterity, and impaired hand grip are potential problems. One solution is double gloving. Use the 2-dimensional glove as an inner glove. The outer glove ideally would be a tight fitting latex examination glove (and is inexpensive). The outer glove would be replaced daily, obviating the need for decontamination. Depending on current work practices, sleeve protectors could also be utilized.

- (4) If technically feasible, the preferable method of eliminating the hazard of hydrocarbon exposure for socklining employees would be product substitution, for example, replacing the organic-based adhesive with a water-based adhesive.
- (5) Industrial hygiene sampling should be routinely conducted in the packing department to ensure that packing department employees are not overexposed to socklining adhesives. This is especially important if there are changes in glue formulation or ventilation modifications. Sampling should consist of full-shift personal monitoring. Detector tube sampling, as conducted by OSHA and the plant manager has some limitations since it indicates instantaneous, or short-term, area contaminant concentrations and is not directly comparable with full-shift PELs, RELs, or TLVs. Therefore, detector tubes should be used for screening purposes only. In addition, most detector tubes have a relative standard deviation of 10 to 20%.

IX. REFERENCES

1. NIOSH [1994]. Hydrocarbons, BP 36-126°C: method number 1500. In: Eller PM, ed. NIOSH manual of analytical methods. 4th rev ed., Cincinnati, OH: U.S. Department of Health and Human Service, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-113.
2. NIOSH [1994]. Hydrocarbons, aromatic: method number 1501. In: Eller PM, ed. NIOSH manual of analytical methods. 4th rev ed., Cincinnati, OH: U.S. Department of Health and Human Service, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-113.
3. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.
4. ACGIH [1994]. 1994-1995 threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of

Governmental Industrial Hygienists.

5. Code of Federal Regulations [1989]. 29 CFR 1910.1000. Washington, DC: U.S. Government Printing Office, Federal Register.
6. ACGIH [1986]. Documentation of threshold limit values and biological exposure indices for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
7. Hathaway GJ, Proctor NH, Hughes JP, Fischman ML [1991]. Proctor and Hughes' Chemical Hazards of the Workplace. 3rd ed. New York, NY: Van Nostrand Reinhold.
8. NIOSH [1977]. Criteria for a recommended standard: occupational exposure to alkanes (C₅-C₈). Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77-151.
9. WHO [1989]. IARC monographs on the evaluation of carcinogenic risks to humans: occupational exposures to the petroleum refining; crude oil and major petroleum fuels. World Health Organization 45: 159-201. 1-8 March 1988.
10. ENVIRON Corporation [1990]. Summary report on individual and population exposures to gasoline. Arlington, VA: ENVIRON Corporation. November 28.
11. NIOSH [1973]. Criteria for a recommended standard: occupational exposure to toluene. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 73-11023.
12. WHO [1981]. Recommended health-based limits in occupational exposure to select organic solvents. Geneva: World Health Organization, Technical Report Series No. 664.
13. Benignus VA [1981]. Health effects of toluene: a review. Neurotoxicology 2:567-568.
14. Anderson I, et al [1983]. Human response to controlled levels of toluene in six-hour exposures. Scand J Work Environ Health 9:405-418.
15. EPA [1983]. Health assessment document for toluene. NTIS. Washington, DC: Environmental Protection Agency.
16. Bruckner JV, Peterson RG [1981]. Evaluation of toluene and acetone inhalant abuse I. Pharmacology and pharmacodynamics. Toxicol Appl Pharmacol 61:27-38.

17. Bruckner JV, Peterson RG [1981]. Evaluation of toluene and acetone inhalant abuse II. Model development and toxicology. *Toxicol Appl Pharmacol* 61:302-312.
18. Forsberg K, Mansdorf SZ [1993]. Quick selection guide to chemical protective clothing. 2nd ed. New York, NY: Van Nostrand Reinhold Company.

Table 1. Health Effects Experienced While at Work

Parsons Footwear - Packing Department
Parsons, West Virginia
May 4, 1995
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| Health Effects of 37 Workers | Percent of Workers Who Frequently Experienced Symptoms While at Work |
|--|---|
| Headache | 35 % |
| Lightheadedness | 24 % |
| Dizziness | 24 % |
| Sinusitis | 19 % |
| Nasal Irritation | 8 % |
| Loss of Balance | 5 % |
| Numbness or Tingling in fingers or toes | 5 % |
| Throat Dryness | 5 % |
| Watering Eyes | 5 % |
| Carpal Tunnel Syndrome | 5 % |
| None | 41 % |

The following symptoms were reported only once (3%): tired or weak, trouble remembering, bronchitis, chest pain, shortness of breath, rash, tightness around eyes, constant runny nose, bad taste in mouth, nose dryness, back pain, neck pain, muscle spasms, bursitis, and arthritis.

Table 2. Employee Suggestions to Improve Work Environment
Parsons Footwear - Packing Department
Parsons, West Virginia
May 4, 1995
HETA 95-0209

| Employee Recommendation | Percent of 37 Workers Making Recommendations |
|--------------------------------------|---|
| Increase General Ventilation | 43 % |
| Softer Floor Mats | 11 % |
| Improve Local Exhaust Ventilation | 5 % |
| Install Air-conditioning | 5 % |
| Increase Ventilation in Bathroom | 5 % |
| Improve Hazard Communication Program | 1 % |
| None | 38 % |

Table 3. Full-shift Employee Exposures to Toluene and Heptane
 Parsons Footwear - Packing Department
 Parsons, West Virginia
 May 4, 1995
 HETA 95-0209

| Employee Job Title | Heptane (ppm) | Toluene (ppm) |
|---------------------------|--------------------------|--------------------------|
| Sockliner | 315 | 132 |
| Sockliner | 241 | 106 |
| Sockliner | 243 | 100 |
| Sockliner | 183 | 90 |
| Sockliner | 213 | 82 |
| Sockliner | 119 | 47 |
| Sockliner | 80 | 34 |
| Production Line Lacer | 80 | 38 |
| Production Line Inspector | 41 | 21 |
| Production Line Inspector | 44 | 20 |
| <i>NIOSH REL</i> | <i>85</i> | <i>100</i> |
| <i>ACGIH TLV</i> | <i>400</i> | <i>50</i> |
| <i>OSHA PEL</i> | <i>500</i> | <i>200</i> |

Table 4. Full-shift Area Concentrations of Toluene and Heptane
Parsons Footwear - Packing Department
Parsons, West Virginia
May 4, 1995
HETA 95-0209

| Sampling Location | Heptane (ppm) | Toluene (ppm) |
|---|--------------------------|--------------------------|
| Above Socklining Workstation #1 | 37 | 30 |
| Below Socklining Workstation #7 | 37 | 17 |
| Socklining Supervisors Area Shelf | 32 | 16 |
| Production Line Repair Area Workstation | 10 | 6 |
| Outside on Front Loading Dock | 0.2 | 0.1 |
| <i>NIOSH REL</i> | <i>85</i> | <i>100</i> |
| <i>ACGIH TLV</i> | <i>400</i> | <i>50</i> |
| <i>OSHA PEL</i> | <i>500</i> | <i>200</i> |

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1. Parsons Footwear
2. United Food and Commercial Workers Union - International
3. United Food and Commercial Workers Union - Local 27
4. OSHA Region III
5. Confidential Requesters

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.

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