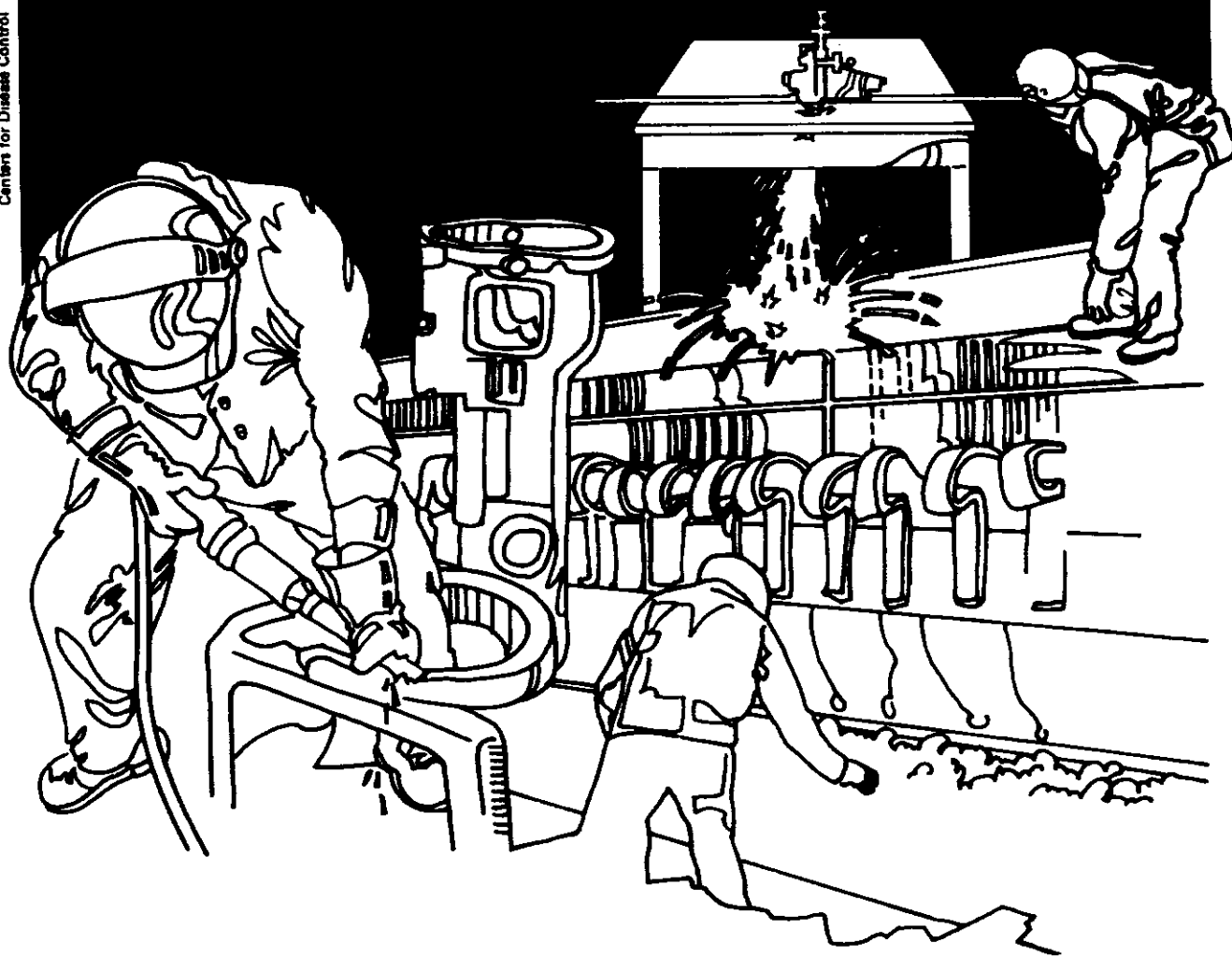


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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 86-468-1875
SURTEK, INCORPORATED
GOLDEN, COLORADO

PREFACE

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

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

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 86-468-1875
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SURTEK, INCORPORATED
GOLDEN, COLORADO

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I. SUMMARY

On August 8, 1986, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate employee exposures to mercury and solvents in laboratory operations at Surtek, Incorporated, Golden, Colorado. A subsequent request was received from this facility to evaluate potential employee exposures during testing of a process designed to neutralize creosote-contaminated soil samples.

In October 1986, NIOSH investigators conducted an initial survey. In November 1986, an environmental survey was conducted during which personal and area air samples were collected in the various laboratories for mercury, hexane, toluene, and acetone. In February 1987, a follow-up environmental survey was conducted, during which area air samples were collected for coal tar pitch volatiles (CTPVs) and polynuclear aromatic hydrocarbons (PNAs).

In six area samples collected, time-weighted average (TWA) concentrations of mercury ranged from 0.0011 to 0.0039 milligrams per cubic meter of air (mg/M^3), with a mean of 0.0023 mg/M^3 . These values are below the NIOSH Recommended Exposure Limit (REL) and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 0.05 mg/M^3 for inorganic mercury. The results of the two personal breathing zone air samples collected for solvent exposure revealed TWA concentrations of 2.3 and 14.6 ppm of acetone; and 0.43 and 0.81 ppm, respectively, of hexane were found in these samples. These values are below the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) of 1000 ppm for acetone and 500 ppm for hexane, the NIOSH REL's of 250 ppm for acetone and 100 ppm for hexane, and the ACGIH TLV's of 750 ppm for acetone and 50 ppm for n-hexane. No CTPV's were detected in samples collected in the work areas in the laboratories. Napthalene was the only PNA found in quantifiable levels in the samples collected in the work area; TWA concentrations were 0.005 and 0.011 mg/M^3 . These values are below the OSHA PEL and ACGIH TLV of 50 mg/M^3 for napthalene.

No overexposures to mercury, acetone, hexane or creosote were found during this survey. Recommendations designed to further reduce exposures among laboratory personnel are included in this report.

KEYWORDS: SIC 7391 (Research and Development Laboratories), Mercury, Acetone, Hexane, Creosote, Coal Tar Pitch Volatiles, Polynuclear Aromatic Hydrocarbons

II. INTRODUCTION

On August 8, 1986, NIOSH received a request from Surtek, Incorporated, Golden, Colorado, to evaluate potential employee exposures to mercury and solvents used in the company's laboratory operations. The requestor was directed to NIOSH by a representative of the Colorado Department of Health following an incident involving a mercury spill in one of the laboratories.

On October 1, 1986, an initial survey visit was conducted at the facility. An opening conference was held during which background information related to the nature of operations in the laboratories was obtained. Following this, a walk-through survey of the various laboratory areas was conducted. On November 10, 1986, an environmental survey was conducted, during which personal and area air samples were collected in the various laboratories for mercury, hexane, toluene, and acetone. The results of this survey were provided to company representatives by telephone on January 7 and February 4, 1987. As a result of concerns with the introduction of a new process involving tests to neutralize creosote in contaminated soil, a follow-up environmental survey was conducted on February 6, 1987, during which area air samples were collected for coal tar pitch volatiles (CTPVs) and polynuclear aromatic hydrocarbons (PNAs).

III. BACKGROUND

Surtek, Inc., located in Golden, Colorado, provides consultation in the field of enhanced oil recovery. One key facet of this consultation is the analysis of samples from oil fields. This analysis aids in determining the suitability of enhanced recovery techniques for recovering residual oil remaining in oil wells after the initial oil extraction. Work usually is done with either fluid or core samples from the wells. The company also does work for firms selling products for enhanced oil recovery - polymers and surfactants. Due to a slowdown in the oil industry, operations were running at a slower than usual pace at the time of the survey. The current number of laboratory personnel was three, which was a five-person reduction from the eight people who had been working previously.

Five major areas were examined during the survey. The first area was a small lab where fluid or water samples were analyzed using atomic absorption to determine mineral content. In a second lab area, referred to as the "Chem" lab, tests were being conducted on polymer and surfactant materials, and equipment and glassware were routinely cleaned. In the third lab area, referred to as the "old lab", various solutions were being pumped through core samples, and the output parameters were being measured to help determine suitable recovery materials. Due to its immiscibility with the oil and other solutions, mercury was used in the pumping cylinders in this process. The pumping operations were contained in eight enclosed pump boxes. Also, in this lab, solvents (i.e., xylene, toluene, hexane) were sometimes used in tar sand recovery experimentation; however, due to economic trends, these operations are being conducted very infrequently. The fourth laboratory

visited, referred to as the "small pump room", was located in the basement of the facility. This room contained a large core sample which was undergoing permeability and recovery testing with a surfactant solution being pumped through it in a manner similar to that described previously. The mercury spill prompting the request had occurred in this lab area. The last area examined was a receiving room, also located in the basement of the building. In this area, the core samples were received and prepared for testing. The samples usually arrived packed in oil, and were then placed on a table for cutting. Between samples, the table was usually cleaned with solvent-soaked rags.

During the course of the survey, the company began a new process, which involved tests designed to neutralize creosote in contaminated soil samples. This testing process was conducted in the pump boxes in the old laboratory. Each pump box was enclosed and had its own recirculating air conditioning system attached to it.

IV. MATERIALS AND METHODS

On November 10, 1986, air samples were collected to assess employee exposures to mercury and solvents in the various labs. This included personal samples collected near the employees' breathing zone, as well as general area samples. All samples were collected using battery-powered pumps attached via Tygon tubing to the appropriate collection media.

Since mercury was not being used directly by any of the employees, general area samples were collected at locations throughout the laboratories. These samples were collected to determine the ambient concentration of mercury that might result from emissions from the extraction cylinders, as well as that which might be vaporized from any residual mercury remaining from spills. Samples were collected at a flow rate of 200 cubic centimeters of air per minute (cc/m) using a hopkalite sorbent tube as the collection media. The samples were later analyzed for mercury by means of cold vapor atomic absorption spectroscopy. A complete listing of information pertinent to sample collection is contained in Table 1.

Personal samples to assess solvent exposure were collected for the two employees working in the laboratory areas at the time of the survey. Samples were collected at a flow rate of 50 cc/m using a charcoal tube collection media. The tubes were analyzed later for hexane, toluene, and acetone by gas chromatography with flame ionization detection according to NIOSH Method 1500, with the identities of the analytes further confirmed by mass spectrometry.¹ A complete listing of information pertinent to sample collection is provided in Table 2.

In order to assess employee exposure to creosote, a follow-up environmental survey was conducted on February 6, 1987. During this survey, side-by-side area air samples were collected for coal tar pitch volatiles (CTPVs) and polynuclear aromatic hydrocarbons (PNAs) at three locations. Samples were collected at a flow rate of 2.0 liters per minute. The collection medium for PNAs consisted of 37-millimeter

Teflon filter followed in-line by an Orbo 43 sorbent tube. The filters and sorbent tube were later analyzed by gas chromatography according to NIOSH Method 5515.¹ For CTPVs, only the Teflon filter was used as the collection medium. These samples were later extracted with benzene and analyzed gravimetrically according to NIOSH Method No. 5023.¹ A complete listing of other information pertinent to sample collection is included in Table 3.

V. EVALUATION CRITERIA

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

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

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) occupational health standards [Permissible Exposure Limits (PEL's)]. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits (REL's), by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 (29 USC 651, et seq.) to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday.

Some substances have recommended short-term exposure limits (STEL's) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high, short-term exposures.

A brief discussion of the toxicity and evaluation criteria for the substances examined during this survey is provided as follows.

A. Mercury

Metallic mercury readily vaporizes at room temperature, and the vapor has no warning properties. Acute exposure to high levels of inorganic mercury can cause severe respiratory irritation, digestive disturbances, and marked kidney damage. Repeated or prolonged exposure to mercury liquid or vapor can cause a variety of effects, which may develop gradually. These may include shaking of the hands, eyelids, lips, tongue, or jaw; allergic skin rash; headache; sores in the mouth; sore and swollen gums; loose teeth; insomnia; and excess salivation. In addition, chronic mercurialism, the form of intoxication most frequently caused by occupational exposure, is characterized generally by neurological and psychic disturbances such as personality change, irritability, indecision, loss of memory, and intellectual deterioration, as well as anorexia and weight loss. Skin absorption of inorganic mercury may also contribute to the toxic effects of vapor inhalation. In addition, sensitization dermatitis has reportedly occurred following dermal contact with mercury.²

The current OSHA standard for mercury is a ceiling level of 0.1 milligram per cubic meter of air (mg/M^3). The NIOSH REL and the ACGIH TLV for mercury are $0.05 \text{ mg}/\text{M}^3$ as an 8-hour TWA.^{2,3}

B. Organic Solvents

Several organic solvents are periodically used in the laboratory. Based on conversations with the employees, three solvents commonly used in the various labs included acetone, hexane, and toluene.

1. Acetone

Acetone is a highly volatile liquid which, due to its rapid rate of evaporation, is used frequently for cleaning and drying equipment and glassware. Exposure to acetone vapors in sufficiently high concentrations may cause dryness of the mouth and throat, dizziness, loss of coordinated movement and speech, and drowsiness. When inhaled in small quantities over long periods of time, it may cause respiratory tract irritation, coughing and headache.⁴

The OSHA PEL for acetone is 1000 ppm as an 8-hour TWA, while the NIOSH REL is 250 ppm as a TWA. The ACGIH TLV is 750 ppm as an 8-hour TWA, and 1000 ppm as a STEL.³

2. Hexane

The commercial forms of hexane are generally a mixture of hexane isomers and may contain small amounts of cyclopentane, cyclohexane, pentane, and

heptane.⁴ Hexane vapor is a narcotic, and short-term exposure may cause lightheadedness, giddiness, nausea, and headache. It is also capable of causing irritation of the eyes and nose, and prolonged skin contact with the liquid may cause dermal irritation.² Hexane has also been shown to cause polyneuropathy. However, recent evidence indicates that this neurotoxicity is limited to n-hexane and is not associated with the other hexane isomers.⁴ The concentration of n-hexane in commercial hexane may range from 20 to 80%.⁴

The current OSHA standard for hexane is 500 parts per million (ppm) as an 8-hour TWA. The NIOSH REL for hexane is 100 ppm as a 10-hour TWA.² The ACGIH recommends a TLV of 50 ppm as an 8-hour TWA for n-hexane, and a TWA of 500 ppm for other hexane isomers.³

3. Toluene

Toluene vapor may cause irritation of the eyes, respiratory tract, and skin. It may cause fatigue, weakness, confusion, headache, and dizziness. Repeated or prolonged skin contact with the liquid has a defatting action, causing drying, fissuring, and dermatitis.

The current OSHA PEL for toluene is 200 ppm as an 8-hour TWA, with a ceiling of 300 ppm not to be exceeded for any 10 minute period, and with exposures not permitted above the peak concentration of 500 ppm. The NIOSH REL for toluene is 100 ppm as an 8-hour TWA, with a ceiling of 200 ppm averaged over a 10-minute period.² The ACGIH recommends a TLV of 100 ppm as an 8-hour TWA, with a STEL of 150 ppm as a 15-minute average.³

C. Creosote

Creosote is a product of the distillation of coal tar, a substance which is produced by the high-temperature carbonization of bituminous coal. It is estimated that 10,000 or more compounds are present in creosote, with fewer than 20 of these being present in concentrations exceeding one percent. It principally is composed of high-molecular-weight aromatic hydrocarbons in addition to tar acids and bases. Although compositions may vary greatly from batch to batch, a sample from a typical lot has shown the major components to be phenanthrene (21%), fluorene and fluoranthene (10% each), and acenaphthene and pyrene (9% each).⁵

The emissions resulting from coal tar products such as creosote are broadly categorized as coal tar pitch volatiles (CTPVs). These CTPVs usually contain several members of the class of compounds referred to as polynuclear aromatic hydrocarbons (PNAHs). NIOSH considers several of these PNAHs to be carcinogenic, including benzo(a)pyrene, chrysene, benzanthracene, and phenanthrene. Other chemicals from coal tar products which are suspected of causing cancer but for which the causal relationship has not been adequately documented include anthracene, carbazole, fluoranthene, and pyrene.⁶

Due to its carcinogenic potential, NIOSH recommends that airborne exposure to creosote be controlled to the lowest feasible level. The

NIOSH REL for creosote is 0.1 mg/M³ (cyclohexane-extractable fraction) as a 10-hour TWA. Presently, there are no NIOSH REL's for the individual PNAs.⁶ Since laboratory studies have also shown that creosote can produce skin tumors in laboratory animals, skin contact should be avoided.

The ACGIH also considers CTPVs to be recognized human carcinogens and recommends a TLV of 0.2 mg/M³ (benzene-soluble fraction). In addition, the ACGIH considers some individual PNAs (i.e., benzo[a]pyrene and chrysene) to be suspected human carcinogens and recommends that exposures be reduced to levels consistent with recent information from toxicologic and epidemiological studies.⁴ The ACGIH does not consider naphthalene to be carcinogenic, and recommends a TLV of 50 mg/M³ as an 8-hour TWA.

The OSHA standard for CTPVs is 0.2 mg/M³ (benzene-soluble fraction) as an 8-hour TWA.

VI. RESULTS

A. Mercury

The results of the general area air samples collected for mercury are presented in Table 1. In the six area samples collected, TWA concentrations of mercury ranged from 0.0011 to 0.0039 mg/M³, with a mean of 0.0023 mg/M³. These values are below the NIOSH REL and the ACGIH TLV of 0.05 mg/M³ for inorganic mercury. Since the volatilization of the mercury vapor would have been expected to occur in a uniform manner, these values also would be below the OSHA PEL of 0.1 mg/M³ as a 10-minute ceiling concentration. Of the two areas sampled where mercury was used, exposures were highest in the small pump lab (mean concentration of 0.0029 mg/M³), followed by the old lab (mean concentration of 0.0012 mg/M³).

B. Organic Solvents

The results of the two personal breathing zone air samples collected for solvent exposure among the laboratory technicians are presented in Table 2. As evidenced by these data, TWA concentrations of 2.3 and 14.6 ppm of acetone, and 0.43 and 0.81 ppm of hexane were found in these samples. These values are below the OSHA PEL of 1000 ppm for acetone and 500 ppm for hexane, the NIOSH REL of 250 ppm for acetone and 100 ppm for hexane, and the ACGIH TLV of 750 ppm for acetone and 50 ppm for n-hexane. Toluene, another solvent reportedly used, was not detected in either of the samples above the limit of detection of 0.01 micrograms (ug) per sample.

C. Creosote

The results of the general area air samples analyzed for emissions from the creosote are presented in Table 3. Of the samples collected for CTPVs, a TWA concentration of 0.058 mg/M³ was found in an area sample collected inside of the pump box where the neutralization testing was

taking place. This concentration is below the OSHA PEL and ACGIH TLV of 0.2 mg/M³ for CTPVs (benzene-soluble fraction). This value may not be directly compared to the NIOSH REL for CTPVs, since the the NIOSH criteria is based on the cyclohexane soluble fraction, which may show some differences from the benzene soluble fraction. No CTPVs were detected above the limit of detection of 0.05 milligrams/sample in either of the two samples collected in the general work areas.

Napthalene was the only PNA found in quantifiable levels in all three of the area samples. TWA concentrations of 0.005, 0.011, and 0.022 mg/M³, with the highest level found in the sample collected in the pump box. These values are below the OSHA PEL and ACGIH TLV of 50 mg/M³. Five additional PNAs were also present in quantifiable levels in the sample collected in the pump box. This included: acenaphthene (0.012 mg/M³), phenanthrene (0.0051 mg/M³), anthracene (0.0016 mg/M³), and fluorene (0.0016 mg/M³). While numeric evaluation criteria currently do not exist for these substances, NIOSH considers phenanthrene carcinogenic, and anthracene potentially carcinogenic, and recommends reducing exposure to these substances to the lowest feasible level. It should be noted that the samples collected inside the pump box were "process" samples reflecting the area of highest contaminant concentrations. These boxes were enclosed and were infrequently opened by employees.

VII. DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

As evidenced by the results of the environmental survey, employee exposures to mercury, organic solvents, and creosote were all below their respective environmental criteria at the time of the survey. However, in order to pinpoint areas where exposures can be reduced further, a brief discussion of each of these materials, as well as general laboratory safety and health, is provided below.

A. Mercury

The environmental results indicated airborne concentrations of mercury in the area samples were more than a factor of 10 below the NIOSH REL. Furthermore, actual employee exposures would have been significantly less since personnel were seldom present in the small pump lab where the highest mercury concentrations were measured. However, it should be noted that these samples reflect the airborne concentration of mercury resulting from volatilization of the mercury being used in the pump boxes and from the evaporation of residual mercury that may have resulted from spills. Since mercury was not handled directly by the employees during the survey, the magnitude by which this activity might influence employee exposures is not reflected in these results. As a general practice, mercury should be handled and transferred under laboratory hoods whenever possible. Not only will this reduce the immediate risk of employee exposure from vapor inhalation, but also, in the event of breakage or spillage, the mercury is contained in an area that can be cleaned up easily. Also, the vapor hazard resulting during the cleanup would be minimized. Gloves should also be used when handling mercury, since skin absorption can contribute to mercury

exposure. If substantial quantities of mercury are used in open areas without the use of local exhaust ventilation, or if spillage of mercury should occur, air sampling should be conducted to ensure employee exposures remain within the environmental criteria.

When dealing with mercury, temperature is also a factor that must be considered closely. On the day of sample collection, the ambient temperature in the laboratories was in the mid-70s. Since the vaporization of mercury increases exponentially with respect to increases in temperature, the airborne concentration of mercury would be expected to increase markedly with any substantial increase in either room or process temperatures. Therefore, whenever significant amounts of mercury are present, ambient temperatures in the work area should be kept cool, and any heating of mercury should only be conducted under an exhaust hood.

B. Solvents

As indicated by the environmental results, employee exposures to the organic solvents being used during the survey were below the environmental criteria. During the period of sample collection, the various solvents were used only briefly and on a sporadic basis. As a matter of good practice, solvents should be used under a laboratory hood whenever possible. This would not only decrease the employees' exposure, but also would reduce the risk of a buildup of flammable or explosive concentrations of the solvent vapors in the work area. In addition, the risk of employee exposure and fire are also reduced in the event of accidental breakage or spillage of the solvents.

C. Creosote

The survey results indicate that employee exposures to contaminants from the creosote (CTPVs and PNAs) also were below the environmental criteria. While the process sample collected in the pump box did indicate the presence of potentially carcinogenic materials, these substances were not detected in significant amounts in the work areas. One operation that was not monitored during the survey was the preparation of the creosote soil samples. During sample preparation, employees may be exposed to potentially toxic substances in the particulate form, as well as from the vapor. Whenever possible, such sample preparation should take place under the laboratory hoods. In addition, a potential for skin contact with the material is also present during this operation, and protective gloves should be worn when handling the contaminated samples.

D. General Laboratory Safety and Health

Up to this point, this report has been limited to a discussion of the substances of particular concern to the requestor. However, since laboratory workers are potentially exposed to a number of substances on a day to day basis, it is important that a comprehensive laboratory safety program be put into place in order to reduce the likelihood of overexposures to all types of substances. Such a program should include an overall written plan that includes standard safe laboratory practices

to be carried out whenever working in the laboratory. In addition, specific written procedures should be developed for working with substances with high acute or chronic toxicities. Examples of chemicals falling into this category are mercury and creosote. The procedures developed for the use of chemicals such as these should include information on the appropriate engineering controls (e.g., fume hoods), personal protective equipment (e.g., respirator, gloves), and work practices to be used as needed.

In order to assist in determining the type of controls that are necessary, material safety data sheets and other supplementary information should be maintained for all chemicals used in the laboratory. This information should address in detail the routes of exposure, toxicity, compatibility, personal protective equipment, emergency first aid procedures, and spill, leak and disposal procedures for the substance. This information should be made readily available to the employees so that it can be referenced easily when necessary.

As previously discussed, it is considered a prudent practice to use exhaust hoods when working with all substances used in the laboratory, especially those having moderate or high acute or chronic toxicities. The periodic testing of local exhaust ventilation hoods is also a necessary procedure to ensure the effective performance of laboratory hoods. Detailed information related to the testing of laboratory hoods can be found in the publication "Industrial Ventilation, A Manual of Recommended Practice", by the American Conference of Governmental Industrial Hygienists.⁷

A lack of proper housekeeping can greatly enhance the likelihood of accidents occurring. Ongoing efforts are necessary to ensure that work areas are kept free from obstruction and that chemicals not in use are stored properly. Adequate space should be allotted to each area to ensure that overcrowding does not occur. Floors and equipment surfaces should be cleaned regularly to minimize dust accumulation in the area. All unlabeled chemicals, chemical waste, and chemical spills should be disposed of in accordance with established procedures, with which all employees should be familiar. The publication entitled "Prudent Practices for Disposal of Chemicals from Laboratories" by the Committee on Hazardous Substances in the Laboratory/National Research Council, provides detailed information related to proper chemical disposal.⁸

It is important to limit the amounts of chemicals stored in the laboratory and to be sure that each chemical in use has a definite storage place and is returned to that space when not in use. Storage of chemicals on counter tops makes the chemical containers more prone to inadvertent breakage or spillage and susceptible to fire. Selection of storage sites for the chemicals should take into consideration such factors as toxicity, flammability, compatibility, and other important properties of the chemical. Storage of flammable liquids should be in accordance with OSHA regulations and National Fire Protection Association (NFPA) standard No. 45, "Fire Protection for Laboratories Using Chemicals", and No. 30, "Flammable and Combustible Liquids Code".^{9,10}

The Occupational Safety and Health Administration has proposed a laboratory safety standard which would require laboratories to develop a "Chemical Hygiene Plan" which would encompass the areas previously discussed.¹¹ While this document is presently only a "proposal", the concepts and ideas presented in its text would be of value in strengthening the current laboratory safety program. Another reference, which might also prove useful, is the publication entitled "Prudent Practices for Handling Hazardous Chemicals in Laboratories", by the Committee on Hazardous Substances in the Laboratory/National Research Council.¹² This document helps form the basis for, and is cited frequently in, the OSHA proposed lab standard.¹¹ A systematic implementation of the key concepts provided in these documents should help to reduce future risks of chemical exposure among laboratory personnel.

VII. REFERENCES

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X. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from the NIOSH publications office at the Cincinnati, address. Copies of this report have been sent to the following:

- A. Surtek, Incorporated, Golden, Colorado
- B. U. S. Department of Labor, OSHA - Region VIII
- C. NIOSH Regional Offices/Divisions

For the purposes of informing the affected employees, copies of the report should be posted in a prominent place accessible to the employees, for a period of 30 calendar days.

TABLE 1
General Room Air Concentrations of Mercury
 Surtek, Inc., Golden, Colorado
 November 10, 1986

<u>SAMPLE LOCATION</u>	<u>MINUTES SAMPLED</u>	<u>LITERS SAMPLED</u>	<u>TWA CONCENTRATION MERCURY (MG/M3)</u>
Old Lab - On Desk South Side of Room	389	76.4	0.0013
Old Lab - On Lab Bench Near North Wall	383	78.7	0.0011
Small Pump Lab - On Lab Bench Center of Room	381	79.3	0.0039
Small Pump Lab - On Lab Bench Center of Room	360	75.6	0.0026
Small Pump Lab - On Lab Bench Southwest Side of Lab	379	75.1	0.0019
Small Pump Lab - On Lab Bench North Side of Lab	380	80.1	0.0032
<u>Evaluation Criteria*</u>	NIOSH REL		0.05
	OSHA PEL (10 minute Ceiling)		0.10
	ACGIH TLV		0.05

TABLE 2
Personal Breathing Zone Air Concentrations of Solvents
 Surtek, Inc., Golden, Colorado
 November 10, 1986

<u>JOB DESCRIPTION/ LOCATION</u>	<u>MINUTES SAMPLED</u>	<u>LITERS SAMPLED</u>	<u>TWA CONCENTRATION ACETONE (PPM)</u>	<u>TWA CONCENTRATION HEXANE (PPM)</u>
Lab Technician #1 Old Lab	368	19.3	2.3	0.43
Lab Technician #2 All Labs	363	19.2	14.6	0.81
<u>Evaluation Criteria*</u>		NIOSH REL	250	100
		OSHA PEL	1000	500
		ACGIH TLV	750	50 n-hexane

*Refer to Section V of this report for a complete discussion of these criteria
 mg/M³ - milligrams of contaminant per cubic meter of air
 ppm - parts of contaminant per million parts of air

TABLE 3
General Area Air Samples Collected for CTPV's and PNA's
 Surtek, Inc., Golden, Colorado
 February 6, 1987

SAMPLE LOCATION	MINUTES SAMPLED	LITERS SAMPLED	TIME-WEIGHTED AVERAGE CONCENTRATIONS IN MILLIGRAMS PER CUBIC METER						
			CTPVs	NAPTH- ALENE	ACE- NAPHTHYLENE	ACE- NAPHTHENE	PHEN- ANTHRENE	ANTHRACENE	FLUORENE
Inside Pump Box Old Lab	429	858	0.058	0.022	< LOQ	0.012	0.0051	0.0016	0.0062
On Shelf Above Desk Old Lab	428	856	< LOD	0.005	< LOD	< LOQ	< LOQ	< LOD	< LOD
Near Dishwashing Area Area - Chem Lab	427	854	< LOD	0.011	< LOD	< LOQ	< LOQ	< LOQ	< LOQ

EVALUATION CRITERIA: Coal Tar Pitch Volatiles (CTPVs)
 NIOSH REL: 0.1 mg/M³ (cyclohexane-soluble fraction)
 OSHA PEL: 0.2 mg/M³ (benzene-soluble fraction)
 ACGIH TLV: 0.2 mg/M³ (benzene-soluble fraction)

EVALUATION CRITERIA: Polynuclear Aromatic Hydrocarbons (PNAs)
 (Refer to Section V of Report)

< LOD - Less than the analytical limit of detection estimated at 0.3 micrograms per sample (ug/sample).
 < LOQ - Substance was detected in a trace amount but the amount was less than the analytical limit of quantitation of 0.9 ug/sample for acenaphthene and phenanthrene, 1.0 ug/sample for anthracene, and 1.1 ug sample for fluorene.

The following PNAs were not found in any of the samples above their respective limits of detection: [fluoranthene, pyrene, benz(a)anthracene, chrysene: LOD 0.3 ug/sample], [benzo(b)fluoranthene, benzo(a)pyrene, benzo(e)pyrene: LOD 0.5 ug/sample], [indeno(123-cd)pyrene, dibenz(a,h)anthracene, benzene(ghi)pyrene: LOD 1 ug/sample].