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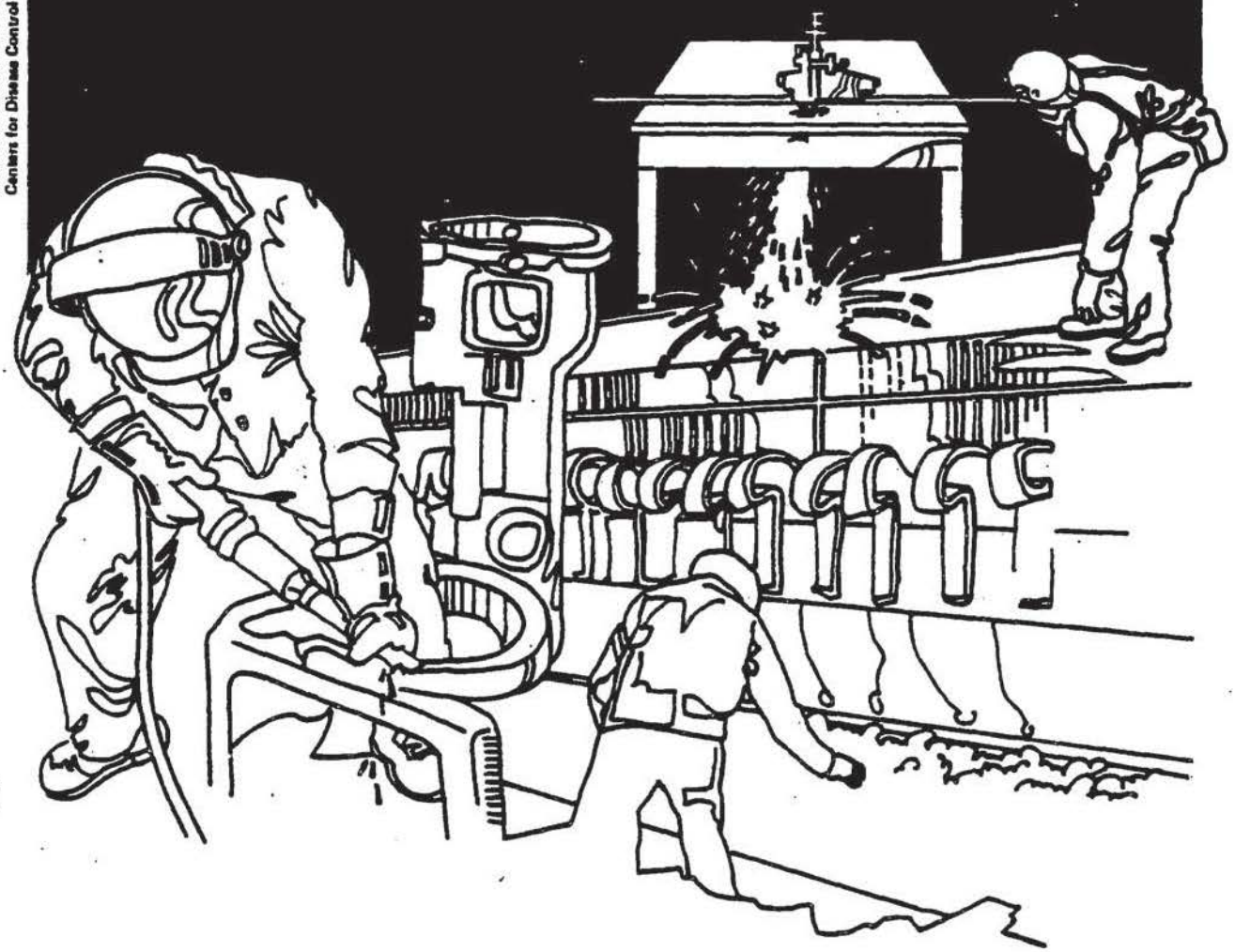

Health Hazard Evaluation Report

HETA 82-309-1630
INLAND STEEL
EAST CHICAGO, INDIANA

PREFACE

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

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

HETA 82-309-1630
OCTOBER 1985
INLAND STEEL
EAST CHICAGO, INDIANA

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I. SUMMARY

On June 21, 1982, the United Steel Workers of America, Local #1010, requested that the National Institute for Occupational Safety and Health (NIOSH) conduct a Health Hazard Evaluation at the Inland Steel Company, East Chicago, Indiana. The request expressed concerns about employee exposures during maintenance of the coke battery precipitator at the #2 coke plant.

On November 23, 1982, NIOSH investigators visited the Inland Steel #2 Coke Plant and conducted an initial survey. Discussions centered on maintenance and clean-up operations at the Coke Battery Precipitator, safety and health procedures, training and education of employees, confined space entry procedures, electrical lock-out and tag-out procedures, health policies, personal protective equipment, and engineering controls. A walk-through evaluation of the #2 coke plant was conducted and confidential, non-directed employee questionnaires were administered to employees who had worked at the precipitator during previous maintenance operations. Additionally, a meeting was held with representatives of the United Steel Workers of America, Local #1010 Safety and Health Committee.

On September 11, and 14, 1984, NIOSH investigators conducted environmental sampling during maintenance work on the coke battery precipitator at the #2 coke plant. Results of these samples showed air concentrations of the cyclohexane soluble fraction of coal tar pitch volatiles (CTPVs) ranged from 0.232 milligrams per cubic meter of air (mg/M^3) to 0.668 mg/M^3. NIOSH recommends that occupational exposures to CTPVs be limited to 0.1 mg/M^3. These samples also showed trace quantities of the polynuclear aromatic hydrocarbons (PNAs); naphthalene, phenanthrene, fluorene, and acenaphthalene. However, several personal protective measures (e.g. barrier creams, respirator, gloves, etc.) were in place and if followed should adequately protect employees involved in these operations from exposures to CTPVs and PNAs.

Results of employee questionnaires indicate that those employees involved in maintenance operations experienced local skin, eye, ear, nose and throat irritation during work on the coke battery precipitators in the past. Since the current personal protective measures were implemented, employees indicated that they no longer experience these symptoms following maintenance operations.

On the basis of the information obtained in this evaluation, it has been determined that a potential health hazard from exposure to CTPVs and PNAs is being adquately addressed and necessary personal protective measures have been implemented. Recommendations are included in section VIII of this report.

KEYWORDS: SIC 3312 Coke Ovens, coal tar pitch volatiles (CTPVs), polynuclear aromatic hydrocarbons (PNAs), coke battery precipitators

II. INTRODUCTION

On June 29, 1982, NIOSH received a request for a health hazard evaluation to be conducted at the Inland Steel Company, East Chicago, Indiana. The requestor expressed concerns about employee exposures during maintenance operations at the coke battery precipitator at the #2 Coke Plant.

NIOSH investigators conducted an initial survey of the facility in November 1982. Due to the infrequent nature of the process a delay in scheduling an environmental survey was unavoidable. On September 11 & 14, 1984, NIOSH investigators conducted environmental sampling during maintenance work at the #2 coke plant, coke battery precipitator.

III. BACKGROUND

A. Plant Production and Workforce

Inland Steel is engaged in the production of iron and steel. Coke is one of the materials used in the making of steel. Coke is a coherent, cellular, carbonaceous residue remaining from the dry distillation of coking coal. In the coking process, the volatile components of the natural coals are driven off to form a substance with substantially higher carbon content.[1]

At the #2 coke plant, metallurgical coke is produced for use in the manufacture of steel. By-product coke ovens are utilized at this facility for making coke and are designed and operated to permit collection of the volatile material evolved from coal during the coking process.

The #2 coke plant employs approximately 650 personnel. During maintenance operations at the coke battery precipitator only 2 electrians and 2 maintenance workers were utilized.

B. Process Description and Employee Duties

In 1979, 1980, and 1981 Inland Steel installed three electrostatic precipitators as a result of an EPA inspection of air pollution emissions from their coke plants. The precipitator's function is to remove particulates from coke oven waste gases prior to their release to the atmosphere. Over time, particulate materials accumulate on the electrodes and the inside of the precipitator, thus, necessitating periodic (last done approximately two years ago) shut down and clean-up of the precipitators.

On September 8, the precipitator at the #2 coke plant was shut down and allowed to cool down until September 10. At this time the unit was watered down for purposes of removing all loose particulate material. On September 11, the hygiene department ran standard tests for confined space entry. Later that morning, one electrician entered the unit for approximately five minutes to retrieve damaged precipitator electrodes. During the afternoon, a second electrian was involved in the cleaning of

electrical insulators on top of the precipitator unit for approximately one and one-half hours. On September 14, two maintenance employees working under the unit replaced dumpster box hoses (one-half hour) and replaced precipitator fan seals (one and one-half hours).

C. Engineering, Administrative, and Personal Protective Controls

All plant personnel are required to wear safety boots with metatarsal guards, hard hats, and safety glasses. Employees involved in clean-up operations were wearing half-mask air purifying respirators equipped with high efficiency particulate air (HEPA) filters, barrier creams on exposed skin areas, acid/oil resistant gloves, and rainsuits with the arms taped over the gloves. Additionally, employees are required to shower and change clothes before leaving the plant.

Employees involved in the clean-up operations, as well as all coke plant personnel, are enrolled in a coke plant medical monitoring program. This program includes an annual physical examination, chest radiograph, spirometry, urine cytology, complete blood count, blood chemistries, vision and hearing testing. If the employee is over forty-five years of age, or has worked in the coke plant for over five years, the physical, chest radiograph, spirometry, and urine cytology are performed every six months with the remaining tests performed yearly.

IV. EVALUATION DESIGN AND METHOD

A. Environmental

During the initial survey of November 1982, bulk samples of particulates from the precipitator were collected in small glass vials with Teflon®-lined caps. These samples were analyzed for polynuclear aromatic hydrocarbons (PNAs) via gas chromatography/mass spectrometry (GC/MS) and sulfur compounds via ion chromatography.

In September 1984, environmental sampling was conducted and included personal breathing zone sampling of employees required to enter the precipitator unit during the course of clean-up and maintenance operations. Based on information obtained from the bulk sample analyses, samples were collected for PNAs and cyclohexane solubles. Samples were collected on a sampling train consisting of a Teflon® 2-micron filter and a cellulose acetate O-ring in an opaque cassette, followed in series by a 7-mm O.D. solid sorbent tube containing two sections of Supelpak-2 (pre-washed XAD-2) 100 mg/50 mg, and were calibrated at a flow rate of 1.7 liters per minute. Teflon® filters were analysed for cyclohexane solubles and PNAs; solid sorbent tubes were analyzed for PNAs.[2]

B. Medical

Discussions were held with four employees who had worked during maintenance operations in the past. Employees were questioned about

problems they may have experienced during and following maintenance operations associated with the coke battery precipitator.

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 pre-existing medical condition, and/or a hypersensitivity (allergy).

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

The primary sources of 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. 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 standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 (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 or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high, short-term exposures.

1. Coal Tar Products[3] - NIOSH recommends that occupational exposure to coal tar products shall be controlled so that employees are not exposed to coal tar, coal tar pitch, creosote, or mixtures of these substances at a concentration greater than 0.1 milligrams per cubic meter (mg/M^3) of the cyclohexane-extractable fraction of the sample, determined as a TWA concentration for up to a 10-hour work shift in a 40-hour work week. Both the ACGIH and OSHA base their standards for coal tar pitch volatiles on the benzene soluble fraction. The ACGIH-TLV for CTPVs is 0.2 mg/M^3 for a normal 8-hour workday or 40-hour workweek and the OSHA Permissible Exposure Limit (PEL) for CTPVs is 0.2 mg/M^3.

The term "coal tar products" as used in the NIOSH recommended standard, includes coal tar and two of the fractionation products of coal tar, creosote and coal tar pitch, derived from the carbonization of bituminous coal. Coal tar, coal tar pitch, and creosote derived from bituminous coal often contain identifiable polynuclear aromatic hydrocarbons (PNAs) which by themselves are carcinogenic, such as benzo(a)pyrene, benzanthracene, chrysene, and phenathrene. Other chemicals from coal tar products, such as anthracene, carbazole, fluoranthene, and pyrene, may also cause cancer, but these causal relationships have not been adequately documented. "Occupational exposure to coal tar products" is defined as any contact with coal tar, coal tar pitch, or creosote in the work environment.

From the epidemiologic and experimental toxicologic evidence on coal tar, coal tar pitch, and creosote, NIOSH has concluded that they are human carcinogens and can increase the risk of lung and skin cancer in workers. Therefore, the permissible exposure limit recommended is the lowest concentration that can be reliably detected by the recommended method of environmental monitoring. While compliance with this limit should substantially reduce the incidence of cancer produced by coal tar products, no absolutely safe concentration can be established for a carcinogen at this time. The environmental limit is proposed to reduce the risk, and the employer should regard it as the upper boundary of exposure and make every effort to keep exposure as low as is technically feasible.

2. Naphthalene[4] - The current OSHA standard for naphthalene is 10 parts of naphthalene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 50 mg/m3. The ACGIH recommends a TLV of 10 ppm as time average for a normal 8-hour workday and a 40-hour workweek.

VI. RESULTS AND DISCUSSION

PNA analysis of bulk samples collected during the initial survey of November 1982, showed the largest single component detected to be naphthalene, all other compounds detected were present at much lower concentrations. Several other lower molecular weight PNAs were detected, these included methyl- and dimethyl naphthalene isomers, biphenyl, biphenylene, acenaphthene, fluorene, and phenanthrene. Other compounds identified included phenol, cresol isomers, styrene, xylenes,

diethylene glycol, diethylene glycol monoethyl ether (Carbitol), methylphenyl acetylene, benzonitrile, benzofuran, methylbenzofuran, dibenzofuran, naphthoquinones, possibly some benzothiophene, and a few adipate and phthalate esters. Further quantitation of the bulk sample by high pressure liquid chromatography (HPLC) showed a naphthalene concentration of approximately 0.4 milligrams (mg) per gram of bulk.

Semi-quantitative analysis for sulfur compounds via ion chromatography showed large concentrations of sulfate to be present with chloride present at much lower concentrations. Extractable sulfate was present at 25 mg SO_4/g of sample and extractable chloride was present at 0.2 mg Cl/g of sample.

Results of environmental samples collected during the survey of September 1984, during clean-up and maintenance operations showed air concentrations of the cyclohexane soluble fraction of coal tar pitch volatiles (CTPVs) ranging from 0.232 milligrams per cubic meter of air (mg/M^3) to 0.668 mg/M^3. These results show concentrations above the NIOSH recommended standard of 0.1 milligrams per cubic meter (mg/M^3) for cyclohexane solubles. However, several personal protective measures were taken to insure that employees were adequately protected from excessive exposure to CTPVs and PNAs. Employees involved in the clean-up and maintenance operations were wearing half-mask air purifying respirators equipped with HEPA filters, barrier creams on exposed skin areas, acid/oil resistant gloves, rainsuits with the arms taped over the gloves, and were required to shower and change clothes before leaving the plant.

Samples were also analyzed for PNAs and indicated the presence of naphthalene in all samples. Additionally, trace amounts of the PNAs phenanthrene, fluorene, and acenaphthalene were detected in an area sample collected at the end of the coal pusher line between the coke ovens and the coke battery precipitator, and trace amounts of the PNA phenanthrene was detected in one personal sample collected on September 14, 1985 (Table I). Results of wipe sampling showed that the potential for employee exposure to CTPVs through skin contact does exist. Two wipe samples collected from the glove of one electrician and the bare hand of the other showed a concentrations of 0.10 milligrams per sample (table II).

Discussions with four employees who had worked during clean-up operations in the past revealed that symptoms of local skin, eye, ear, nose and throat irritation had developed during work on the precipitator. These symptoms disappeared within a few days following cessation of exposure. Since implementation of the above listed personal protective measures employees indicated that they no longer have these symptoms following clean-up operations.

VII. CONCLUSION

On the basis of the information obtained in this evaluation, it has been determined that a potential health hazard from exposure to CTPVs and PNAs is being adquately addressed and necessary personal protective measures have been implemented.

Discussions with employees indicate that since the present personal protective measures were instituted they have not experienced the irritative effects associated with exposures to CTPVs and PNAs.

VIII. RECOMMENDATIONS

The following recommendations are made to assure that employee exposures are kept to a minimum.

A. Medical

The company should continue the present medical monitoring program currently in place for all coke oven employees.

B. Industrial Hygiene

1. The confined space policy and procedures established by the company should include: areas to be designated as confined spaces and these areas should be clearly posted, conditions where entry to confined spaces is authorized, procedures to be followed before entry is permitted (testing for oxygen deficiency prior to entry, obtaining an entry permit, training, lock/out tagout procedures, etc.).

2. A training program should be developed, and fully documented, by the company to ensure that workers who are expected, in the course of their work, to enter and work in confined spaces, have knowledge of the hazards they may encounter, are fully cognizant of the requirements of the confined space evaluation and entry procedures, and are versed in emergency rescue procedures.

3. Policies and procedures for emergency rescue should be established and employees should be given periodic training. Practice drills should be conducted on a periodic basis to ensure that all employees are fully aware of these procedures and their individual responsibilities.

4. The present personal protective measures should be continued to assure that employees are not unduly exposed to CTPVs and/or PNAs.

5. Employees involved in precipitator maintenance operations should be advised of any and all hygiene sampling results which have been collected by the company.

IX. REFERENCES

1. International Labour Office. Encyclopaedia of Occupational Health and Safety. Vol I/a-k. Geneva: International Labour Office, 1971.

2. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol. , 3rd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. (DHEW publication No. (NIOSH) 78-107).

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4. Occupational Health Guidelines for Chemical Hazards, National Institute for Occupational Safety and Health and Occupational Health and Safety Administration, United States Government, DHHS(NIOSH) publication 81-123, 1981.

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XI. 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, 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), Port Royal Road, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH publications office at the Cincinnati address. Copies of this report have been sent to the following:

A. Safety Coordinator, Inland Steel

B. USWA Local #1010

C. U.S. Department of Labor, OSHA - Region V

D. NIOSH, Region V

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 I

Personal Breathing Zone Air Concentrations of Cyclohexane Solubles & Naphthalene

Inland Steel Company
East Chicago, Indiana

Date	Job/Location	Sample Duration	sample volume (liters)	Cyclohexane Solubles	Naphthalene
9/11/84	Electrian #1	11:32-11:38	10.2	<LOD	-----
9/11/84	Electrian #2	11:34-11:39 & 13:00-14:23	149.6	0.668 mg/M^3	0.107 mg/M^3
9/14/84	Maint. mechanic #1	09:35-11:42	215.9	0.232	0.019
9/14/84	Maint. mechanic #2	09:37-11:41	210.8	<LOD	0.019†
9/14/84	Area sample - end of coal pusher line	09:40-11:45	212.5	0.376	0.024††
9/11/84	Blank	---------	-0-	<LOD	<LOD
9/14/84	Blank	---------	-0-	<LOD	<LOD

Laboratory limit of detection:	0.05 mg/sample	0.05 ug/sample
Environmental Criteria:		
NIOSH Recommendation	0.1 mg/M^3	---
ACGIH-TLV (benzene solubles)	0.2	50 mg/M^3
OSHA-PEL (benzene solubles)	0.15	50

Abbreviations:
<LOD - Less than laboratory limit of detection
mg/M^3 - milligrams of contaminant per cubic meter of air
ug/sample - micrograms per sample

† - trace levels of the polynuclear aromatic compound phenanthrene was detected in this sample
†† - trace levels of the polynuclear aromatic compounds phenanthrene, fluorene, and acenaphthalene were detected in this sample

Table II

Wipe samples Collected on September 11, 1984

Inland Steel Company
East Chicago, Indiana

Job/Location	Sample Duration	sample volume (liters)	Cyclohexane Solubles
Area - Electrode #2	NA	NA	<LOD
Area - Insulator Field #1	NA	NA	<LOD
Electrian #2, glove	NA	NA	0.10
Electrian #1, bare hand	NA	NA	0.10
Laboratory limit of detection:			0.05 mg/sample

Abbreviations: NA - Not applicable

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