U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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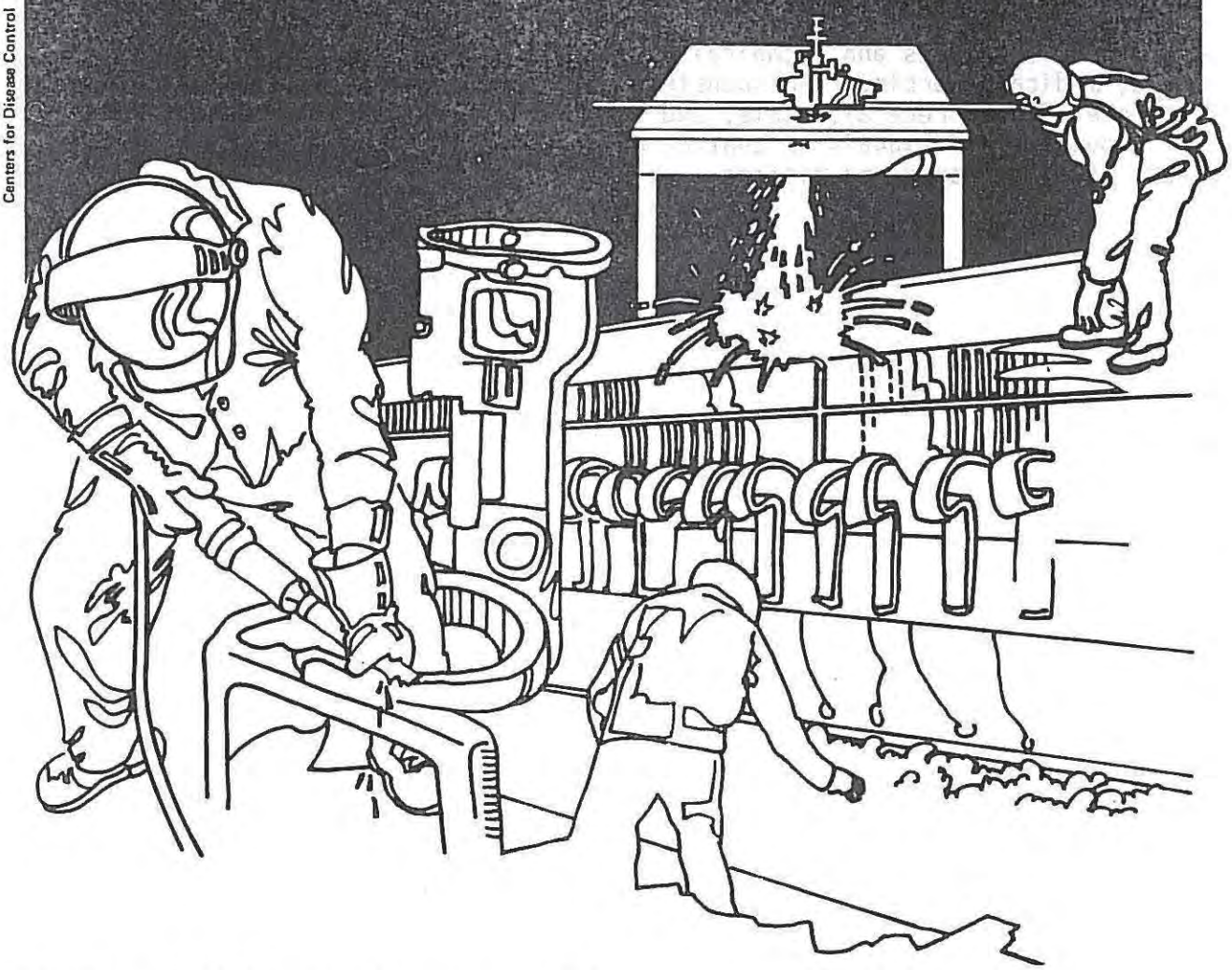
NIOSH



Health Hazard Evaluation Report

HETA 84-284-1701
REVISED
GRANITE CITY STEEL
GRANITE CITY, ILLINOIS

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 84-284-1701
MAY 1987 (REVISED)
GRANITE CITY STEEL
GRANITE CITY, ILLINOIS

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I. SUMMARY

On May 16, 1984, the International Chemical Workers Union requested that the National Institute for Occupational Safety and Health (NIOSH) conduct a health hazard evaluation at Granite City Steel, Granite City, Illinois. The request expressed concerns about potential employee exposures to a "tar-like substance" being added to incoming coal.

In June 1984, NIOSH investigators conducted a walk-through inspection of the coke oven coal handling area and by-products department. In September 1984, a NIOSH physician conducted employee interviews and in August 1985, an environmental survey was conducted during which samples were collected for benzene soluble coal tar pitch volatiles (CTPVs), polynuclear aromatic hydrocarbons (PNAs), and respirable coal dust.

Bulk samples of the coal tar sludge and coal tar sludge/coal mixture were collected at the tar pit and inside the pulverizer building, respectively. These samples were qualitatively analyzed and showed the presence of benzene soluble CTPVs, as well as, the following PNAs: naphthalene, phenanthrene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(e)pyrene, benzo(a)pyrene, and benz(g,h,i)perylene. NIOSH considers coal tar products to be carcinogenic.

Personal air sampling results showed that five of the eight samples had detectable concentrations of benzene solubles ranging from 88 micrograms per cubic meter (ug/M^3) to 141 ug/M^3. All sample concentrations were below the OSHA PEL of 200 ug/M^3 for CTPVs however, three were above the NIOSH recommended exposure limit (REL) of 100 ug/M^3. More importantly, some of these samples indicated exposure to PNAs in the 20 to 100 ug/M^3 range. It should be noted that benzene was the solvent of choice used to extract these samples whereas, the NIOSH Criteria Document on Coal Tar Products references using cyclohexane to extract solvent soluble CTPVs. However, it should be further clarified and understood that the recommended use of cyclohexane to extract solvent soluble CTPVs was based on the toxicity of benzene. Cyclohexane was selected as a less toxic substitute for benzene; however, it has become apparent that cyclohexane is not as good of a solvent as benzene for some sample matrix. Therefore, NIOSH recommends extracting CPTVs and PNAs using a solvent appropriate to the sample matrices. Further, the historical data upon which the defined health effects of exposure to CTPVs is based is derived from benzene generated data, therefore, these sample results can be and are compared to the NIOSH REL of 100 ug/M^3.

High volume general area air samples of coal dust collected in the basement of the pulverizer building showed that the total particulate fraction contained 1.6% quartz and that the respirable fraction was less than the analytical limit of quantitation (LOQ) of 1.5% for quartz. A coal dust bulk sample was less than the LOQ for quartz.

Personal samples for respirable coal dust ranged from 0.14 milligrams per cubic meter (mg/M^3) to 1.52 mg/M^3. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 2.0 mg/M^3 for coal dust containing less than 5% quartz and the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) is 2.4 mg/M^3.

Confidential medical interviews administered to the fifteen employees working in the coke oven coal handling and by-products areas revealed that approximately two-thirds of the workers experienced symptoms of mucous membrane and skin irritation, headaches, shortness of breath, and nausea and about one-half complained of cough and phlegm. There were no reported cases of skin or respiratory cancers among these workers.

On the basis of the information obtained in this evaluation, it has been determined that a health hazard existed in the coal handling area and the by-products department at Granite City Steel, due to employee exposures to coal tar pitch volatiles (CTPVs) which contained identifiable carcinogens and/or suspect carcinogens in the form of polynuclear aromatic compounds (PNAs). Recommendations for reducing employee exposures are included in Section VIII of this report.

KEYWORDS: SIC 3312, coke ovens, coal tar pitch volatiles (CTPVs), polynuclear aromatic hydrocarbons (PNAs), respirable coal dust

II. INTRODUCTION

On May 16, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Chemical Workers Union, to conduct a health hazard evaluation at Granite City Steel, Granite City, Illinois. The requestor expressed concerns about potential employee exposures to a "tar-like substance" being added to incoming coal.

On June 29, 1984, NIOSH investigators conducted an initial survey of the facility, including an opening conference with representatives of the management, a walk-through inspection of the coal handling area and by-products department, and collection of bulk samples. Additionally, a meeting was held with representatives of the International Chemical Workers Union, Local #50, Safety and Health Committee. On September 5, 1984, a NIOSH physician conducted confidential interviews with employees working in the coal handling area and by-products department. Results of the qualitative analysis of bulk samples of the coal tar sludge and coal tar sludge/coal mixture were transmitted to management and employee representatives via letter on November 7, 1984.

On November 27, 1984, NIOSH investigators returned to the facility to conduct environmental sampling. However, due to inclement weather the environmental survey was canceled and it was agreed that the survey should be rescheduled the following summer. On August 6 and 7, 1985, the environmental survey was conducted to evaluate exposures of coal handlers and the by-products utility man to the coal tar sludge being added to the incoming coal. Additionally, coal handlers were monitored for exposure to respirable coal dust. Environmental survey sample results were transmitted to management and employee representatives via letter on January 16, 1986.

III. BACKGROUND

A. Plant Production and Workforce

Coal is one of the raw products used in the making of coke and coke is used in the production 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 a substantially higher carbon content.[1] 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.

Granite City Steel is engaged in the production of iron and steel. The plant employs approximately 3800 personnel and produces about 150,000 tons of steel per month. The coal handling area employs about 20 workers plus 4 supervisors and has the capacity to process about 2400 tons of coal per day. Maintenance personnel are used as needed.

B. Process Description and Employee Duties

By-products of the coking process are processed in the by-products department of the coke plant. A coal tar sludge residue (the tar-like substance referred to in the request) remains from the distillation process. Approximately 400 gallons of the coal tar sludge are produced per day. According to company representatives this coal tar sludge is approximately 97% carbonaceous materials and 3% coal tar. Prior to 1980 and the passage of the Resource Conservation and Recovery Act (RCRA) the company considered the coal tar sludge a waste product. Because of the passage of RCRA and the promulgation of regulations thereunder, the coal tar sludge is now recycled by adding it to the incoming coal.

In the by-products department the coal tar sludge is drained from three waste decanters into 25 gallon wheel barrels. The by-products utility man pushes the full wheel barrels to an open concrete pit approximately once an hour and dumps the coal tar sludge onto a pile of coal. The coal tar sludge and coal are then mixed using a front end loader. The mixture is transported via front end loader to incoming train cars loaded with coal. One front end loader bucket full is added to each car.

The train cars are then moved to the coal handling area where the coal is processed. At the coal shake-out operation two coal handlers (unloaders) unload the train cars. The coal is emptied from the bottom of the train car onto a conveyor belt leading to the crusher building. The crusher man is responsible for monitoring the crusher control panel. The crushed coal proceeds via conveyor belt to the top of the pulverizer building. Two employees working inside the pulverizer building monitor the operations. In the pulverizer building, the coal is separated by grades and dumped into the appropriate bins. Three to four types of coals are mixed to obtain the proper blend and #2 diesel fuel is sprayed on the coal to give it the proper density. From the pulverizer building, the coal travels via conveyor belt to the coal bunker storage bins. The coal bunker man is responsible for monitoring these operations.

C. Engineering, Administrative, and Personal Protective Controls

All plant personnel are required to wear safety boots with metatarsal guards, hard hats, and safety glasses. The by-products utility man wears protective gloves when transporting the coal tar sludge via wheel barrel to the coal pit. Additionally, all coke plant employees are required to shower and change clothes before leaving the plant.

Preemployment physicals are performed on all employees. At the time of our surveys there was no routine medical program in place for the by-products department and coal handling area employees. These employees are now included in the medical program for coke oven employees.

IV. EVALUATION DESIGN AND METHOD

A. Environmental

During the initial survey, bulk samples of the coal tar sludge and coal tar sludge/coal mixture were collected in glass vials with Teflon lined caps. These samples were qualitatively analyzed by extracting the coal tar pitch volatiles (CTPVs) and polynuclear aromatic hydrocarbons (PNAs) using four different solvents (acetonitrile, benzene, cyclohexane, and methylene chloride) and analyzing the extract via gas chromatography/mass spectrometry (GC/MS).

Based on information obtained from the bulk sample analyses which indicated that benzene was the most appropriate solvent for this matrix, samples were collected for benzene soluble CTPVs and PNAs. Additionally, samples for respirable coal dust were collected. Personal samples and/or general area air samples were collected in the by-products department and the coal handling area of the coke oven batteries. Personal samples were collected by placing the sample media near the employees breathing zone and general area air samples were placed in areas where the employees were likely to be present. The appropriate sample media was connected via Tygon tubing to a battery powered pump operating at the prescribed flow rate. Table 1 contains pertinent sample collection data.

The shake-out operator, the shake-out helper, the crusher operator and the coal bunker beltman were monitored for exposure to respirable coal dust. The two coal handlers working in the pulverizer building and the by-products department utility man were

monitored for exposure to benzene soluble coal tar pitch volatiles (CTPVs) and the sixteen Environmental Protection Agency (EPA) priority polynuclear aromatic compounds (PNAs). The sixteen EPA priority PNAs include: acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(e)pyrene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene.

The sampling train for benzene soluble CTPVs and PNAs consisted 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 (lpm). The Teflon filters were analyzed for benzene soluble CTPVs and PNAs, and the solid sorbent (XAD-2) tubes were analyzed for PNAs.[2]

High volume general area air sampling for total and respirable coal dust and a bulk sample of settled rafter coal dust were collected and analyzed for crystalline silica, specifically % quartz and % cristobalite. Samples were analyzed via x-ray diffraction according to NIOSH method 7500[2].

B. Medical

Confidential medical questionnaires were administered to coal handlers and the by-products utility man. These included questions concerning their past medical history, and symptoms related to the respiratory tract, digestive systems, and the skin.

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 Recommended Exposure Limits (REL's)[3], 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's)[4], and 3) the U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) occupational health standards[5]. Often, the NIOSH REL's and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH REL's 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 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) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high, short-term exposures.

A. Coal Tar Products

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.[6] In the NIOSH criteria document, cyclohexane was selected as a less toxic substitute for benzene; however, it has

become apparent that cyclohexane will not extract CPTVs and PNAs from some sample matrices as well as benzene or other solvents. Therefore, in the third edition of the NIOSH Manual of Analytical Methods it is recommended that CTPVs and PNAs be extracted using a solvent appropriate to the sample matrix, which is determined by evaluating bulk samples. The air samples are then extracted accordingly.[2] 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 also 0.2 mg/M^3.

The term "coal tar products" 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 phenanthrene. 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.[6]

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.[6]

B. Polynuclear aromatic hydrocarbons (PNAs)

There is no specific criteria for individual PNAs however, NIOSH recommends that exposures be limited to the extent feasible by the use of engineering or administrative controls and personal protective clothing and equipment.[6]

The evaluation criteria and the primary health effects of other substances for which samples were collected are contained in Table 2.

VI. RESULTS

Bulk samples of the coal tar sludge and coal tar sludge/coal mixture collected during the initial survey were analyzed for solvent soluble CTPVs and PNAs. Solvent soluble materials were extracted using the following solvents, acetonitrile, benzene, cyclohexane, and methylene chloride. Solubles were measured which included the following PNAs; naphthalene, phenanthrene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(e)pyrene, benzo(a)pyrene, and benz(g,h,i)perylene. Results indicated benzene was the best solvent for extracting the PNAs from these materials and was therefore, selected for use in analyzing the air samples. These results clearly show the presence of PNAs in the coal tar sludge and the coal tar sludge/coal mixture. The results of the bulk sample analyses are presented in Table 7.

Personal and general area air samples for benzene soluble CTPVs and PNAs were collected on filters connected in series to solid sorbent XAD-2 tubes. Filters were analyzed for CTPVs and PNAs and XAD-2 tubes were analyzed for PNAs. Results of sampling for benzene soluble fraction ranged from non-detectable concentrations to 141 micrograms per cubic meter (ug/M^3). Five of the eight samples showed detectable concentrations of benzene solubles. All sample concentrations were below the OSHA Permissible Exposure Limit (PEL) of 200 ug/M^3, but three were above the NIOSH recommended standard of 100 ug/M^3. It should be noted that benzene was the solvent of choice used to extract these samples whereas, the NIOSH Criteria Document on Coal Tar Products references using cyclohexane to extract solvent soluble CTPVs.[6] However, it should be further clarified and understood that the recommended use of cyclohexane to extract solvent soluble CTPVs was based on the toxicity of benzene. Cyclohexane was selected as a less toxic substitute for benzene; however, it has become apparent that cyclohexane is not as good of a solvent as benzene for some sample matrix. Therefore, NIOSH recommends extracting CPTVs and PNAs using a solvent appropriate to the sample matrix. Further, the historical data upon which the defined health effects of exposure to CTPVs is based, is derived from benzene generated data, therefore, these sample results can be and are compared to the NIOSH recommended exposure limit of 100 ug/M^3.

Diesel fuel was added to the coal inside the pulverizer building to increase the density which in turn increases production. Diesel fuel is soluble in benzene and would thereby be expected to slightly increase the sample weight, therefore, samples collected from the employees working inside the pulverizer building (coal handler operator

and the pulverizer operator) should be considered to be a maximum concentration of benzene solubles. Filters also showed that one or more of the following PNAs were detected on five of the air samples collected: phenanthrene, anthracene, fluoranthene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene. The total quantity of PNAs and the individual quantities of the each PNA detected on each sample are presented in Table 5.

PNA analysis of the solid sorbent XAD-2 tubes attached to the Teflon filters showed five to seven of the following PNAs to be present: acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene. The total quantity of PNAs and the individual quantities of the each PNA detected on each sample are presented in Table 6.

High volume general area air samples of coal dust collected in the basement of the pulverizer building were analyzed for percent quartz and percent cristobalite. The analytical limit of detection (LOD) for quartz was 0.75% by weight and the analytical limit of quantitation (LOQ) was 1.5% by weight. Total particulates contained 1.6% quartz but were less than the LOD for cristobalite. The respirable particulate fraction was less than the LOQ for quartz and did not contain cristobalite. A bulk sample of settled coal dust collected in the pulverizer building was less the than LOQ for quartz and did not contain cristobalite. Complete sample results are presented in Table 3.

All respirable coal dust samples collected were below the applicable environmental criteria. Sample concentrations ranged from 0.14 milligrams per cubic meter (mg/M^3) to 1.52 mg/M^3. The American Conference of Governmental Industrial Hygienist (ACGIH) recommends a time weighted average (TWA) concentration of 2.0 mg/M^3 and the Occupational Safety and Health Administration (OSHA) permissible exposure limit is 2.4 mg/M^3. A complete listing of sample results are presented in Table 4.

The 15 coal handlers and the by-products utility men interviewed were all male, over 27 years of age with most over 40, with at least 7 years of seniority at Granite City Steel. Four workers never smoked, 5 were former smokers and 6 were smokers. Five reported chronic cough, 7 daily phlegm, 10 were troubled by shortness of breath when hurrying on level ground, 5 could not keep up with other people their own age on level ground. These findings were not significantly different for those who smoked or did not.

Sinus congestion bothered 10 of the workers, rhinitis and chest tightness, 10 reported intermittent skin rashes, 11 had eye irritation, and nine occasional nausea. Most workers associated these symptoms to exposure to the coke oven by-products added to the coal.

VII. CONCLUSION

On the basis of the information obtained in this evaluation, it has been determined that a health hazard existed in the coal handling area and the by-products department at Granite City Steel, due to employee exposures to coal tar pitch volatiles (CTPVs) which contained identifiable carcinogens and/or suspect carcinogens in the form of polynuclear aromatic (PNAs) compounds.

The environmental levels and reported symptoms indicate a chronic exposure to CTPVs and PNAs. The eye, skin, and respiratory tract symptoms reported are consistent with exposure to the coal tar sludge/coal mixture, which contained CTPVs and PNAs. The environmental levels of coal dust recorded would not be expected to produce substantial pulmonary deficits. However, the shortness of breath reported by individuals should be followed up by their personal physician.

VIII. RECOMMENDATIONS

The following recommendations are made to assure that employee exposures to coal tar pitch volatiles (CTPVs) and polynuclear aromatic compounds (PNAs) are kept to a minimum.

1. Elimination is the recommended method for controlling occupational exposures to toxic substances. The coal tar sludge waste product from the by-products department has been shown to contain benzene soluble CTPVs which contain known carcinogens in the form of PNAs. To effectively eliminate this source of PNAs the coal tar sludge waste product should be properly disposed of according to EPA regulations governing the disposal of toxic substances.

2. If elimination is not a feasible alternative, engineering controls and personal protective equipment should be used to reduce employee exposures to the CTPVs which have also been shown to contain identifiable carcinogens and/or suspect carcinogens in the form of PNAs. The coal tar waste product should be piped in an enclosed system directly to the coal pit thereby eliminating exposure to the by-product utility man.

3. Engineering controls being installed at the coal bunker at the time of the environmental survey consisted of an isolated room with an outside air supply. Similar engineering controls should be installed in the pulverizer building.

4. Employees responsible for handling of the coal tar sludge during disposal or recycling should be properly protected from exposure to CTPVs which have also been shown to contain identifiable carcinogens and/or suspect carcinogens in the form of PNAs by the use of appropriate skin and respiratory protection. Chemical protective clothing should include gloves which cover the arms from the elbow to the hands. Coveralls may be needed when directly handling the coal tar sludge waste product.

5. A half mask air purifying respirator equipped with an organic vapor cartridge should be provided to employees when working with the coal tar sludge waste product or coal tar sludge/coal mixture.

6. Employees who are expected, in the course of their work, to come in contact or work with the coal tar sludge or coal tar sludge/coal mixture, should be informed of the hazards involved and should be trained in the correct handling procedures.

7. Employees potentially exposed to the coal tar sludge should be enrolled in a coke plant medical monitoring program. This program should include an annual physical examination, biannual chest radiograph, spirometry, urine and sputum cytology, and complete blood count.

8. Employees involved in handling of coal tar sludge or coal tar sludge/coal mixtures should be advised of all industrial hygiene sampling results which are collected.

IX. REFERENCES

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3. NIOSH Recommendations for Occupational Safety and Health Standards. Morbidity and Mortality Weekly Report Supplement. Volume 35/No. 1S. September, 1986.

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X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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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. Manager, Environmental Health, Granite City Steel
B. International Chemical Workers Union, Akron Ohio
C. International Chemical Workers Union, Local #50
D. U.S. Department of Labor, OSHA - 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 1

Sampling and Analysis Methodology

Granite City Steel
Granite City, Illinois
HETA 84-284

Substance	Collection Media	Flowrate (LPM)	Analysis	Detection Limit (ug/sample)	NIOSH Reference Method
COAL DUST (respirable)	PVC Filter with 10 mm cyclone	2.0	Gravimetric	0.010 mg/sample	0600
FREE SILICA (total)	PVC Filter	8.8	X-ray Diffraction	0.015 mg/sample	7500
FREE SILICA (respirable)	PVC Filter with 10-mm cyclone	9.0	X-ray Diffraction	0.015 mg/sample	7500
COAL TAR PITCH VOLATILES (benzene soluble fraction)	Teflone Filter	1.7	Gravimetric	50	5515
POLYNUCLEAR AROMATICS	Teflone Filter	1.7	Gas Chromatography	0.3 - 0.5	5515
POLYNUCLEAR AROMATICS	XAD-2	1.7	Gas Chromatography	0.3 - 0.5	5515

Table 2

Evaluation Criteria and Health Effects Summary

Granite City Steel
Granite City, Illinois
HETA 84-284

Substance	Evaluation Criteria* (mg/M3) NIOSH	OSHA	ACGIH	Primary Health Effects
Coal Dust (< 5% quartz)	-	2.4	2.0	Coal workers pneumoconiosis.
Coal Dust (> 5% quartz)				Refer to crystalline silica formula
Crystalline Silica (respirable)	0.05	$\frac{10 \text{ mg/M3}}{\% \ SiO_2+2}$	$\frac{10 \text{ mg/M3}}{\% \ SiO_2+2}$	Silicosis; a pneumoconiosis due to the inhalation of silicon dioxide containing dust, which is a disabling, progressive and sometimes fatal pulmonary fibrosis characterized by the presence of typical nodulation in the lungs.
Coal Tar Pitch Volatiles	100 ug/M^3	200 ug/M^3	200 ug/M^3	CTPVs generally contain PNAs, which have been shown in both laboratory and industrial situations to cause lung cancer in exposed subjects.
Polynuclear Aromatics	--	--	--	NIOSH recommends that exposures be limited to the extent feasible by the use of engineering or administrative controls and personal protective clothing and equipment. One way to reduce PNA exposures is to maintain CTPV exposures below the NIOSH recommendation.

* Values represent time-weighted average (TWA) exposure limits for up to a 10 hour workday unless otherwise specified.

Table 3

High Volume Area Air Samples for Total and Respirable Crystalline Silica

Granite City Steel
Granite City, Illinois
HETA 84-284

Date	Location	sample time (minutes)	sample volume (liters)	Crystalline Silica (% by weight) Quartz	Cristobalite
8/6/85	Pulverizer building (Total)	65	572	1.6	<LOD
8/6/85	Pulverizer building (Resp.)	65	585	<LOQ	<LOD
8/6/85	Coal dust rafter sample	--	---	<LOQ	<LOD

Abbreviations: LOD - Laboratory Limit of Detection (0.75% by weight)
LOQ - Laboratory Limit of Quantitation (1.5% by weight)

Table 4

Respirable Coal Dust Exposures of Coal Handlers

Granite City Steel
Granite City, Illinois
HETA 84-284

Date	Job/Location	sample time (minutes)	sample volume (liters)	Coal Dust (mg/M^3)
8/6/85	Shake-out operator	404	687	0.38
8/7/85	" "	425	722	1.52
8/6/85	Shake-out helper	401	682	0.28
8/7/85	" "	443	753	0.61
8/6/85	Crusher operator	397	675	0.18
8/7/85	" "	451	767	0.14
8/6/85	Coal bunker beltman	393	668	0.70
8/7/85	" " "	452	768	1.17
Laboratory Limit of Detection				0.01 mg/sample

Abbreviations: mg/M^3 - milligrams of coal dust per cubic meter of air

Table 5

Personal Breathing Zone Air Concentrations of Benzene Soluble CTPVs and PNAs

Granite City Steel
Granite City, Illinois
HETA 84-284

Date	Job/Location	Sample Duration	Sample Volume (liters)	Benzene Solubles (ug/M^3)	Quantities of Individual PNAs detected on Filters (micrograms per sample)								Total PNAs (ug/M^3)
					A†	B*	C*	D†	E†	F	G	H†	
8/6/85	Coal handler operator	12:44 - 18:54	740	<LOD	ND	ND	ND	ND	ND	ND	ND	ND	<LOD
8/7/85	" " "	12:43 - 19:17	788	102	ND	ND	ND	ND	ND	ND	ND	ND	<LOD
8/6/85	Pulverizer operator	12:51 - 18:51	720	111	1.0	ND	0.3	ND	ND	ND	ND	ND	1.8
8/7/85	" "	13:11 - 19:27 &20:02 - 21:26	920	141	2.5	0.7	0.6	ND	ND	ND	ND	ND	4.1
8/6/85	By-products utility man	15:00 - 22:27	894	89	ND	ND	ND	0.6	0.7	0.7	0.5	0.7	3.6
8/7/85	" " "	14:48 - 22:23	910	88	1.0	0.3	ND	ND	ND	ND	ND	ND	1.4
8/6/85	Area sample at Coal tar sludge decanter	15:03 - 16:46 &17:01 - 21:22	728	<LOD	ND	ND	ND	ND	ND	ND	ND	ND	<LOD
8/7/85	" " "	14:40 - 22:18	916	<LOD	ND	ND	4.9	ND	ND	ND	ND	ND	5.3
Laboratory limit of detection (ug/sample)				50	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5	

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

† - carcinogen
* - suspect carcinogen

A = phenanthrene
B = anthracene
C = fluoranthene
D = benz(a)anthracene
E = chrysene
F = benzo(b)fluoranthene
G = benzo(k)fluoranthene
H = benzo(a)pyrene

Table 6

Personal Breathing Zone Air Concentrations of Polynuclear Aromatics (PNAs)

Granite City Steel
Granite City, Illinois
HETA 84-284

Date	Job/Location	Sample Duration	Sample Volume (liters)	Quantities of Individual PNAs detected on XAD-2 Tubes (micrograms per sample) A	B	C	D†	E*	F*	G*	Total PNAs (ug/M^3)
8/6/85	Coal handler operator	12:44 - 18:54	740	12	2.5	3.8	1.3	0.4	ND	ND	27
8/7/85	" " "	12:43 - 19:17	788	7.8	1.9	2.1	1.0	0.5	ND	ND	17
8/6/85	Pulverizer operator	12:51 - 18:51	720	19	13	14	4.6	1.7	ND	ND	73
8/7/85	" "	13:11 - 19:27 &20:02 - 21:26	920	11	10	8.9	3.2	1.5	ND	ND	38
8/6/85	By-products utility man	15:00 - 22:27	894	14	2.2	6.3	5.5	2.1	1.1	0.8	36
8/7/85	" " "	14:48 - 22:23	910	12	1.5	5.5	5.3	2.2	0.7	ND	30
8/6/85	Area sample at Coal tar sludge decanter	15:03 - 16:46 &17:01 - 21:22	728	30	3.0	16	8.7	3.4	0.9	0.5	86
8/7/85	" " "	14:40 - 22:18	916	36	4.3	24	12	6.9	1.7	1.0	94
Laboratory limit of detection (ug/sample)				0.5	0.5	0.5	0.5	0.3	0.5	0.5	

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

† - carcinogen
* - suspect carcinogen

A = acenaphthylene
B = acenaphthene
C = fluorene
D = phenanthrene
E = anthracene
F = fluoranthene
G = pyrene

Table 7
Bulk sample concentrations of Coal Tar Pitch Volatiles (CTPVs) and Polynuclear Aromatics (PNAs)

Granite City Steel
Granite City, Illinois
HETA 84-284

Solvent	Sample Location	Naphthalene	Phenanthrene	Fluoranthene	Pyrene	B(a)A	Chrysene	B(e)P	B(a)P	B(ghi)P	Total PNAs	Solubles (mg/g)
		micrograms per gram (ug/g)										
Acetonitrile	Waste decanter	53,000	30,000	16,000	12,000	8400	4400	2200	4300	1600	132,000	380
	Coal bunker	27	16	8	6	6	3	3	3	<2	72	1.40
Benzene	Waste decanter	54,000	33,000	18,000	14,000	9800	5400	3400	6200	3200	148,000	590
	Coal bunker	33	31	20	18	24	17	5	7	6	161	5.87
Cyclohexane	Waste decanter	77,000	37,000	17,000	13,000	7700	4100	1900	3700	1300	163,000	310
	Coal bunker	18	19	8	8	5	3	<2	3	<2	64	0.60
Methylene chloride	Waste decanter	69,000	36,000	18,000	14,000	9200	5000	3100	5700	3200	163,000	590
	Coal bunker	49	21	9	8	6	6	2	4	3	108	2.3
Limit of Detection		2	2	2	2	2	2	2	2	2		0.20

Abbreviations: B(a)A - benz(a)anthracene
B(e)P - benzo(e)pyrene
B(a)P - benzo(a)pyrene
B(ghi)P - benzo(g,h,i)perylene

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