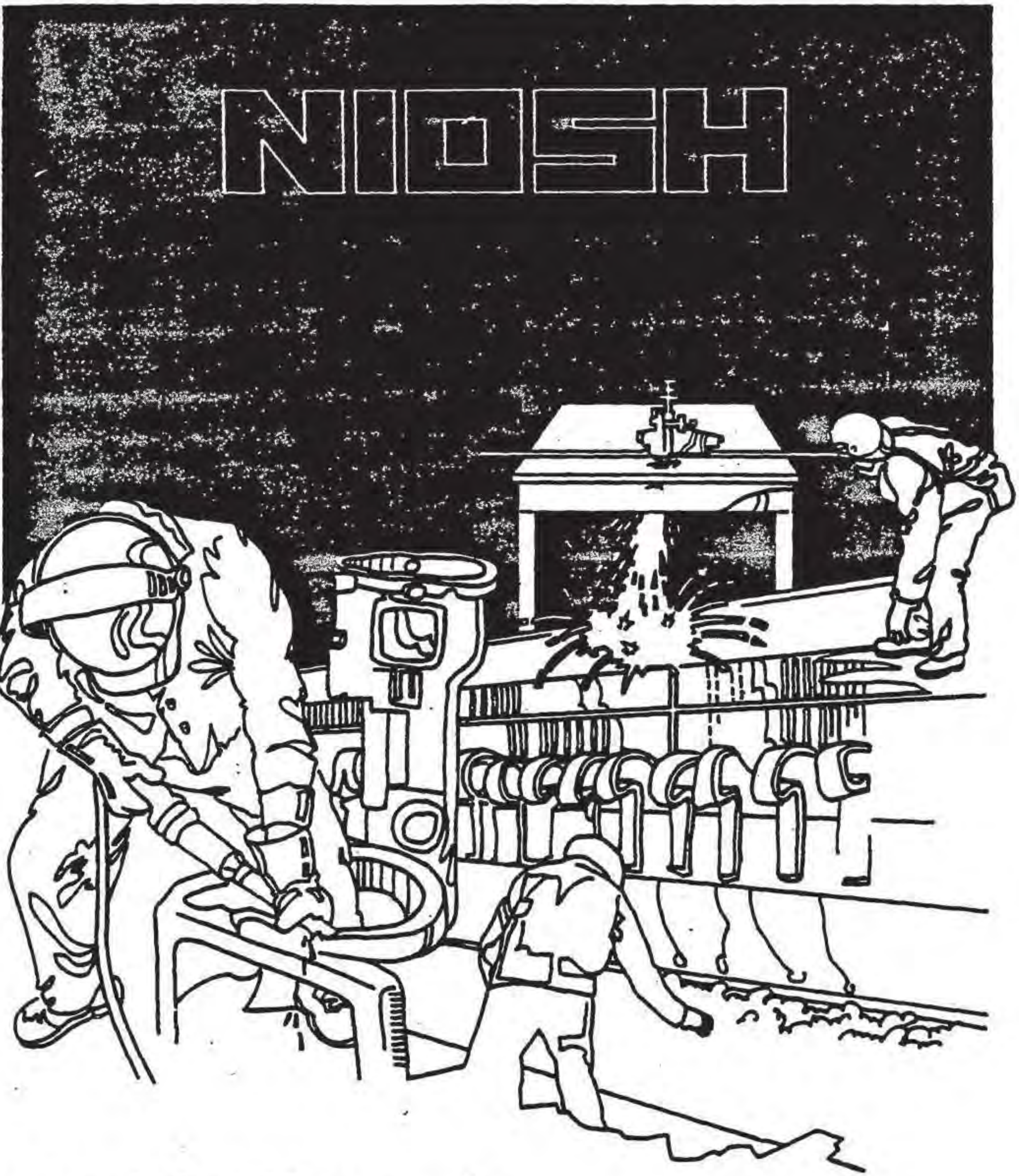
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 84-033-1576
AIRCO CARBON
ST. MARYS, PENNSYLVANIA

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 84-033-1576
September, 1985
AIRCO CARBON
ST. MARYS, PENNSYLVANIA

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I. SUMMARY

On November 7, 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from employees of the Airco Carbon Company, located in St. Marys, Pennsylvania. Airco Carbon manufactures specialty graphite and graphite electrodes. The request was for investigation of employee exposures to polynuclear aromatic hydrocarbons (PNAs) within the car bottom and sagger bake areas of the plant and to crystalline silica in the sagger bake area. NIOSH conducted an environmental and medical evaluation of these areas on January 16-19, 1984.

Personal, or breathing zone, environmental air samples were collected from employees in the car bottom bake and sagger bake operations to determine exposures to total airborne particulates. The benzene soluble fraction of the particulate samples was measured, plus seventeen PNAs. NIOSH conducted confidential, structured interviews with employees in the sagger bake and the car bottom bake areas. Medical records for all employees in these two departments were reviewed. Employee X-rays were sent to NIOSH and read independently.

Nineteen personal samples obtained in the bake areas showed airborne concentrations of total particulate ranging from 0.8 to 17 mg/m^3, averaging 5.7. Two of these exceeded the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit (PEL) of 15 mg/m^3 for total particulates. The benzene soluble fractions of these samples ranged from 0.5 to 5.0 mg/m^3, averaging 1.9. NIOSH recommends that exposures to suspect carcinogens be maintained at the lowest feasible level. The NIOSH recommended standard for the soluble fraction of coal-tar pitch volatiles (CTPV) is 0.1 mg/m^3(considered to be the lowest detectable level), and the OSHA PEL is 0.2 mg/m^3. All samples collected in the bake areas were above these evaluation criteria. Two of seven samples obtained to measure employee exposures to airborne respirable free silica in the sagger bake department were reported above the 0.03 mg/sample detection limit; at 0.09 and 0.06 mg/m^3, exceeding the NIOSH recommended standard for respirable free silica of 0.05 mg/m^3. The OSHA PEL, which is based on the percentage of free silica in the respirable particulate, was not exceeded. Five samples obtained from employees during sagger can filling were below the detectable limits.

Of the 43 employees interviewed, those working in both bake areas with relatively higher particulate exposure reported a significantly greater proportion of symptoms including skin, nose, and eye irritation, cough or sore/dry throat, chest tightness, shortness of breath, and breathing difficulty. Except for one possible early case, there was no evidence of pneumoconiosis from review of the 50 chest X-rays.

Based on the environmental and medical data, the NIOSH investigators concluded that a health hazard exists in the sagger and car bottom bake areas of Airco Carbon. Recommendations for reduction of the particulate exposures created during the manufacture of the graphite electrodes are made in Section VII of this report. These recommendations include enclosure of vehicles used for movement of the electrodes, clean-up of settled dust in process areas, and repair of leaks, or otherwise control of fumes emitted from the sagger kilns .

KEYWORDS: SIC 3624 (Carbon and Graphite Products) Polynuclear aromatic compounds, silica, graphite electrode, coal-tar pitch volatiles, particulates, X-ray

II. INTRODUCTION

On November 7, 1983, NIOSH received a confidential request for a health hazard evaluation of the Airco Carbon car bottom and sagger bake operations. The employees expressed concern for their exposures to "soot, coal-tar pitch volatiles, and sand." The request listed job catagories including car bottom utility operators, sagger bake furnace loaders, sagger bake equipment operators, inspectors, miscellaneous employees, foreman, and janitor. The basis for their concern was environmental data collected in July, 1982, which indicated CTPV exposures exceeding the 0.2 mg/m^3 OSHA PEL.

III. BACKGROUND

Airco Carbon, a carbon products manufacturer, was founded in 1899 at St. Marys, Pennsylvania, as Speer Carbon. The company was purchased by Airco, Inc. in 1961. There are two product lines consisting of specialty graphite parts, and graphite electrodes (which comprise the majority of the production). At the time of the NIOSH evaluation, total plant employment was approximately 840 (660 hourly and 180 salaried). The plant was unionized in the late 1930's by the International Union of Electrical, Radio, and Machine Workers, Local 502.

The production of the carbon electrodes can be divided into five general processes; formulation or mixing, baking, impregnation, graphitization, and finishing. The request for a health hazard evaluation was for the baking operations (both sagger and car bottom bake). The primary raw materials used are calcined petroleum coke (needle coke), coal-tar pitch, and petroleum pitch. During mixing and formulation, petroleum coke is sized and heated, and liquid coal-tar pitch is added as a binding material. This mixture is then extruded in a rod shape to form the electrode. The baking process, which converts the coal-tar pitch binder to solid coke and decreases shrinkage of the final procuct, utilizes three methods of baking: mass, car bottom, and sagger. Mass bake consists of loading the rods "in mass", surrounded by sand in gas fired furnases. The sagger bake method involves loading rods into cylindrical containers and packing with sand. The sand acts as reinforcement during the baking operation, allowing the rod to maintain its shape while heated. The cans are placed vertically into gas fired kilns. Car bottom kilns are a variation of the sagger bake system, where the sagger cans are loaded in "baskets" and placed onto refractory rail cars, which form the bottom of the kiln. The baking processes were designed to collect and incinerate the waste gases. The effluent air is recirculated back to the furnaces to conserve heat loss and reduce energy costs.

The sagger operation is used primarily to bake "green" rods; i.e., those which have not undergone previous baking. The car bottom system is usually used to bake rods which have undergone both a bake and impregnation process. Impregnation improves the properties of the baked carbon by forcing liquid petroleum pitch into the porous surface.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Environmental monitoring was conducted to determine employee exposures to vapors and particulates generated from the production of the graphite electrodes. Measured airborne substances included total particulates (plus polynuclear aromatic compound (PNA) content and benzene soluble fraction) and respirable free silica.

Historically, exposures to PNAs were estimated by determining exposures to the "soluble" fraction of the airborne particulate. Then current research indicated that if the soluble portion (benzene normally used as the solvent for extraction) of the particulate was less than a specified level (0.2 mg/m^3 OSHA PEL; 0.1 mg/m^3 NIOSH recommended standard) exposures to the airborne PNAs should be below levels expected to result in advance health effects. This method was employed due to the difficulty in analyzing for specific PNAs. Recently, advances in analytical chemistry have enabled the direct measurement of PNAs. NIOSH is revising its sampling and analytical methodology to reflect this ability. Although this antiquates the traditional method of estimation via soluble extract, the benzene soluble fractions were also determined during the Airco evaluation for comparison and reference with the coal-tar pitch volatiles evaluation criteria.

Coal tar pitch volatile samples were collected at one liter/minute on a 2.0 micron (pore size) 37 mm diameter PTFE laminated membrane filter backed with a washed XAD-2 resin 150 mg. sorbent tube, in accordance with the NIOSH sampling and analytical method # 5506. General area samples collected at the work site were analyzed using various desorbing agents. Benzene showed the best desorbing ability for this particular environment, and was therefore used in analyzing the personal, or breathing zone samples.

Two days of monitoring was conducted in both the sagger bake and car bottom bake areas. Although the sampling train consisted of a filter backed with a sorbent tube during both days of sampling, difficulties encountered during field monitoring precluded analysis of the sorbent tubes collected on the second day. Therefore, exposures to the lower molecular weight (lower boiling) PNAs are somewhat underestimated for these samples (Sample #'s 0389 through 0411, Table I).

Environmental sampling was also conducted for respirable free silica in the sagger bake area during routine operations and during a can filling operation. Samples were collected on pre-weighed PVC filters equipped with 10 mm nylon cyclones at a flow rate of 1.7 lpm. The duration of the can filling operation was less than two hrs. Therefore, based on the 0.3 mg/sample detection limit, and the approximate 0.2 m^3 sample volume, the lowest measurable airborne concentration of free silica would be approximately 0.15 mg/m^3, or three times the NIOSH recommended standard.

B. Medical

During the site visit, the NIOSH investigator conducted confidential, structured interviews with employees in the sagger bake and car bottom bake areas. Medical records for all employees in these two departments were reviewed. X-rays were sent to NIOSH and read independently by two B-readers.

The questionnaire included an assesment of occupational history, smoking status, symptoms associated with disease of the upper and lower respiratory tract, eye and nose irritation and factors related to work-relatedness of these symptoms.

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 (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 reviewing 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 & Health Act of 1970 to meet those levels specified by OSHA standards.

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.

The potential adverse health effects of PNAs are well recognized.[1-4] Several PNAs such as benzo(a)anthracene, and pyrene have been shown to be carcinogenic in animals. Excess risk of lung cancer, oral cancer, and skin neoplasms (benign and malignant) have been found in working populations handling coal-tar products which NIOSH has defined to include coal-tar, coal-tar pitch, and creosote.[2] A TWA exposure of 0.2 ug/m_3 was recommended by the coke oven advisory committee for benzo(a)pyrene under the OSHA 29 CFR 1910.1029 coke oven emissions standards, but was not adopted;[2] and a special NIOSH hazard review of chrysene recommended that it be controlled as an occupational carcinogen. Also, ACGIH includes chrysene and benzo(a)pyrene in its list of industrial substances suspect of carcinogenic potential for man.[5] The carcinogenic potential of the other PNAs (benzo(a)anthracene, anthracene, pyrene, and fluoranthene) has also been documented.[2]

The acute toxic effects of exposure to coal-tar pitch include skin and mucous membrane irritation mediated directly and more noticeably through photosensitivity reactions of the phototoxic type involving an interaction beween the photosensitizing agent (PNAs) and ultraviolet (UV) radiation. Most phototoxic reactions require UV_A (320-400nm). The mechanism involves the absorption of this radiant energy by the skin and by the PNAs on the skin which can then result in cell changes.[1] As expected, these reactions affect outdoor workers who handle these materials and receive exposure to sunlight. Thus these reactions are more frequent and severe in the summer and during mid-day when UV radiaton is most intense. The effects most often described include erythemia (reddening of the skin) and conjunctivitis. Typically, onset of symptoms may be delayed until the day after exposure when the pitch worker goes outdoors and receives UV light that can interact with the PNAs on the skin. Elimination of either the light or contact with the phototoxic substance eliminates the problem. Increased skin pigmentation (melanin) such as in blacks has been shown to have a protective effect.

Crystalline silica, usually referred to as free silica, is defined as silicon dioxide (SiO_2) molecules arranged in a fixed pattern as opposed to a nonperiodic, random molecular arrangement defined as amporphous silica. The three most common crystalline forms of free silica encountered in industry are quartz, tridymite, and crisotblite, with quartz being by far the most common of these. NIOSH, in its recommendations for a free silica standard, has proposed that exposures to all forms of free silica be controlled so that no worker is exposed to respirable airborne concentrations greater than 0.05 mg/m^3, as averaged over a 10-hour working day, 40-hour workweek. Exposures to free silica greater than one-half the recommended standard, or "action level", should initiate adherence to the environmental, medical, labeling, recordkeeping, and worker protection guidelines as contained in Chapter I of the NIOSH criteria document, "Occupational Exposure to Crystalline Silica".[6] The current federal, or OSHA standard for respirable free silica exposure is an 8-hour time-weighted average based upon the 1968 ACGIH TLV formulas of 10 mg/m^3 divided by the percent SiO_2 plus 2 (10 $mg/m^3/\%SiO_2 + 2$) for respirable quartz. One-half this amount was established as the limit for cristobalite and tridymite. As can be seen from the calculation, the OSHA regulation is based on the percentage of free silica contained in the respirable particulate exposure, whereas the NIOSH recommended standard applies directly to the airborne concentrations of respirable free silica.

Silicosis is a form of diffuse interstitial pulmonary fibrosis resulting from the deposition of respirable crystalline silica in the lung. Conditions of exposure may affect both the occurrence and severity of silicosis. Although it usually occurs after 15 or more years of exposure, some forms with latent periods of only a few years are well recognized and are associated with intense exposures to respirable dust high in free silica.[7] Early, simple silicosis usually produces no symptoms. However, both acute and complicated silicosis (PMF) are associated with shortness of breath, intolerance for exercise, and a marked reduction in measured pulmonary function. Diagnosis is most often based on a history of occupational exposure to free silica and the characteristic appearance of a chest radiograph. Respiratory failure and premature death may occur in advanced forms of the disease. Individuals with silicosis are also at increased risk of contracting tuberculosis. No specific treatment is available, and the disease may progress even after a worker is no longer exposed to silica.

VI. RESULTS AND DISCUSSION

A. Environmental

Table I presents results of environmental sampling for particulates, benzene solubles, and PNAs. Although benzene soluble fractions were reported as greater than the total particulate weights for three of the samples appearing in Table I, slight net negative particulate weights are to be expected due to various factors such as overloading, hygroscopicity of the sample, humidity and the physical integrity of the filter itself. However, these variables do not have an effect on determining the amount of benzene soluble material or PNAs.

Exposures to PNA containing fumes at the bake operations are primarily a result of effluents escaping from the kilns, particularly the sagger bake kilns. Although designed to operate under negative pressure, these furnaces were observed to intermittently liberate smoke. The sagger furnaces are primarily used to bake rods which have not undergone a previous baking cycle, therefore the PNA containing volatiles of the coal-tar pitch (which has traditionally shown higher PNA content than petroleum pitch) are driven off. Employees engaged in loading rods into the furnaces in the sagger bake area, or "setting kiln" had the highest of any measured exposures to PNAs. Two samples collected from employees during this operation were reported at 1.12 and 2.33 mg/m^3 for total particulate with benzene soluble fractions of 1.55 and 2.05, respectively. PNA content of these samples was 25.9 and 55.9 ug/m^3 (of the seventeen measured PNAs).

Particulate exposures in the car bottom and sagger bake operations have numerous origins, including attrition from the rods during transport, loading and unloading the sagger cans, pounding the sagger cans to loosen the hardened material following baking, liberation of pitch and soot accumulations during container dumping in the car bottom area, and travel of hysters in the general bake areas. This latter situation created the most chronic and widespread particulate exposures, due to the large amounts of dust accumulated on most floor areas. To catagorize the dusts and gain insight as to those which contribute the most to PNA exposures, several bulk dust samples were obtained and analyzed.

A sample of floor dust obtained in the general bake area contained 5.1 mg/g of benzene soluble material, and a total of 20 ug/g PNAs (of the 17 PNAs analyzed). Table II presents results of the bulk analysis; indicating the specific PNAs found. Floor dust accumulations were observed in most work areas. Hyster traffic was the major contributor toward making this dust airborne.

A sample of rafter dust, which should give an indication of the benzene soluble and PNA content of dusts generated in the past, showed a benzene solubles content of 9.6 mg/g with 197 ug/gm PNAs. Following car bottom bake and removal of the rods from the bake baskets, the containers are dumped via hyster. Since the rods have undergone pitch impregnation, deposits of partially coked and coked petroleum pitch are in the bottom of the containers. Soot deposits are also present, consisting of extremely fine carbonacious material which becomes and remains airborne quite readily during unloading. A bulk sample of the soot was shown to contain 30 mg/gm of benzene solubles, and a total of 107 ug/gm PNAs. Efforts were underway at the time of the evaluation to decrease the amount of soot build up during baking by fluctuating the amount of oxygen delivered to the car bottom kilns, and by equipping these kilns with "de-soot" air systems. The partially coked pitch from the bottom of the rebake baskets contained 0.44 mg/gm benzene soluble material, with no detectable PNAs. The pitch material from the rebake basket contained 860 mg/g benzene solubles, with a total PNA content of 26,000 ug/gm, the highest PNA content of any bulk materials obtained. The car bottom dumping operation was of major concern among the employees, due to the large amounts of dust generated from dumping the baskets. However, as indicated in Table I, (sample #'s 0415 and 0412) the dust would appear to be primarily made up of the soot material (107 ug/gm PNA) rather than the more heavily PNA-containing pitch (26,124 ug/gm PNA).

Seven samples were collected from employees in the sagger bake area for respirable free silica (Table III). Sampled jobs included banding rods, setting kiln, hyster operation, dumping sagger cans, and pounding sagger cans. Two exposures were measured above the NIOSH recommended standard of 0.05 mg/m^3. Both of these exposures involved the dumping and pounding of sagger cans. Once the rods are removed from the cans following sagger bake, the cans are tilted upright with a hyster and pounded by an employee using a sledge. All material from the can, including the packing sand and pitch material that flowed out during the baking operation, is piled in a central area within the sagger bake area.

All other samples obtained for free silica within the sagger bake area were below the analytical limit of detection, which was generally below 0.04 mg/m^3. Exposures to respirable particulate within the sagger bake area ranged from 0.05 to 0.82 mg/m^3, with the two highest exposures resulting from the can dumping operation.

The duration of the can filling operation was less than two hrs. Therefore, based on the 0.3 mg/sample detection limit, and the approximate 0.2 m^3 sample volume, the lowest measurable airborne concentration of free silica would be approximately 0.15 mg/m^3, or three times the NIOSH recommended standard.

B. Medical

Forty-three employees were interviewed. Twenty worked in the sagger bake area, 15 worked in the car bottom bake area, and 8 worked in jobs that involved working in both areas. These workers were divided into a low exposure group of 8 employees and a presumed higher exposure group of 33 employees. The low exposure group included three job titles: foreman, clerk, and kiln attendant. These employees spend a majority of their time in offices or control rooms. The other 33 workers spend most of their time in production areas with exposure to silica, coal-tar pitch volatiles, and soot.

(a) Demographic and Medical History Data

All interviewed individuals were white males. The low exposure group was comparable to the higher exposure group (Table IV) with respect to age, years employeed at Airco Carbon, prevalence of reported allergies, and prevalence of chronic cough. The low exposure group had no non-smokers. In the lower exposure group, both current smokers (31 vs 23 pack years) and ex-smokers (35 vs 9 pack years) smoked more than their counterparts in the higher exposed group.

(b) Symptoms

The higher exposure group reported a greater proportion of all symptoms except headache than the low exposure group (Table V), and this increase was statistically significant for skin irritation, and nose or eye irritation.

Although increased pigmentation of the skin has been seen in pitch workers, and was mentioned by these workers as occurring in other departments, this symptom was not reported by any individual during the last three months at his present location.

(c) X-Rays

Fifty chest X-rays were reviewed by both B-readers (one X-ray, which was not obtained, had been previously reported by the company's reader as exhibiting pleural thickening, a blunted costophrenic angle, and fibrosis). There were a number of discrepencies between the readings of the abnormal X-rays by Airco and each of the B-readers. Eight individuals had X-rays in which abnormalities were seen by Airco Carbon. One individual had an abnormal X-ray about which all three readers agreed. Two were seen by one B-reader but not by the other. Five individuals had abnormalities read by Airco which were not seen by either B-reader: two were judged to be of inadequate quality for reading for pneumoconiosis, while the other three were completely negative. In addition, there were five other films where one B-reader detected an abnormality that neither the other B-reader nor Airco mentioned. Of the remaining 37 X-rays in which no abnormalities were detected by Airco, 28 were also considered completely negative by the B-readers. Both B-readers judged one of the remaining nine to be of inadequate quality for reading for pneumoconiosis; eight were judged inadequate by one reader and negative by the other.

One individual had a chest X-ray consistent with pneumoconiosis (s type opacities, involving the right and left lower lung fields, profusion 0/1). Three other X-rays had a single "nodule". Two of these X-rays were of long-term employees who had worked for over 10 years in areas with potential exposure to silica. There were, however, other non-occupational explanations for both of these nodules. The other abnormal chest X-rays included one with pleural thickening, one with a pleural abnormality and blunting of a costophrenic angle, one with an elevated hilum, one with an old calcified granuloma, one with an enlarged heart, and one with a possible anatomical variant or (unspecified) lung abnormality.

In summary, all jobs monitored during the health hazard evaluation involved exposures to pitch volatiles above the NIOSH recommended standard and the OSHA federal standard. "Setting kiln" had the highest reported exposures of any job (it was reported by company representatives that these employees were observed standing in the fumes generated by the saggar kiln; an unusual practice). The higher exposed workers in the sagger bake and the car bottom bake areas reported a greater percentage of all symptoms except headache than the lower exposed workers; the differences in prevalence for both skin irritation, and nose and eye irritation were statistically significant. These differences were seen in spite of a larger proportion of smokers and greater number of pack years in the lower exposed group. Except for one possible early case, there was no X-ray evidence of pneumoconiosis.

Exposures to respirable free silica were above the NIOSH recommended standard of 0.05 mg/m^3 during the can dumping operation. All samples collected for respirable free silica during the can filling operation were below the analytical limit of detection; however, the short duration of this operation resulted in a relatively high detection limit, when adjusted for sampled air volume (a level somewhat above the NIOSH recommended exposure criteria).

VII. RECOMMENDATIONS

The following recommendations are based on results of the environmental and medical evaluation and are designed to reduce employee exposure to the potentially hazardous substances used in their workplace. Since the time of the health hazard evaluation, the saggar baking operation has been discontinued, and the sand injection system is operating at a much reduced level. Therefore, the recommendations directed toward these operations are for if/when they are resumed.

1) Repair the leaks in the sand injection system for the can filling operation.

2) Enclose the sand system with local exhaust ventilation to control a substantial amount of particulate.

3) Enclose the hysters and supply with filtered air.

4) Remove debris from the bake areas on a routine basis.

5) Use the mechanical sweepers on a routine basis to prevent a build-up of the carbon dust material.

6) Special attention should be given to the sagger kilns toward reducing the amount of escaping fumes. Workers engaged in loading and unloading these kilns had the highest reported exposures to PNAs.

7) While the above measures are being implemented, workers should be supplied with respiratory protection in accordance with part 1910.134 of the OSHA General Industry Standards.[8] NIOSH generally recommends that only supplied air respirators are appropriate for protection against carcinogens. However since this is an interim measure, half-face respirators equipped with organic vapor cartridges plus dust and mist pre-filter pads should suffice.

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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TABLE I

PARTICULATE, BENZENE SOLUBLE, and PNAs
AIRCO CARBON

ST. MARYS, PA.
JANUARY 16-19, 1984
HETA 84-033

Sample #	Duration	Location/Operation	Exposure Concentrations Total Particulate (mg/m3)	Benzene Soluble (mg/m3)	PNAs* (ug/m3)
0370	06:06-15:31	Sagger Bake/Banding Rods	2.12**	2.66	18.9
0231	06:13-15:30	Sagger Bake/Banding Rods	[illegible].40	0.81	18.3
0376	06:11-13:20	Sagger Bake/Setting Kiln	2.33	2.05	55.9
0382	06:12-15:32	Sagger Bake/Hyster Operator	0.77	0.71	13.0
0359	06:57-15:27	Sagger & CB/Inspector	5.10	0.49	11.0
0381	06:35-15:23	Car Bottom/Hyster Operator	13.6	1.48	9.8
0357	06:27-15:28	Car Bottom/Crane Operator	3.33	1.63	5.1
0368	06:26-15:20	Car Bottom/Hook-up	5.81	1.46	3.4
0384	15:21-17:11	Car Bottom/Hook-up	17.3	2.96	ND***
0414	15:23-17:02	Car Bottom/Hyster	12.6	4.95	6.0
0389	05:57-15:05	Sagger Bake/Dumping Cans	15.7	2.0	11.5
0392	05:56-15:04	Sagger Bake/Pounding Cans	3.28	1.64	2.9
0400	06:01-15:11	Sagger Bake/Hyster Operator	1.12	1.63	1.4
0416	05:55-15:31	Sagger Bake/Hyster Operator	2.63	2.63	6.0
0395	05:58-15:09	Sagger Bake/Drawing Kiln	1.72	1.51	6.2

(Continued)

Table I
(Continued)

Sample #	Duration	Location/Operation	Exposure Concentrations Total Particulate (mg/m^3)	Benzene Soluble (mg/m^3)	PNAs* (ug/m^3)
0391	06:13-14:58	Car Bottom/Hook-up	6.29	1.58	1.0
0415	06:10-14:57	Car Bottom/Hyster Operator	5.16	0.90	ND
0412****	08:04-09:25	Car Bottom/Hyster Operator	32.7	9.88	0.5
0411	06:11-14:59	Car Bottom/Crane Operator	2.84	2.08	0.8

*PNA Concentration represents sum of 17 EPA priority PNAs

**The instrumental precision of weighings done at one sitting is 0.01 mg. Due to variable factors such as overloading, hygroscopicity of the sample, humidity and the physical integrity of the filter itself, the actiral precision can be considerably poorer and occasional slight net negative particulate weights are to be expected. However, this is not a factor in determining the amount of benzene soluble material or PNAs because this material is extracted from the filters prior to analysis.

***ND = non detectable

****collected during container dumping

TABLE II

BULK SAMPLE ANALSIS
BENZENE SOLUBLES and PNAs
AIRCO CARBON
ST. MARYS, PA.

JANUARY 16-19, 1984
HETA 84-033

Sample	Benzene Sol. (mg/g)	PNA Sum (ug/g)	Individual PNAs (ug/g)* 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Soot on Electrodes	30	107	6	6	ND**	64	6	5	20	ND	ND	ND	ND	ND	ND	ND	ND	ND
Coked Pitch from Basket	0.44	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pitch from Basket	860	26124	660	240	500	2900	980	2200	5900	370	3300	4400	1100	1400	1900	88	140	46
Floor Dust	5.1	21	1	ND	1	4	1	2	7	ND	3	2	ND	ND	ND	ND	ND	ND
Rafter Dust	9.6	197	27	7	6	57	8	25	33	2	7	5	5	4	3	3	2	3

*1 = Acenaphthylene; 2 = Acenaphthene; 3 = Fluorene; 4 = Phenanthrene; 5 = Anthracene; 6 = Fluoranthene; 7 = Pyrene; 8 = Benzo(c)phenanthrene; 9 = Benz(a)Anthracene; 10 = Chrysene; 11 = Benzo(b)fluoranthene + Benzo(k)fluoranthene; 12 = Benzo(e)pyrene; 13 = Benzo(a)pyrene; 14 = Indeno(1,2,3,-cd)pyrene; 15 = Dibenz(a,h)anthracene; 16 = Benzo(g,h,i)Perylene

**ND = non detectable

TABLE III

RESPIRABLE FREE SILICA
AIRCO CARBON
ST. MARYS, PA.

JANUARY 16-19, 1984
HETA 84-033

Sample #	Duration	Operation	Exposure Concentration (mg/m³)		
			Quartz	Cristobalite	Total Weight
Sagger Bake Operations					
FB 183	06:06-15:31	Banding rods	ND*	ND	0.26
M5 9756	06:09-16:22	Setting Kiln	ND	ND	0.28
FB 179	06:11-13:20	Setting Kiln	ND	ND	0.29
FB 55	06:12-15:32	Hyster Operator	ND	ND	0.12
FB 184	06:13-15:30	Banding Rods	ND	ND	0.21
M5 9774	10:24-17:05	Dumping Sagger Cans	0.09	ND	0.69
M5 9767	10:30-17:00	Pounding Sagger Cans	0.06	ND	0.82
Can Filling Operations					
M5 9753	19:56-20:06	Sand Injecter Op.	ND	ND	0.32
M5 9772	19:55-21:54	Green Sand Operator	ND	ND	0.05
M5 9796	19:55-21:52	Crane Op.- Platform	ND	ND	0.20
M5 9754	19:58-22:00	Hyster Operator	ND*	ND	ND
M5 9755	16:09-22:06	Area - Platform	0.60	<0.151	2.31

*ND=non detectable

TABLE IV

DEMOGRAPHIC DATA
AIRCO CARBON
ST. MARY's, PA

JANUARY 16-19, 1984
HETA 84-033

All interviewees were white males.

	EXPOSURE GROUP		
	Low	Higher	
Number in group	10	33	
Age: Mean	38	37	
Range	(29-63)	(25-58)	
Yrs. at plant: Mean	12.7	14.2	
Range	(6-20)	(3-32)	
Smokers	8 (80%)	12 (36%)	p = 0.035
Pack yrs: Mean	31	23	
Range	(12-90)	(7.5-62.5)	
Ex-smokers	2 (20%)	10 (30%)	
Pack yrs: Mean	35	9	
Range	(20-50)	(1-25)	
Never smoked	0	11 (33%)	
Allergies - Yes	2 (20%)	5 (15%)	
Chronic cough - Yes	3 (30%)	7 (21%)	

Low = 8 kiln attendants, 1 clerk, 1 foreman
Higher = 6 Equipment operators, 6 furnace loaders, 3 inspectors, 2 laborers, 12 utility operators and 4 rotating employees

TABLE V

REPORTED SYMPTOMS BY EXPOSURE GROUP
AIRCO CARBON
ST. MARY'S, PA.

HETA 84-033
JANUARY 16-19, 1984

Number with symptom and (%) of group

Number with Symptom	EXPOSURE GROUP Low	High	Fisher' exact test, 1-tailed
Skin irritation	0	15 (45)	p = .007
Nose or eye irritation	4 (40)	26 (79)	p = .03
Upper respiratory (cough or sore/dry throat	1 (10)	13 (39)	p = .08
Lower respiratory (chest tightness shortness of breath, or difficulty breathing)	0	8 (24)	p = .10
Headache	2 (20)	7 (21)	

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