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WALK-THROUGH SURVEY

AIRCO CARBON  
800 THERESIA STREET  
ST. MARY'S, PENNSYLVANIA 15857

SURVEY CONDUCTED BY:

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REPORT WRITTEN BY:

Alice Greife

DATE OF SURVEY:

February 28-March 1, 1983

REPORT NUMBER:

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Industrial Hygiene Section  
Industrywide Studies Branch  
Division of Surveillance, Hazard Evaluations and Field Studies  
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16. Abstract (Limit: 200 words) An on-site visit was made to Airco Carbon (SIC-3624), a producer of carbon products, to gather data concerning the feasibility of using this facility in an industrywide industrial hygiene and epidemiology study of the carbon products industry. Two different product lines were manufactured at this facility: specialty graphite products, and graphite electrodes. Raw materials for both lines included petroleum coke, coal tar pitch, and petroleum pitch. Airborne samples were shown to contain 17 polycyclic aromatic hydrocarbon (PAH) compounds; all of these compounds were listed as tumorigenic and several were positive animal carcinogens. Overall levels of the compounds were low. The areas of the facility involved in formulation and baking appeared to have the highest overall concentrations. Ventilation appeared to be effective in reducing these levels. The author concludes that this particular facility is not suitable for inclusion in the larger project because it is impossible to identify a population of workers with an exposure of adequate duration to only petroleum pitch. To assign either source (coal tar pitch or petroleum pitch) to the PAHs identified in the two major areas where levels of PAHs were detected, would have been exceedingly difficult.			13. Type of Report & Period Covered  14.	
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**PURPOSE:**

To ascertain the feasibility of an industrywide industrial hygiene and epidemiology study of the carbon products industry.

**EMPLOYER REPRESENTATIVE:**

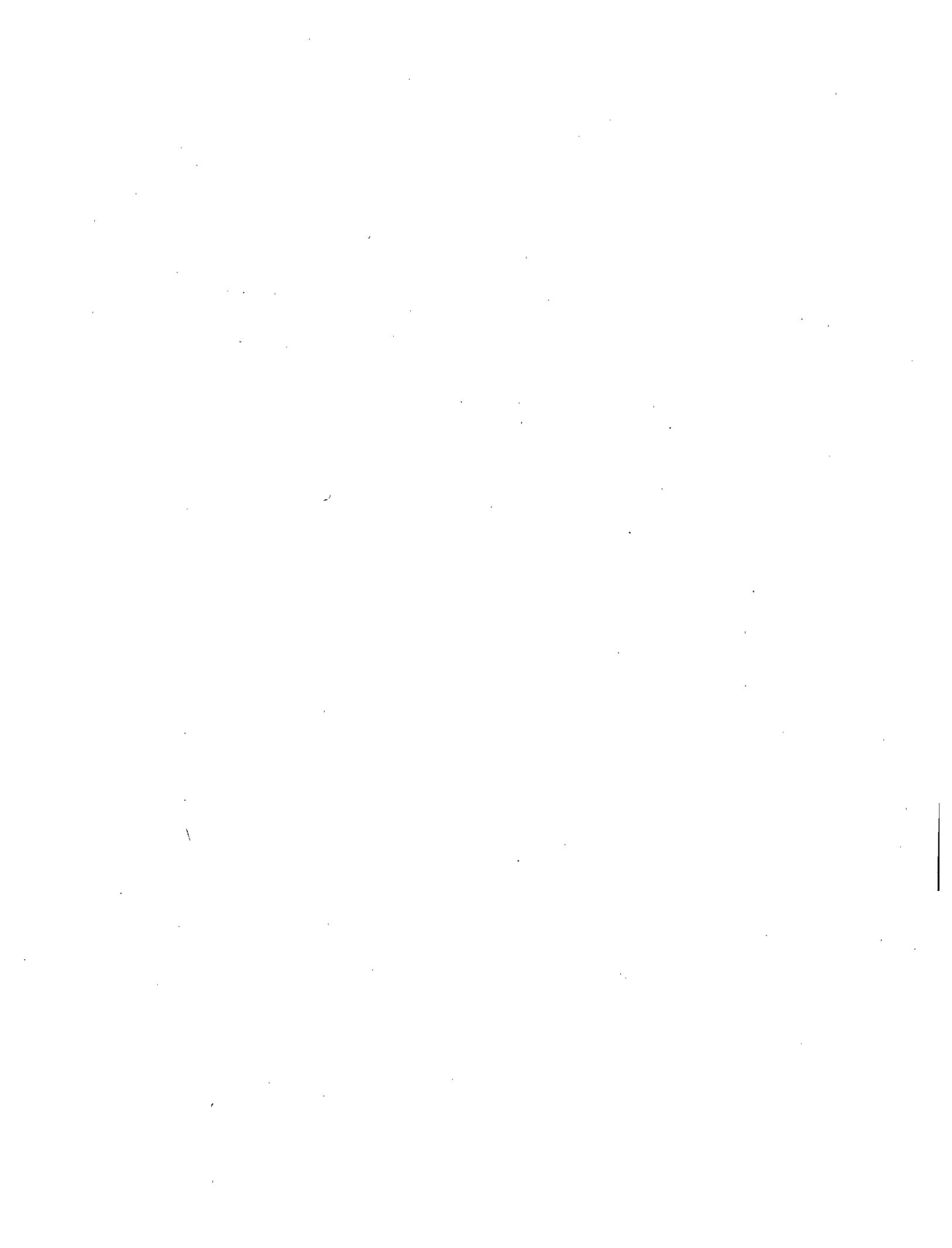
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**STANDARD INDUSTRIAL  
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3624 Electrical Industries Apparatus  
- Carbon and Graphite Products



## ABSTRACT

On February 28 and March 1, 1983, a site visit to Airco Carbon, a carbon products manufacturer, St. Mary's, Pennsylvania, was conducted to gather data concerning the feasibility of conducting an industrywide industrial hygiene and epidemiology study of the carbon products industry. This company was founded about 1899, as Speer Carbon, and was purchased by Airco Reduction Company, Incorporated in September, 1961. It has been known as Airco Carbon since that time. The company manufactures two different product lines: specialty graphite products (e.g., brushes) and graphite electrodes which are the majority of the product produced. The basic raw materials for both product lines are petroleum coke, coal tar pitch, and petroleum pitch.

Industrial hygiene sampling was conducted in the following areas of the facility: storage, formulation, extrusion, baking, impregnation, and graphitizing. General area samples were collected in each area and analyzed for 17 polyaromatic hydrocarbons (PAH). General area air samples were also collected in the baking and impregnation areas and analyzed for the benzene soluble fraction of the PAHs present.

There were 14 PAHs quantitated, the remaining 3 were not present in any sample at or above the limit of detection. The formulation and baking areas had the highest overall levels of PAHs while the impregnation and graphitizing areas had the lowest (Table I).

The levels of the benzene soluble fractions present were quite variable, ranging from 0.07 mg/m<sup>3</sup> to 0.16 mg/m<sup>3</sup> (Table II).

Results of the industrial hygiene data and evaluation of the personnel records indicate that this facility does not meet the selection criteria for the study, because it is not possible to identify a population of workers with an exposure of adequate duration to only petroleum pitch. Inclusion of this facility would require re-evaluation of the hypothesis which could be done at some time in the future.



## BACKGROUND AND PURPOSE

The carbon and graphite products industry produces a variety of carbon products ranging from brushes to electrodes utilizing petroleum coke, coal tar pitch and/or petroleum pitch as basic raw materials. Petroleum coke, a by-product of the petroleum industry, is a solid carbonaceous residue resulting from a high temperature treatment of heavy petroleum fractions.<sup>1</sup> It contains hydrocarbons with a high carbon to hydrogen ratio. Petroleum coke is generally calcined (900-1200°C) to decrease the moisture content prior to being ground and sized for use by the carbon industry.<sup>2</sup> Calcining also causes any volatile material in the petroleum coke to elute. Coal tar pitch is a dark brown or black solid material which is obtained as a residue in the partial evaporation or fractional distillation of coal tar. Coal tar is produced by the destructive distillation of bituminous coal. Petroleum pitch is a highly aromatic and resinous substance which is produced by dehydration and dealkylation and subsequent condensation and polymerization of low boiling aromatic oils and residues.<sup>1</sup> These oils and residues are obtained from extraction and/or cracking processes in the refinement of crude petroleum.

There are 100 companies listed under SIC 3624 in the Dunn and Bradstreet Index; these companies employ about 14,500 workers.<sup>3</sup> The major exposures of concern in this industry are coal tar pitch and petroleum pitch. These compounds release a complex mixture of polycyclic aromatic hydrocarbons (PAHs) when heated. These PAHs have traditionally been measured as the benzene soluble fraction of total airborne particulates. Several of these PAHs, which are released as pyrolysis products of coal tar pitch and petroleum pitch, have been identified and several have proven to be animal carcinogens e.g. benzo(a)pyrene, benzo(a)anthracene, chrysene and benzo(b)fluoranthene.<sup>4</sup> These airborne PAH mixtures have traditionally been called coal tar pitch volatiles (CTPVs), even when they are produced from combustion of non-coal substances.

Petroleum pitch has been documented to be carcinogenic and mutagenic in laboratory studies.<sup>1</sup> The collection of human data however, has been hampered because most worker populations exposed to petroleum pitch are also exposed to coal tar pitch. The most closely related industries or processes which have been evaluated are aluminum reduction and production of coal tar products e.g., coke oven workers. Comparison between these industries can not be done, however, without a more comprehensive study of the carbon products industry.

The relative carcinogenicity, mutagenicity, and health effects of coal tar pitch versus petroleum pitch has recently been under debate because of the January, 1983, re-interpretation of the 1971 OSHA standard for CTPVs. The carbon products industry may yield a useful study population to evaluate the chronic health effects of exposures to coal tar pitch and petroleum pitch and/or petroleum pitch alone. There appears to be a trend toward regulating CTPVs by industry and exposure type, rather than by a generic standard (promulgating a more stringent standard for CTPV exposure in coke ovens,

exemption of petroleum asphalt from CTPV standard). An epidemiologic/industrial hygiene study estimating the risk of CTPV exposures in the carbon products industry may provide useful information to be used in the formulation of occupational health standards relating to this industry.

Preliminary perusal of available data on this industry indicates there are several large U.S. plants which have been in operation for 20 years or more. An epidemiologic/industrial hygiene study may therefore be feasible. The purpose of this walk-through survey was to aid in the determination of the need to and feasibility of conducting an industry-wide epidemiological mortality and industrial hygiene study of the carbon products industry. Specifically this walk through ascertained the following:

1. The existence of any operation in this plant with a sole or predominant exposure of workers to petroleum rather than coal tar pitch volatiles.
2. The existence of historic use e.g., past exposure to coal tar pitch and petroleum pitch, and characterize current exposures to coal tar pitch and petroleum pitch by PAH content.
3. The feasibility of using this facility for an industrywide mortality study based on such information as demographic data and work histories contained in the personnel files.
4. The availability of records for alternate study designs (PMR, SMR).

Airco Carbon Company, the facility being examined in this walk through, was chosen because of the type of product produced, and its close proximity to several other carbon product manufacturers in the area.

#### DESCRIPTION OF FACILITY

Airco Carbon, a carbon products manufacturer, was founded as Speer Carbon Company about 1899 in St. Mary's, Pennsylvania. There are two product lines: specialty graphite parts and graphite electrodes which comprise the majority of the production. The plant covers several acres with most of the site devoted to production and storage. The company was purchased by Air Reduction Company, Incorporated in 1961. The names used by the company are:

1961 to 9/67	Speer Carbon Company, Incorporated A division of Air Reduction Company, Incorporated
9/67 to 9/70	Airco Speer-Graphite Division A division of Air Reduction Company, Incorporated
9/70 to 10/71	Airco Speer Carbon Graphite A division of Air Reduction Company, Incorporated

10/71 to 2/25/80	Airco Speer Carbon-Graphite A division of Airco, Incorporated
2/25/80 to 10/1/83	Airco Carbon A division of Airco, Incorporated
10/1/83 to present	Airco Carbon Division of BOC, Incorporated

#### DESCRIPTION OF WORKFORCE

The workforce has steadily increased since the founding of the company, reaching a peak in the mid 1970's. After that time, the size of the workforce was cyclic. At the time of the survey there were two (2) workshifts, a full first shift (7:00 a.m.-3:00 p.m.) and a partial second shift (3:00 p.m.-11:00 p.m.). In the mid 1970's there were full first and second shifts with a partial third shift. Most of the 840 employees (660 hourly and 180 salaried) are men. Work areas are defined as cost centers, rather than by departments, which may change frequently. There are approximately 207 job classifications which are negotiated in the union contract, and these have been fairly stable since 1955. The workforce was unionized about 1939 by the International Union of Electrical, Radio, and Machine Workers, Local 502.

In general, work histories exist from 1940 to the present, however, they are not known to be complete until the 1950's. There is a 5 year period in the 1950's for which work histories do not exist, however, demographic data (job applications) are available for these employees. There is a "roladex" file which contains approximately 1200 individuals who were inactive as of 5 years ago. A similar file is also maintained for employees active since that time. The majority of all records contain the essential demographic and work history information including name, date of birth, social security number, and beginning and ending dates of employment. Many records also had additional information such as, military discharge records, employee badge number, and employment application with additional personal data and address.

#### DESCRIPTION OF PROCESS

This facility produces two (2) main product lines: specialty graphite (e.g., brushes) and graphite electrodes. As the majority of the production is in the electrode area, the following process description will be limited to this area of the facility. Production of precursor materials for many of the graphite specialties follows similar processes. The production of graphite electrodes may be divided into five general processes: formulation or mixing, baking, impregnation, graphitization, and finishing (Figure 1).

The primary raw materials used are calcined petroleum coke (e.g., needle coke) coal tar pitch, and petroleum pitch. The raw materials arrive at the plant by rail or truck and are put into silos. The petroleum coke is removed

from the silos and is passed through a series of screens and/or crushers until the appropriate sized particles are achieved. It is then transferred into bins where the amount needed is weighed and is transferred to mixers. Mixing or formulation is done in heated mixers. Liquid coal tar pitch is added to the heated mixer to serve as a binding material. The company has used liquid pitch since 1979, before that time, solid coal tar pitch was used as a binding material. Various additives such as fatty acids are then added to the pitch-coated coke to aid in the extrusion process. The mix is allowed to cool as it is transported to the forming or extruding area by an enclosed, ventilated conveyor system. Extrusion is used to condense and shape the mix into the desired end-product. The extruded product is cooled and stabilized in a water bath. It is then either placed into "green" storage or is sent to baking.

The baking process which converts the coal tar pitch binder to solid coke and decreases shrinkage of the final product utilizes three methods of baking: mass, sagger and carbottom. The mass method consists of green product baked in mass, surrounded by sand. The sagger method utilizes "saggers" or cans into which the green products are placed before being loaded into the oven. Carbottom kilns are a variation of the sagger bake system. The saggers are loaded onto refractory rail cars, which form the bottom of the kiln. The entire car is then loaded into the kiln for baking.

Once the green product is in an oven, the oven is sealed and gas-fired to a predetermined temperature. During the baking process, the waste gases, which contain various polyaromatic hydrocarbons, are collected and incinerated. The air is recirculated back to the furnace to conserve heat loss and reduce energy costs. This ventilation equipment has been on-line since the early 1970's. At the end of the baking cycle, which may be as long as a month, the ovens are allowed to cool before the product is removed and sent to impregnation.

Impregnation, a batch process, has utilized liquid petroleum pitch since 1979. Solid petroleum pitch which was used from 1972 to 1979 replaced coal tar pitch as an impregnation material. Impregnation occurs in a pressurized, heated vessel and serves to improve the properties of the baked carbon stock by forcing the petroleum pitch into the open pores. The impregnated stock is allowed to cool, the vessel is opened, and the stock is sent back to the baking area to be rebaked. The baskets in which the stock is impregnated are heated in enclosed ovens to remove any pitch residue before the baskets are used again.

Graphitization of impregnated, rebaked stock is done in order to orient the carbon atoms of the various carbon materials added to the product into the graphite crystal lattice configuration. There are two types of furnaces used at this company, the Acheson and longitudinal furnaces. In the past, the Acheson furnace was used exclusively; in recent times, however, the longitudinal furnaces have been utilized to a greater extent.

The Acheson furnace is an electrically-fired furnace, which is used today very much as it was in 1895 when it was invented. The furnace is comprised of a bed of refractory tiles resting on concrete piers. The stock or carbon material to be fired is placed on a layer of metallurgical coke which has previously been spread over the refractory tiles. The stock is then insulated on all sides by additional metallurgical coke, sand, and sawdust. The stock is graphitized by the very high electrical current which runs through the furnace. The furnace is cooled before it is dismantled to remove the graphitized product. The insulating material is salvaged when possible. The bottom layer of metallurgical coke that was spread over the refractory tiles is collected and reused.

The longitudinal furnace is also used to graphitize impregnated, rebaked stock. In this case, stock is laid end to end on the furnace bed. Metallurgical coke is used as pack around the electrodes. Hoods are placed over the furnaces at the end of the power cycle to remove off gases. The pack is removed after a cooling period, using a crane mounted vacuum.

The finishing or machining area receives the cool, graphitized stock. The extent and type of machining done on any piece of stock is dependent on its end use, but may include such items as setting threads on electrodes. The machined stock is then sent through a quality control check before it is put into on-site storage or transported from the plant site.

#### DESCRIPTION OF ENGINEERING CONTROLS

In general, employee exposures to airborne contaminants was much higher in the past than levels observed during this survey. Concentrated effort began in the mid 1970's to late 1970's to reduce these levels through a variety of engineering control and process modifications.

A few of the modifications are:

1. Liquid petroleum pitch has been used since 1979,
2. Ventilated enclosures have been installed over the conveyor belt system between the mixing area and extrusion area,
3. Dust collection systems have been installed above mixers in Building 303,
4. Hoods are used above mass bake and sagger furnances which capture gaseous by-products,
5. Utilization of longitudinal furnaces, which have more efficient contaminant capture systems than Acheson furnances, reduces employee exposure to airborne contaminants, and
6. A vaccum system has been installed to remove the layer of insulation material from the longitudinal furnances.

In general, efforts have been made to reduce employee exposure to airborne contaminants by these engineering controls. There are a few areas such as the bottom of silos where employees are still required to wear respirators. Historical industrial hygiene data on employees is available after 1977.

#### DESCRIPTION OF MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

##### Industrial Hygiene and Safety

The company employs a full time industrial hygiene and safety staff at the division and plant level. Resources are directed toward loss control and abatement of hazards by engineering controls. These efforts have resulted in a decrease in the number of areas where respirators are required. Industrial hygiene data e.g., dust and PAH levels, which have been collected at this facility since 1977, document these reduced exposures. There are training programs for the employees in various aspects of safety and health such as proper use of respirators and safe lifting procedures. Employees are supplied with NIOSH-certified dust respirators in high dust level areas which are clearly marked, and efforts are being made to reduce the airborne dust concentrations in these areas. Safety shoes, hard hats, and safety glasses are required to be worn by all production employees.

##### Medical

All new employees receive preemployment physicals which consist of audiometry, pulmonary function testing (PFT), chest roentgenography, and a visual examination from a local physician. Periodic examinations consist of PFT and chest x-rays. Audiometric testing is conducted on noise exposed employees annually. There is a full-time occupational health nurse on duty during the first shift. The nurse is located in a small building which is used as a first aid station.

#### RECOMMENDED LEVELS AND APPLICABLE STANDARDS

The recommended levels or applicable standards used in this report as related to toxic substances are (1) NIOSH recommended levels, (2) Federal Occupational Standards as promulgated and enforced by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor (29 CFR 1910, 1000) Permissible Exposure Limit (PEL) and, (3) American Conference of Government Industrial Hygienist (ACGIH) Threshold Limit Values (TLVs).<sup>5,6,7</sup>

Listed below are the recommended levels or applicable standards for the substances sampled in this survey:

SUBSTANCE	NIOSH RECOMMENDED LEVEL	OSHA PEL	ACGIH TLV
Coal tar pitch	0.1mg/m <sup>3</sup>	0.2mg/m <sup>3</sup>	0.2mg/m <sup>3</sup>
volatiles as Benzene solubles	10 hr TWA	8 hr TWA	8 hr TWA

## DESCRIPTION OF SURVEY METHODS

General area air samples were collected in several processing areas to qualitate and quantitate the PAHs present. Samples were collected with a sampling train consisting of a Zefluor 2-micron filter and a cellulose acetate o-ring in an opaque cassette. This was followed by a 7-mm O.D. glass tube containing two sections of Supelpak-2 (pre-washed XAD-2 resin). Additional samples were collected for analysis of the benzene soluble fraction of the PAHs present. This sampling train consisted of the aforementioned filter and opaque cassette without the back-up tube. All samples were collected at 2.0 liter per minute (LPM) utilizing a Dupont model P4000 pump. Specific PAH quantitation and all bulk sample analyses were done according to NIOSH Technical Bulletin TB-001.<sup>8</sup> Benzene solubles were analyzed by a modified NIOSH Method P&CAM 217.<sup>9</sup>

The general area samples were collected in the following areas:

DEPARTMENT	LOCATION	SAMPLE NUMBER	ANALYSIS
Storage	Location between baked scrap bin and lift tower, Building 300	10	PAH quantitation
Formulation	Mixing platform, Building 300	9	PAH quantitation
	Mixing platform, Building 303	13	PAH quantitation
Extrusion	Extrusion press 48 inch, Building 300	11	PAH quantitation
	Extrusion Press 25 inch, Building 303	12	PAH quantitation
Baking	Mass bake, Building 705 between furnance 351 & 353	5,6 19	PAH quantitation Benzene solubles
	Sagger bake, Building 705 between furnance 409 & 411	3,4 18	PAH quantitation Benzene solubles
	Impregnation	Base of preheat unit, Building 701	14 16
Exterior wall, Building 701		15	PAH quantitation
		17	Benzene solubles

## RESULTS AND DISCUSSION

The results of the sample analyses are listed in Tables I, II, III, and IV. The raw data are presented in Tables V and VI. There were 17 PAH compounds quantitated in the airborne samples, however, three (3) PAH compounds (Indeno(1,2,3-cd)pyrene, Benz(g,h,i)perylene, and Dibenz(a,h)anthracene) were not present in any airborne sample at or above the limit of detection.

The data presented here indicate that airborne PAHs were present in the work environment of this facility, however, overall levels of specific PAHs were generally low (Table I). The levels of benzene solubles (0.07 mg/m<sup>3</sup> to 0.16 mg/m<sup>3</sup>), were quite variable (Table II).

The formulation and baking areas of the facility appeared to have the highest overall concentrations of PAHs, however, this finding is not unexpected due to the nature of the process. The ventilation equipment which has been installed in the formulation area of Building 303 (field sample 13) appears to have been effective in reducing the overall PAH levels when compared to the formulation area of Building 300 (field sample 9).

It was of interest to note the comparably high levels of PAHs in the storage area (field sample 10). This area contained primarily crushed and sized petroleum coke. Analysis of the PAH content of the bulk samples of the solid petroleum coke did not appear to correlate well with these data. This may have been due to the efficiency of the extraction procedure for the analysis of the bulk coke.

All 17 PAHs are tumorigenic compounds, and many of them are listed as positive animal carcinogens (Benz(a)anthracene, Benzo(b)fluoranthene, chrysene, Benzo(a)pyrene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene) in the 1983 Registry of Toxic Effects.<sup>4</sup> The 1982 American Conference of Governmental Industrial Hygienists TLV booklet lists benzo(a)pyrene and chrysene as suspected human carcinogens, but does not give recommended exposure limits.<sup>7</sup>

## CONCLUSIONS

From the data collected, it appeared to be difficult to identify a population of workers at this plant exposed to sufficient airborne quantities of PAHs relating only to exposure to petroleum pitch. The areas with the highest overall values (formulation and baking) represented an exposure to only coal tar pitch or coal tar pitch and petroleum pitch. Analysis of the bulk samples of the two compounds revealed that 15 of the 17 PAHs were common to both analytes. Assignment, therefore, of the source(s) (coal tar pitch or petroleum pitch) of a specific PAH in these two areas would have been very difficult.

The impregnation area which represents exposure to PAHs from petroleum pitch only, exhibited very low overall levels. These low levels may have been due to the ventilation system in place at the impregnation tanks and/or work practices of the employees.

Results of the industrial hygiene data and evaluation of the personnel records indicate that this facility does not meet the selection criteria for the study because it is not possible to identify a population of workers with an exposure of adequate duration to only petroleum pitch. Therefore, this facility would not be included in an industrywide study of the carbon products industry at this time. Re-evaluation of the hypothesis, may be done at sometime in the future, however, and may alter the decision to exclude this facility from study.

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FIGURE 1  
AIRCO CARBON  
PROCESS FLOW DIAGRAM

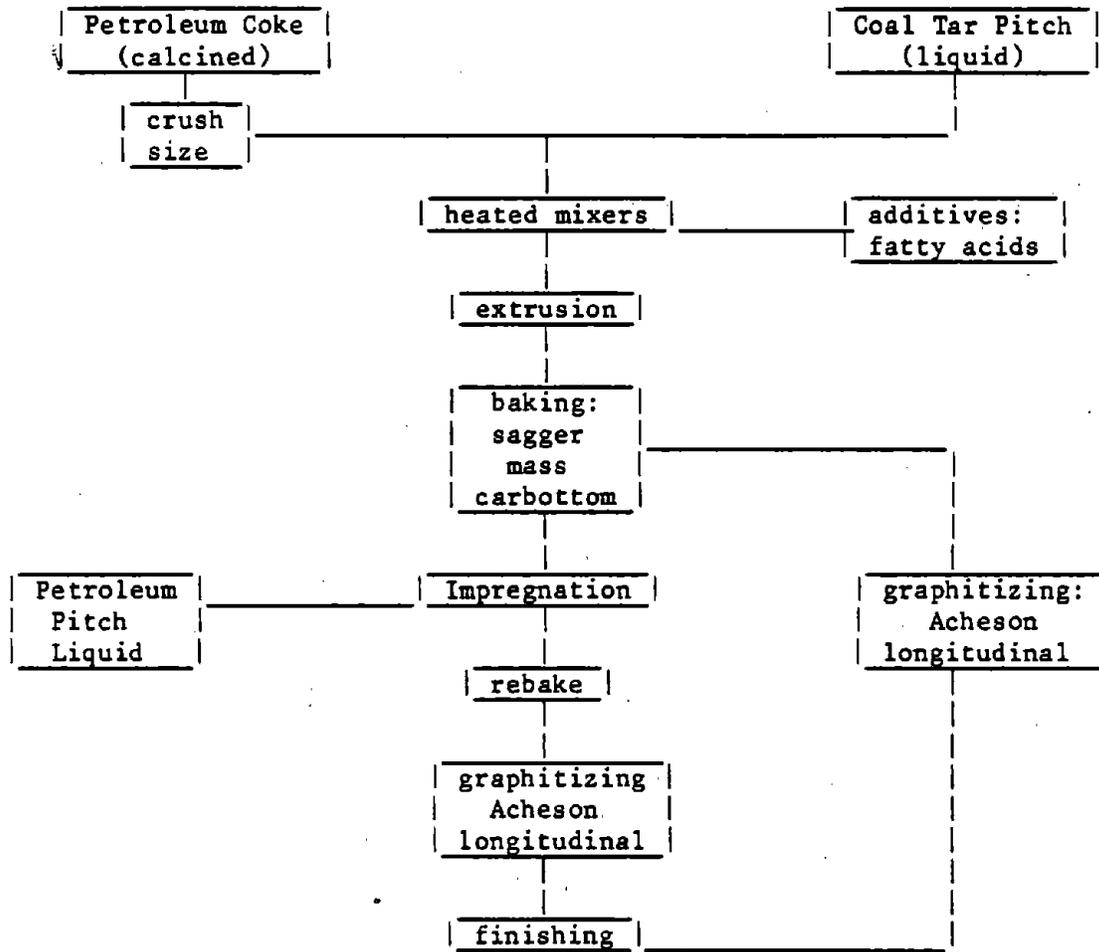


TABLE I  
Airco Carbon  
St. Mary's, Pennsylvania  
February 28-March 1, 1983

Summary of Airborne PAH Levels by Sample, ug/m<sup>3</sup>

AREA	SAMPLE NUMBER	1*	2	3	4	5	6	7	8	9	10	11	12	13
STORAGE	10	25.74	1.38	1.49	2.20	9.69	4.47	0.74	ND**	ND	6.17	0.72	45.75	21.28
FORMULATION	9	37.47	2.34	2.23	2.55	16.24	6.69	1.38	0.48	1.59	9.02	0.76	72.19	30.79
	13	10.73	ND	ND	ND	3.57	1.62	ND	ND	ND	2.38	ND	10.82	5.09
EXTRUSION	11	9.19	ND	ND	ND	3.74	1.71	1.18	ND	ND	2.24	ND	10.68	5.24
	12	16.82	0.71	0.85	1.41	6.09	2.07	ND	ND	ND	3.59	ND	14.13	6.96
BAKING	5	15.48	2.86	8.43	7.98	1.79	9.41	3.69	0.48	2.50	14.65	1.79	0.90	0.65
	6	15.48	2.86	7.62	8.10	1.79	9.52	3.93	0.50	2.26	14.29	1.55	0.94	0.58
	3	3.95	0.87	2.21	ND	ND	2.21	0.73	ND	ND	2.21	ND	0.84	ND
	4	3.14	1.02	2.79	1.40	ND	1.98	0.80	ND	ND	1.98	ND	ND	ND
IMPREGNATION	14	0.39	ND	1.48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GRAPHITIZING	2	0.75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LIMIT OF DETECTION (ug/sample)		0.28	0.52	0.77	0.65	1.2	0.70	0.60	0.39	0.52	1.1	0.50	0.54	0.28

\*\*ND = amount present was less than the limit of detection

- \* 1 = Phenanthrene
- 2 = Benz(a)anthracene
- 3 = Chrysene
- 4 = Benzo(b)fluoranthene & Benzo(k)fluoranthene

- 5 = Anthracene
- 6 = Pyrene
- 7 = Benzo(e)pyrene
- 8 = Benzo(c)phenanthrene

- 9 = Benzo(a)pyrene
- 10 = Fluoranthene
- 11 = Acenaphthylene
- 12 = Acenaphthene
- 13 = Fluorene

TABLE II  
 Airco Carbon  
 St. Mary's, Pennsylvania  
 February 28-March 1, 1983

Airborne Concentrations of Benzene Soluble PAHs, mg/m<sup>3</sup>

AREA	SAMPLE NUMBER	EXPOSURE LEVEL (mg/m <sup>3</sup> )	SAMPLE CONCENTRATION (mg/sample)	Time On	Time Off	TOTAL TIME (min)	SAMPLE VOLUME (L)
IMPREGNATION	16	0.07	0.06	8:20	15:40	440	880
	17	0.07	0.06	8:14	15:35	441	882
BAKING	18	0.16	0.14	8:40	15:50	430	860
	19	0.12	0.10	8:50	15:50	420	840

LIMIT OF DETECTION - 0.02 mg/sample

TABLE III  
Airco Carbon  
St. Mary's, Pennsylvania  
February 28-March 1, 1983

PAH Quantitation of Bulk Raw Materials, ug/g

SAMPLE	*1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Solid Petroleum Coke	1.0	2	0.6	2	3	3	3.0	1	1	2	2	2	2.6	7	10	10
Solid Petroleum Pitch	10	20	5	220	26	131	690	220	920	1100	510	490	770	86	110	170
Solid Coal Tar Pitch	50	890	1000	4900	660	5300	4100	660	3800	3200	4100	1700	3400	1200	560	1200

Limit of  
Detection\*\*

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

\*\* Limits may vary for individual analytes due to dilution factor of sample

TABLE IV  
Airco Carbon  
St. Mary's, Pennsylvania  
February 28-March 1, 1983

Individual Results of Airborne PAH Levels, ug/m<sup>3</sup>

SAMPLE #	1*	2	3	4	5	6	7	8	9	10	11	12	13
10	2.34	1.38	1.49	1.38	1.6	3.3	0.74	ND***	ND	4.57	ND	ND	ND
10T**	23.4	ND	ND	0.82	8.09	1.17	ND	ND	ND	1.60	.72	45.74	21.28
9	2.44	2.34	2.23	2.55	1.38	4.46	1.38	0.48	1.59	5.52	ND	ND	ND
9T	35.03	ND	ND	ND	14.86	2.13	ND	ND	ND	3.50	.76	72.19	30.79
13	0.34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
13T	10.38	ND	ND	ND	3.57	1.62	ND	ND	ND	2.38	ND	10.82	5.09
11	ND	ND	ND	ND	ND	ND	1.18	ND	ND	ND	ND	ND	ND
11T	9.19	ND	ND	ND	3.74	1.71	ND	ND	ND	2.24	ND	10.68	5.24
12	0.52	0.71	0.85	1.41	ND	ND	ND	ND	ND	ND	ND	ND	ND
12T	16.3	ND	ND	ND	6.09	2.07	ND	ND	ND	3.59	ND	14.13	6.96
5	ND	2.86	7.5	7.98	ND	1.31	3.69	0.48	2.52	1.55	ND	ND	ND
5T	15.48	ND	0.93	ND	1.79	8.10	ND	ND	ND	13.10	1.79	0.90	0.65
6	ND	2.86	7.62	8.10	ND	1.19	3.93	0.50	2.26	ND	ND	0.94	0.58
6T	15.48	ND	ND	ND	1.79	8.83	ND	ND	ND	14.29	1.55	0.94	0.58
3	ND	0.87	2.21	ND	ND	ND	0.73	ND	ND	ND	ND	ND	ND
3T	3.95	ND	ND	ND	ND	ND	ND	ND	ND	2.21	ND	0.84	ND
4	ND	1.02	2.79	1.40	ND	ND	0.80	ND	ND	ND	ND	ND	ND
4T	3.14	ND	ND	ND	ND	1.98	ND	ND	ND	1.98	ND	ND	ND
14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14T	0.39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15T	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2T	0.75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Limit of Detection .28 .52 .77 .65 1.2 .70 .60 .39 .52 1.1 .50 .54 .28  
(ug/sample)

\*\* = Sorbent back-up tube for corresponding filter  
\*\*\*ND = Amount present was less than limit of detection

- \*1 = Phenanthrene
- 2 = Benz(a)anthracene
- 3 = Chrysene
- 4 = Benzo(b)fluoranthene
- 5 = Anthracene
- 6 = Pyrene
- 7 = Benzo(e)pyrene
- 8 = Benzo(c)phenanthrene
- 9 = Benzo(a)pyrene
- 10 = Fluoranthene
- 11 = Acenaphthylene
- 12 = Acenaphthene
- 13 = Fluorene

15

TABLE V +  
Airco Carbon  
St. Mary's, Pennsylvania  
February 28-March 1, 1983  
Individual Results of Airborne PAH Quantitation, ug/sample  
Laboratory Data

SAMPLE #	1*	2	3	4	5	6	7	8	9	10	11	12	13
10	2.2	1.3	1.4	1.3	1.5	3.1	0.70	ND**	ND	4.3	ND	ND	ND
10T***	22.0	ND	ND	0.77	7.6	1.1	ND	ND	ND	1.5	0.68	43.0	20.0
9	2.3	2.2	2.1	2.4	1.3	4.2	1.3	0.45	1.5	5.2	ND	ND	ND
9T	33.0	ND	ND	ND	14.0	2.1	ND	ND	ND	3.3	0.72	68.0	29.0
13	0.31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
13T	9.6	ND	ND	ND	3.3	1.5	ND	ND	ND	2.2	ND	10.0	4.7
11	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	ND	ND
11T	8.6	ND	ND	ND	3.5	1.6	ND	ND	ND	2.1	ND	10.0	4.9
12	0.48	0.65	0.78	1.3	ND	ND	ND	ND	ND	3.3	ND	13.0	6.4
12T	15.0	ND	ND	ND	5.6	1.9	ND	ND	ND	1.3	ND	ND	ND
5	ND	2.4	6.3	6.7	ND	1.1	3.1	0.40	2.1	11.0	1.5	0.76	0.55
5T	13.0	ND	0.78	ND	1.5	6.8	ND	ND	ND	12.0	1.3	0.79	ND
6	ND	2.4	6.4	6.8	ND	1.0	3.3	0.42	1.9	ND	1.3	0.79	0.49
6T	13.0	ND	ND	ND	1.5	7.0	ND	ND	ND	ND	ND	ND	ND
3	ND	0.75	1.9	ND	ND	ND	0.63	ND	ND	1.9	ND	0.72	ND
3T	3.4	ND	2.4	ND	ND	1.9	ND	ND	ND	ND	ND	ND	ND
4	ND	0.88	2.4	1.2	ND	ND	0.69	ND	ND	1.7	ND	ND	ND
4T	2.7	ND	ND	ND	ND	1.7	ND	ND	ND	ND	ND	ND	ND
14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14T	0.34	ND	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15T	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2T	0.65	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Limit of Detection 0.28 (ug/sample) 0.52 0.77 0.65 1.2 0.70 0.60 0.39 0.52 1.1 0.50 0.54 0.28

- \*1 = Phenanthrene
- 2 = Benz(a)anthracene
- 3 = Chrysene
- 4 = Benzo(b)fluoranthene & Benzo(k)fluoranthene
- 5 = Anthracene
- 6 = Pyrene
- 7 = Benzo(e)pyrene
- 8 = Benzo(c)phenanthrene
- 9 = Benzo(a)pyrene
- 10 = Fluoranthene
- 11 = Acenaphthylene
- 12 = Acenaphthene
- 13 = Fluorene

\*\*ND = Amount present was less than limit of detection  
\*\*\* = Sorbent back-up tube for corresponding filter  
+ = See Table VI for sampling time and volume

TABLE VI +  
 Airco Carbon  
 St. Mary's, Pennsylvania  
 February 28-March 1, 1983

Sampling Time and Volume for PAH Quantitation Samples

SAMPLE NUMBER	TIME ON	TIME OFF	TOTAL TIME (MIN)	SAMPLE VOLUME L
10	7:30	15:20	470	940
10T				
9	7:24	15:15	471	942
9T				
13	7:48	15:30	462	924
13T				
11	7:35	15:23	468	936
11T				
12	7:45	15:25	460	920
12T				
5	8:50	15:50	420	840
5T				
6	8:50	15:50	420	840
6T				
3	8:40	15:50	430	860
3T				
4	8:40	15:50	430	860
4T				
14	8:20	15:40	440	880
14T				
15	8:14	15:35	441	882
15T				
2	8:30	15:45	435	870
2T				

+ = See Table V for individual PAH values

