

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 79-16-628

ASHLAND PETROLEUM COMPANY
2nd AVENUE
FREEDOM, PENNSYLVANIA

NOVEMBER, 1979

I. TOXICITY DETERMINATION

On November 6, 1978, NIOSH received a request from Local 8-621 Oil Chemical and Atomic Workers International Union for a health hazard evaluation in the Filter House-Burner Building of the Ashland Petroleum Company. The request alleged employee exposure to bauxite dust and unknown toxic substances. It was also reported that three out of four burners, when X-rayed, had "spots-on-their-lungs".

A walk-through evaluation of the Filter House-Burner Building was conducted on November 21, 1978. This consisted in the observation of operations, materials handled and administration of a preliminary non-directed medical questionnaire. A decision was made that environmental air sampling should be performed for particulate polycyclic aromatic hydrocarbons (PPAH), total dust particulate, lead and sulfur dioxide gas.

Environmental air sampling for the above air contaminants was performed on March 6-7, 1979, and the results showed that the burner's exposure to the benzene soluble fraction of PPAH exceeded the recommended environmental exposure limits (fluoranthene was positively detected). Exposure to all other contaminants were below their respective recommended limits.

There is historical evidence of acute irritation of the eyes and mucous membranes of the respiratory tract in employees in the Filter House-Burner Building. These symptoms are particularly associated with increased heat, with the burning of certain products such as "Bright stock", and/or with heavy dust concentration. Although no sulfur dioxide (SO₂) was detected on the day environmental samples were obtained, it is considered to be present intermittently, i.e., when certain products are burned. It is presumed to be present because the physical signs and symptoms noted by those individuals present during the initial walk-through evaluation were consistent with exposure SO₂ and because of the characteristic odor which was present. The acute symptoms of irritation noted by employees may be a result of chronic, intermittent exposure to SO₂ as well as to dust exposure. There was no substantial information to suggest systemic toxicity as a problem. The chest X-rays of the three burner operators originally said to have "spots-on-their-lungs" were negative for pneumoconiosis.

II. DETERMINATION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this report are available from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability can be obtained from the NIOSH Publications office at the Cincinnati address. Copies have been sent to:

- a) Ashland Petroleum Company
- b) OCAW Local No. 8-621
- c) OCAW International Union
- d) U.S. Department of Labor, OSHA, Region III
- e) NIOSH, Region III

For the purpose of informing the approximately 15 "affected employees," the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place(s) near where exposed employees work.

III. INTRODUCTION/BACKGROUND

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) authorizes the Secretary of Health, Education, and Welfare, following a written request by an 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.

On November 6, 1978, the National Institute for Occupational Safety and Health received such a request from an authorized representative of employees of Ashland Petroleum Company, Freedom, Pennsylvania. The request alleged employee exposure to bauxite dust and to unidentified toxic gases. It was also reported that three of four burners, when X-rayed, had "spots-on-their-lungs".

In 1974, the union requested that the company provide chest X-rays and physical examinations for employees in the Filter House-Burner Building. This request was prompted by a general concern over the presence of unidentified gases and dusty conditions in the Burner Building and what effect this might have on the lungs of employees working in this area. In 1978, a similar union request of the company was made after which eight Filter House employees received physical examinations and chest X-rays. Concern was generated when three of four burner operators received a "positive" report from the hospital. Copies of these particular films were obtained and sent to the Mt. Sinai Medical Center, New York, for reading and interpretation. The union received a letter from Mt. Sinai dated November 30, 1978, stating that the chest X-rays were negative for pneumoconiosis. In the letter, it was mentioned that some of the films were not of the best quality, probably, they noted, a result of the copying process.

IV. HEALTH HAZARD EVALUATION

A. Plant Process/Conditions of Use

This plant manufacturers specialty lubricants from crude oil. The area of concern was the Filter-Burner house. In this area the oil is filtered through a bauxite media to remove the impurities that may be present. Each column is 32 feet high and holds about 50 tons of bauxite. Periodically the spent bauxite in these columns is dropped into a holding bin. From here the material is conveyed onto the top of the multi-stage burner which is either gas or oil-fired depending on availability of fuel. The burner is approximately 20 feet wide and 50 feet high with 12 hearths. Six of the hearths are fired and six are for cooling cycles. The top hearth temperature is about 1000°F. The schedule for burning off the impurities is 1) bright stock every 6-8 weeks; 2) neutral stock every 2-3 weeks. Naptha-kerosene wash stock filter does not have to be burned. Approximately 50 tons of bauxite has to be replaced per month.

Exposure to the employees occurs during the filling and emptying of the filters and during the periodic tours of the burner house that must be taken to check temperatures and adjust valves and gates.

Total dust particulate (bauxite) exposure occurs from the leakage of the burner and during filter filling. Exposures to PPAH sulfur dioxide and lead would be the pyrolysis products from combustion of the impurities from the oils. A tour of the burner house is done hourly and lasts about 15 minutes.

Once a week there is a manual sweeping of the building and, according to the employees this takes about 30-40 minutes.

B. Medical Surveillance Program

The company has employed a part-time physician who since 1972 has provided pre-employment and, upon special request, periodic medical evaluations. This pre-employment evaluation includes a medical history, physical examination, and back and chest X-rays. The X-rays are performed at Rochester General Hospital.

C. Evaluation Design

1. Environmental/Medical

On November 21, 1978, Walter J. Chrostek and Frank A. Lewis, NIOSH Industrial Hygienists, conducted a walk-through survey. From visual and olfactory sensual observations it was determined that environmental air sampling should be performed for particulate polycyclic aromatics hydrocarbons, total dust particulate (bauxite), and sulfur dioxide. During this visit two bulk samples of the spent filtration material were collected. These samples were quantitatively analyzed for lead, quartz and cristobalite. Non-directed medical questionnaires were administered to nine employees.

An interim no. 1 report was sent on December 11, 1978, to Ashland Oil and OCAW Local No. 8-621.

Analysis of the bulk samples showed that no quartz or cristobalite was present. The percentage of lead in the bulk sample was 0.016 percent. Although this amount was not very significant, the industrial hygienist decided to do environmental air sampling for lead to determine what the employee exposures were.

On March 6-7, 1979, Walter J. Chrostek and Linda Shea, R.N., NIOSH medical investigator, visited the plant to perform a medical-environmental evaluation.

At that time, twelve environmental air samples were collected for various contaminants.

2. Medical

The NIOSH medical investigator conducted a walk-through evaluation consisting of a tour of the Filter House-Burner Building production process and interviews with employees, company officials, and union representatives. The nine employees present in the Filter House-Burner Building were interviewed concerning alleged health problems, specifically, respiratory. The four remaining employees assigned to that area were later contacted by telephone.

D. Evaluation Methods

1. Environmental

a. Particulate Polycyclic Aromatic Hydrocarbons (PPAH)

Four personal samples were collected for PPAH. The collection media was a 0.08 pore size, 37mm diameter silver membrane filter preceded by 37mm diameter glass fiber in a three piece "closed face" cassette. This was followed by a porous polymer resin tube. Air was drawn through the collection media at a rate of 1.5 liters/minute.

All samples and blanks were analyzed according to NIOSH method P&CAM #217⁸ for the benzene-soluble fraction of PPAH and for the composition and quantity of the PPAH in the work environment. The results of these samples are presented in Table I.

b. Total Particulate (bauxite)-Lead

Four general air and personal atmospheric samples were collected on preweighed membrane filters at an air flow of 1.7 liters per minute. These samples were analyzed gravimetrically for total particulates and by NIOSH method P&CAM #173⁸ for lead. The results are presented in Table II.

c. Sulfur Dioxide

Four personal environmental air samples were collected on charcoal specially treated to trap sulfur dioxide at an air flow rate of 200cc per minute. The samples were desorbed using a 0.003 Molar Na_2CO_3 /0.003 Molar NaHCO_3 eluent and quantitated by use of ion chromatography. The limit of detection of this method was two times the blank level of 3.1 micrograms sulfur dioxide. All the samples collected were below 3.1 micrograms of sulfur dioxide.

2. Medical

Pertinent company medical records were reviewed and photocopies by the NIOSH medical investigator. The union representative provided the medical investigator with copies of the chest X-rays of the three employees alleged to have "spots-on-their-lungs" along with a letter of interpretation from Mt. Sinai Medical Center.

The original chest X-rays of these three individuals were reviewed at the Rochester General Hospital with the radiologist in charge. These original films were later sent to the NIOSH contract reader trained in the UICC/UC classification for the interpretation of pneumoconioses.

E. Evaluation Criteria-Environmental

The following environmental standards or criteria were considered in this report:

	<u>Substance</u>	<u>Source</u>	<u>8-hr.TWA (mg/m³)</u>
1.	<u>Organics</u>		
	PPAH	ACGIH ¹	0.2 (benzene solubles)
	Coal Tar Pitch Volatiles (CTPV)	NIOSH ¹³ OSHA ¹⁶	0.1 (cyclohexane solubles) 0.2 (benzene solubles)
	Chrysene	NIOSH ¹⁵ ACGIH ²	to be controlled as a potential occupational carcinogen (lowest reliable detection limit)

2.	<u>Inorganics</u>	<u>Source</u>		
	<u>Substance</u>	<u>NIOSH</u>	<u>ACGIH</u>	<u>OSHA</u>
	Total Particulate* (bauxite)		10	15
	Lead**	100	150	50
	Sulfur Dioxide	1.3	5	13

* - denotes milligrams of substance per cubic meter of air sampled (mg/m³).

** - denotes micrograms of substance per cubic meter of air sampled (mg/m³).

The NIOSH criteria document on coal tar products recommends a permissible exposure limit of 0.1 mg/m³ measured as the cyclohexane soluble fraction of the total particulate matter. Because of the high toxicity of benzene, NIOSH now recommends cyclohexane be used as it will likely extract kinds and quantities of substances similar to those extracted by benzene.

The ACGIH's "Threshold Limit Values for Chemical Substances in Workroom Air", 1978 recommends a TLV-TWA of 0.20 mg/m³ for both coal tar pitch volatiles and particulate polycyclic aromatic hydrocarbons.

OSHA's current standard 1910.1000 Table Z-1 of 0.2 mg/m³ 8-hr.TWA for coal tar pitch volatiles (benzene solubles - anthracene, benzo(a)pyrene, phenanthrene, acridine, chrysene, and pyrene) is applicable to employee exposures outside of coke plants.³ The OSHA exposure limit for coke oven emissions (200VFR 1910.1029) is 0.15 mg/m³ measured as the benzene-soluble fraction of total particulate matter and as a time-weighted average (TWA).¹⁷

OSHA has defined the term "coal tar pitch volatiles" as including..."the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum wood, and other organic matter." The inclusion of these volatiles is justified accordingly: "Since all of these volatiles have the same basic chemical composition and since all of them present the same basic dangers to a person's health, the standard prescribed by [1910.1000] is applied to the use of all of them."^{15,17}

As for standards for the particulate polycyclic aromatic hydrocarbons, only benzo(a)pyrene and chrysene have been addressed directly. A TWA of 0.2 µg/m³ was recommended by the coke oven advisory committee for benzo(a)pyrene under the OSHA 20 CFR 1910.1029 coke oven emissions standards but was not adopted.¹³ A special NIOSH hazard review of chrysene recommended that it be controlled as an occupational carcinogen. Also, the ACGIH report on chemical agents TLV committee, May 1979, has added chrysene to its list of industrial substances suspected of having carcinogenic properties for man. The carcinogenic potential of the other polycyclic aromatic hydrocarbons, benzo(a)anthracene, anthracene, and pyrene has also been documented.¹

F. Toxicity of Substances

Bauxite^{1,5}

Bauxite (aluminum oxide powder), if free from toxic impurities and with a quartz content less than 1%, is considered a nuisance dust. Although it is considered inert, it must be remembered that any inhaled dust which settles in the alveoli or air sacs will invoke some cellular response. Nuisance dusts, in contrast to fibrogenic or scar-tissue forming dusts, have relatively little harmful effect on the lung provided exposures are kept within reasonable limits. High concentrations of such dust may cause skin and mucous membrane irritation, bronchitis, and safety hazards such as decreased visibility.

Particulate Polycyclic Aromatic Hydrocarbons (PPAH)^{1,6,12,19}

Much of what is known of the health effects of exposure to particulate polycyclic aromatic hydrocarbons (PPAH) has been learned from studies conducted in the coal tar products industry. Exposure to substances containing similar or identical components occur in various enterprises such as the petroleum industry. These industrial exposures often contain PPAH's which themselves have been identified as carcinogens, such as benzo(a)pyrene, benzanthracene, chrysene, and phenanthrene. There are other substances usually present such as anthracene, carbazole, fluoranthene, and pyrene which may also cause cancer, but these causal relationships have not been as well documented. Fluoranthene, in particular, has been reported to have co-carcinogenic activity but no direct tumor-producing activity.

In the coal tar products industry, long-term exposure to coal tar products has been associated with an increased risk of lung and skin cancer in workers. In the petroleum industry, recent studies suggest an increased risk of cancer of the digestive system, lung and skin with long-term exposure.

Sulfur Dioxide (SO₂)^{3,4,11,14}

Sulfur dioxide (SO₂) is a colorless gas with a characteristic strong, suffocating odor. Gaseous sulfur dioxide is particularly irritating to the eyes, and mucous membranes of the upper respiratory tract. Some individuals are more sensitive to its effects than others. Based in part on recent reports of significant pulmonary function impairment in workers exposed to levels lower than the current OSHA standard of 5 ppm [levels ranging from 0.4 - 1.3 ppm (1 - 6 mg/m³)], NIOSH has recommended an exposure limit of 0.5 ppm (1.3 mg/m³), determined as a TWA concentration for up to a 10-hour workday, 40 hour workweek.

Lead²⁰

The important routes of absorption of lead in man are the gastrointestinal tract and the lungs. Dermal absorption is relatively insignificant in most cases.

The effects of lead poisoning are cumulative and result in a large variety of health problems beginning with nonspecific symptoms such as fatigue, dizziness, cramps, and headaches and eventually leading to a variety of disorders that can end in paralysis, brain damage, and death.

G. Evaluation Results

1. Environmental

a. Particulate Polycyclic Aromatic Hydrocarbons

Sampling was done on March 6 and 7, 1979, on the Burner and the Filter House operators. On March 7, 1979, the Burner House operator's exposure exceeded the ACGIH permissible limits for PPAH. The analysis for the constituents of the polycyclic aromatic hydrocarbons, viz., 1) benzo(a)pyrene 2) chrysene 3) pyrene 4) benzo(a)anthracene were all below their respective lower limit of detection (See Table I). In three of the four samples fluoranthene concentrations ranged from 0.15 to 0.37 micrograms per cubic meter of air.

b. Total Dust Particulate - Lead

Because the employees were wearing air monitoring equipment to collect environmental samples for PPAH and sulfur dioxide, general air samples were collected for total dust particulate and lead in areas where the highest exposures could occur. The total dust levels ranged from 1.1 milligrams per cubic meter of air on the bottom floor to 8.5 milligrams per cubic meter of air on the top floor. The lead levels were below the lower limit of detection (See Table II).

c. Sulfur Dioxide

Four environmental air samples were collected for sulfur dioxide gas. The sulfur dioxide levels were all below the lower limit of detection for this contaminant (See Table III).

2. Medical

A total of 12 employees who worked in the Filter House-Burner Building and one former burner operator who now works in another area were interviewed concerning alleged work-related health problems. Interviews were directed toward complaints of mucous membrane irritation and respiratory tract symptoms. Current symptoms were distributed among nine of the twelve present Filter House-Burner Building employees. Respiratory tract symptoms included: cough and/or production of sputum (3), shortness of breath on vigorous exertion (4), shortness of breath on mild exertion (1), wheezing and cough with chest tightness on strenuous activity (1), and wheezing and/or shortness of breath with strenuous activity or with heavy dust concentrations (1). Two out of the three with productive cough had symptoms suggestive of chronic bronchitis. They are included among those four who complained of shortness of breath with strenuous exertion. The average age of the four was 44 (range 40 - 48). All smoked cigarettes. The individual who complained of shortness of breath on mild exertion had other medical problems to which his symptoms could be attributed.

Other reported symptoms included: burning or sore throat (3), dry nose (1), watery eyes (2), sinus congestion (1), headache (1) and "lightheadedness" with exposure to naphtha fumes. The mucous membrane symptoms were intermittent and were particularly associated with increased heat and with the burning of certain products such as "bright stock" and "PET".

All symptoms appeared to be mild in nature. Three of the twelve employees interviewed (one from each job category) were currently asymptomatic. They included one non-, one former and one current cigarette smoker. One former burner operator recalled having had an "asthma attack" many years ago while working in the Filter House area as a burner operator. This individual had a history of childhood asthma.

The chest X-rays of the three burner operators in question were read by the NIOSH contract reader and reported to be negative for pneumoconiosis. Additional information obtained from review of the original films at Rochester General Hospital and from correspondence with the private physicians of these individuals did not provide any evidence to contradict these findings.

H. Discussion

1. Environmental

During the walk-through evaluation of November 6, 1978, the floors and overhead beams of the Burner House were noted to be covered with approximately 2-3 inches of bauxite. NIOSH, union and management personnel experienced a choking, eye-tearing sensation. The employees claimed this was typical whenever bright stock filtrate was burned as this material contains the most sulfur. Bulk samples of the filtrate were collected prior to being burned; analysis by the NIOSH laboratory revealed 0.016 percent lead. If a one-gram sample containing the above percentage of lead was dispersed in a cubic meter of air, the concentration would be 0.016 microgram of lead per cubic meter of air. This is well below the EPA limit in city air of 1.5 microgram per cubic meter of air. No cristobalite or quartz was present.

During the environmental air sampling on March 6-7, 1979, the filtrate from waxy distillates columns was processed. It was noted that a thorough housekeeping had been performed. No choking or eye-tearing in the building area was experienced this time. Also general air area samples showed no lead to be present. Management could not explain where the lead came from and said that lead would be an undesirable contaminant in their product.

On March 7, 1979, the major portion of the Burner operator's working day was spent in the Burner House performing various tasks and also preparing the Burner House for a maintenance shut down which was scheduled for the following day. This could explain the higher PPAH exposure, compared to the preceding day, March 6, 1979.

Although no lead was detected in the area, samples taken at the top and bottom of the burner building during the environmental sampling period, 0.016 percent was present in the bulk sample collected on November 21, 1978. Exposure to lead fume may be a problem if an employee is working on the top floor of the burner building where dust and fume leakage from the burner was noted.

Although no sulfur dioxide was detected on the day environmental samples were obtained, it is considered likely to be present intermittently, i.e., when various products are burned. Its presence is presumed because the physical signs and symptoms (tearing of the eyes, etc.) noted by those present during the initial walk-through evaluation, were consistent with sulfur dioxide gas exposure and because of the characteristic odor which was present. Sulfur dioxide is a strong skin, eye and mucous membrane irritant and exposure should be minimized.

2. Medical

There is historical evidence of acute, intermittent irritation of the eyes and mucous membranes of the upper respiratory tract, dry skin, occasional headache, sinus congestion, and/or wheezing with exertion in some employees of the Filter House-Burner Building. The acute irritation symptoms are particularly associated with increased heat and with the burning of certain products such as "bright stock" and "PET".

Six individuals noted shortness of breath on vigorous exertion, such as climbing the stairs or the ladder on the sides of the tank. Five of the six are cigarette smokers and all but one are over 40 years of age (range 36 - 48 years). This apparently was not a perceived problem by the workers.

The episodes of wheezing are associated with heavy dust concentrations, such as that generated when sweeping down the Filter House, and with strenuous exertion.

Although no sulfur dioxide was detected on the day environmental samples were obtained, it is considered to be present intermittently, i.e., when various products are burned. Sulfur dioxide is a strong skin, eye, and mucous membrane irritant and is likely responsible for the acute irritation symptoms experienced by employees of the Filter House-Burner Building.

The present occupational SO₂ TWA standard is based primarily on preventing acute effects. NIOSH has recently proposed lowering the environmental exposure limit to 0.5 ppm TWA (1.3 mg/m³). This is based, in part, on results of recent reports of significant pulmonary function impairment associated with chronic low level exposure to SO₂ in the 8-hour (TWA) range of 1-6 mg/m³ (0.4-1.3 ppm).^{4,11} In regard to possible chronic pulmonary effects it has also been suggested that an inhaled irritant which provokes an acute response among some individuals of a group may produce "irreversible cumulative lung damage" (p. 363)³ with frequent repeated exposures over a long period of time.

The primary concern of the Filter House employees and the union appeared to center on the possible adverse health effects of aluminum oxide dust and unknown toxic substances - particularly on the lungs. This is what prompted the two separate union requests for chest X-rays of Filter House employees. There was apparently some misunderstanding concerning the quality and interpretation of the chest X-rays taken during the summer of 1978 on three burner operators.

Although present evidence indicates that exposure to aluminum oxide powder does not result in pneumoconiosis, prudence would dictate avoidance of any unnecessary exposure.

V. RECOMMENDATIONS

1. Establish a program of periodic housekeeping in the Burner House. Cleaning should be performed by vacuum methods.
2. Establish a periodic maintenance program to seal all leaks that may develop in the burner and ducts.
3. Establish an environmental monitoring program testing for the presence of sulfur dioxide and particulate polycyclic aromatic hydrocarbons (PPAH) to establish the degree of exposure of the burner operator and the Filter House operator.
4. Emphasize personal hygiene and cleanliness, i.e., daily clothing change, showers after work, etc.
5. Provide medical surveillance in the form of pre-placement and periodic examinations to those workers exposed to particulate polycyclic aromatic hydrocarbons (PPAH) with particular attention to the oral cavity, the digestive system, skin and respiratory system. Records should be maintained for at least 30 years. Additional information as provided in the NIOSH criteria document, Occupational Exposure to Coal Tar Products, DHEW (NIOSH) Publication No. 78-107, may be useful.
6. Comprehensive pre-placement and annual medical examinations should be performed whenever exposure to sulfur dioxide exposure exceeds 0.25 ppm ($\geq 1/2$ the recommended workroom environmental standard). Examination should be directed toward complaints of eye and mucous membrane irritation, cough and shortness of breath. Particular attention should be paid to individuals with a history of asthma or with subnormal pulmonary function. Simple expiratory function tests [FVC and FEV (1sec)] should be performed. The advisability of an employee's using a negative- or positive-pressure respirator should be evaluated.

Medical records shall be maintained for persons employed one or more years in work involving exposure to sulfur dioxide. X-rays for the 5 years preceding termination of employment and all medical records with pertinent supporting documents shall be maintained at least 20 years after the individual's employment is terminated.¹⁴

7. Review the present practice of routine pre-employment films of the lower back for relevance and effectiveness. The value of this procedure in predicting future back injury or disability has been seriously questioned and is doubtful. The person(s) responsible for such a program must consider whether the information thus obtained justifies the risk associated with this additional radiation exposure.^{5,7,8}

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Acknowledgements

Analytical Laboratory Services

Utah Biomedical Test Laboratory
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Table I
 Ashland Oil Company
 Freedom, Pennsylvania
 HHE 79-16
 March 6-7, 1979
 Results of Personal and Area Air Samples for Polycyclic Aromatic Hydrocarbons
 (PAH) in the Filter House-Burner Building

<u>March 6, 1979</u> <u>Operator</u>	<u>Sample Number</u>	<u>Time</u>	<u>Benzene Solubles</u> <u>mg(M³)*</u>	<u>B(a)P*</u>	<u>PPAH (µg/M³)*</u>			<u>Fluoranthene</u>
					<u>Chrysene</u>	<u>Pyrene</u>	<u>B(a)A**</u>	
Burner	1 A	7:47-14:30	0.14	< 0.04	< 0.10	< 0.40	< 0.08	0.23
Filter House Operator	2 A	7:57-14:45	0.15	< 0.04	< 0.10	< 0.40	< 0.08	< 0.06
<u>March 7, 1979</u>								
Burner	1 B	7:15-14:45	0.43	< 0.04	< 0.10	< 0.40	< 0.08	0.37
Filter House Operator	2 B	7:24-14:45	.14	< 0.04	< 0.10	< 0.40	< 0.08	0.15

* B(a)P = Benzo(a)Pyrene

** B(a)A = Benzo(a)Anthracene

*** mg/m³ = milligrams of substance per cubic meter of air sampled.

**** µg/m³ = micrograms of substance per cubic meter of air sampled.

<u>Substance</u>	<u>Lower Limit of Detection</u>
Benzene Solubles	0.02 milligram/sample
Benzo(a)Pyrene	0.04 microgram/sample
Chrysene	0.10 microgram/sample
Pyrene	0.40 microgram/sample
Benzo(a)Anthracene	0.08 microgram/sample
Fluoranthene	0.06 microgram/sample

Evaluation Criteria
 0.20 mg/m³ (ACGIH - OSHA)
 0.10 mg/m³ - cyclohexane soluble (NIOSH)
 NIOSH - to be controlled as a potential occupational carcinogen = lowest reliable analytical detection limit

Table II
 Ashland Oil Company
 Freedom, Pennsylvania
 Results Area Air Samples for Total Particulate
 Lead in the Filter House-Burner Building

<u>Date</u>	<u>Operation</u>	<u>Sample Number</u>	<u>Sampling Period</u>	<u>Concentration</u>	
				<u>Total mg/m³*</u>	<u>Lead µg/m³**</u>
3/6	Gen'l air prior to Burning	1906	Sample taken in very dusty area, as a gen'l air bulk sample	10.15	< 5
3/7	Gen'l air, bottom of Burning House	1902	8:45-13:00	5.2	< 5
	Gen'l air, bottom of Burner House	1901	13:00-14:50	1.1	< 5
	Gen'l air, top of Burner House	1909	8:45-14:40	8.5	< 5

*mg/m³ = milligrams of substance per cubic meter of air sampled.

** = lower limit of detection was 5 micrograms

Table III
 Ashland Oil Company
 Freedom, Pennsylvania
 HHE 79-16

March 6-7, 1979

Results of Personal Air Samples for Sulfur Dioxide Gas in the
 Filter House-Burner Building

<u>Date</u>	<u>Operation</u>	<u>Sample Number</u>	<u>Sampling Period</u>	<u>Concentration $\mu\text{g}/\text{m}^3$*</u>
3/6	Burner	1 A	7:47-14:30	< 3.1**
	Filter House Operator	1 B	7:57-14:45	< 3.1
3/7	Burner	2 A	7:15-14:45	< 3.1
	Filter House Operator	2 B	7:24-14:45	< 3.1

* - denotes micrograms of sulfur dioxide per micrograms of air sampled.

** - lower limit of detection - $3.1 \mu\text{g}/\text{m}^3$ sulfur dioxide.

Permissible Levels - Sulfur Dioxide

NIOSH	$1.3 \text{ mg}/\text{m}^3$ ***
ACGIH	$5 \text{ mg}/\text{m}^3$
OSHA	$13 \text{ mg}/\text{m}^3$

*** - denotes milligrams of substance per cubic meter of air.