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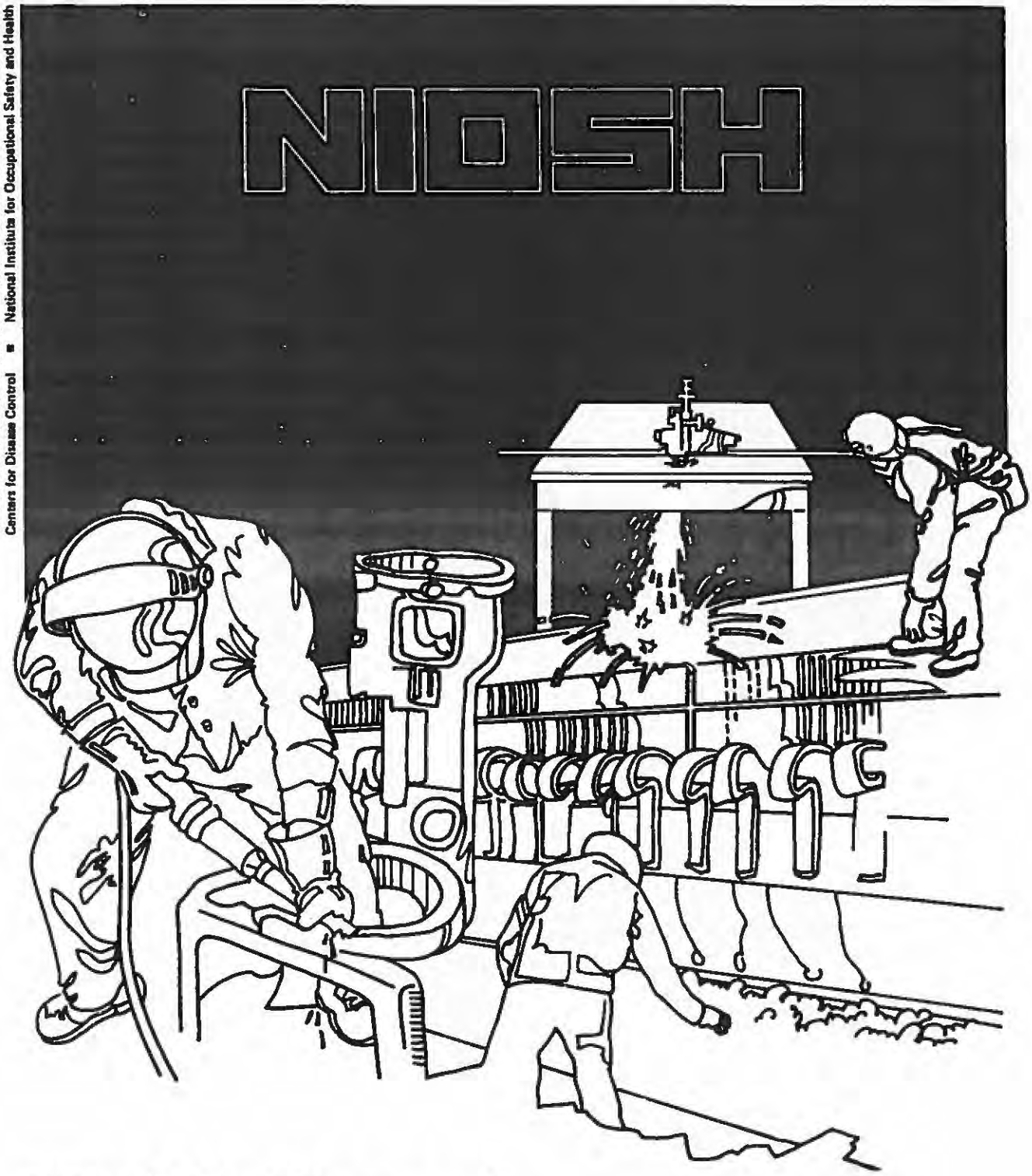
NIOSH



Health Hazard Evaluation Report

HETA 85-432-1878
CHEVRON U.S.A., INC.
PORT ARTHUR, TEXAS

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 85-432-1878
MARCH 1988
CHEVRON U.S.A., INC.
PORT ARTHUR, TEXAS

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I. SUMMARY

In July 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate conditions leading to concern of current/former employees relative to cancer percentages at the Chevron, U.S.A. Laboratory (formerly Gulf Oil) in Port Arthur, Texas, versus the national average.

On February 5, 1986, a NIOSH industrial hygienist and a medical officer conducted a walk-through evaluation of the facility. General safe practices for laboratory activities, safety procedures for benzene-designated areas, and prior results of plant monitoring activities were discussed with the plant industrial hygienist and laboratory manager. In addition six (6) current employees were privately interviewed and discussions were held with the plant physician relative to the medical monitoring program.

On December 16, 1986, the NIOSH industrial hygienist conducted a follow-up evaluation, during which: a) environmental monitoring was performed to determine employee exposure(s) to total hydrocarbons, benzene, toluene, xylene, n-heptane, and n-hexane; and b) a ventilations study was performed of exhaust hoods used for the control and removal of airborne contaminants generated by laboratory operations. In order to determine if there was any unusual pattern in the causes of death of the 148 male laboratory employees who had died after 1949, the NIOSH medical officer performed a proportional mortality analysis. Expected number of deaths for each cause-specific category of interest was calculated by using the mortality experience of the United States white male population.

Results of nine (9) personal breathing zone (PBZ) and three (3) general area (GA) samples showed airborne concentrations of benzene, toluene, xylene, n-heptane, and n-hexane to be below the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), eight-hour time-weighted average (TWA) standard, and concentrations of toluene, xylene, n-heptane, and n-hexane were below NIOSH's recommended ten-hour, TWA exposure limits. Five (5) PBZ samples and one (1) GA sample exceeded the NIOSH recommended ten-hour exposure limit for benzene.

Thirteen of 16 laboratory hoods evaluated had face velocities less than 100 feet per minute (fpm) when open to a convenient work height between 24-32 inches. Results suggest that, based on usage, some hoods are deficient in meeting minimum requirements to maintain contaminant concentrations below exposure limits, and are, therefore, operating with less than optimal effectiveness.

The employee interviews revealed that workers were concerned about possible health effects of chemical exposure (particularly benzene), as well as the occurrence of cancer in former laboratory workers. Because of this concern regarding cancer, mortality data was obtained from the company. The cause of death for 148 male employees who died after 1949 was made available. A proportional mortality analysis for these men revealed that deaths due to all malignant neoplasms were not elevated (31.16 -vs- 31 observed); however, rectal cancer was significantly elevated (1.19 expected -vs- 5 observed), as was benign brain tumor (0.233 expected -vs- 2 observed). Also of note was the occurrence of three (3) deaths due to hematopoietic disorders (one due to chronic myeloid leukemia, one due to multiple myeloma, and one due to polycythemia vera). While the occurrence of the hematopoietic disorders was not in significant excess, and the excess in brain tumors and rectal cancers may have no relation to the deceased employees work in the plant laboratory, the occurrence of these illnesses does raise concern about possible health effects of chemical exposures in the laboratory, and underlines the importance of keeping such exposures at the lowest feasible level.

The number of observed cases of rectal and brain cancer exceeded the number expected, although these cases could not definitely be linked with occupational exposure. The measured exposures to toluene, xylene, heptane, and hexane did not constitute health hazards, based upon NIOSH exposure limit criteria. However, air monitoring results demonstrated several exposures to benzene in excess of the NIOSH 0.1 ppm recommended exposure limit. That, combined with several inadequate laboratory hood capture velocities, is deemed to present a potential health hazard. Recommendations to reduce employee exposures to chemicals used in this laboratory are presented.

KEYWORDS: SIC 2911 (petroleum refining), benzene, toluene, xylene, n-hexane, n-heptane, total hydrocarbons, quality control laboratory

II. INTRODUCTION/BACKGROUND

On July 8, 1985, NIOSH received a request to evaluate possible adverse health effects -- namely cancer -- to employees as the result of exposure to various chemicals -- especially benzene -- in the laboratory. The request was accompanied by a list of former employees who had died of various types of cancer. The requestors were specifically concerned about "cancer percentages here, against the national average". On February 5, 1986, a combined environmental/medical walk-through evaluation was conducted at the facility.

III. DESIGN AND PROCEDURES

Environmental

During the February 5, 1986, walk-through evaluation, general safe practices for laboratory activities, safety procedures for benzene-designated areas, and prior results of plant monitoring activities were discussed with the plant industrial hygienist and laboratory manager. Comments received from randomly-selected employees also addressed: a) inadequate laboratory fume hoods, in general; and b) frequent "chemical" odors in the distillation and flash point rooms which were, in some instances, reportedly strong enough to produce symptoms of nausea.

On December 16, 1986, the NIOSH industrial hygienist conducted a follow-up evaluation, during which: a) environmental monitoring was performed to determine employee exposure(s) to total hydrocarbons, benzene, toluene, xylene, n-heptane, n-hexane; and b) a ventilation study was conducted of exhaust hoods used for the control and removal of airborne contaminants generated by laboratory operations.

At the time of the NIOSH visit(s), the laboratory employed approximately 75 chemists and technicians to perform product analyses and tests on environmental samples to satisfy Environmental Protection Agency (EPA) requirements.

Medical

Six (6) employees were privately interviewed by the NIOSH medical officer during the February 5, 1986, walk-through evaluation, and discussions were held with the plant physician relative to the medical monitoring program.

Because of the concern about the occurrence of cancer among employees of the laboratory, mortality data on former employees of the laboratory was requested from the plant medical department. Mortality data had been collected by the company and several mortality studies regarding the plant had been performed by epidemiologists formerly employed by the Gulf Oil Corporation. Since there were few deaths among females, the analysis was limited to deceased males. The company epidemiologist's search of the mortality records revealed death records for 168 men who had been employed for at least one year in the refinery laboratory.

The cause of death was available for 157 of these employees, but the nine (9) male employees who died before 1950 were not included in the mortality analysis, because of the common occurrence of inconsistencies in the classification of hematopoietic malignancies prior to 1950. None of these nine (9) men died of a malignancy.

To determine if there was any unusual pattern in the causes of death of the 148 male laboratory employees who had died after 1949, a proportional mortality analysis was performed. Expected number of deaths for each cause-specific category of interest was calculated by using the mortality experience of the United States white male population. Cause-specific proportions of all white male deaths were obtained from the publication, Vital Statistics Of The United States for the years 1958, 1974, and 1982. These rates (done by 10-year age groups) were applied to the number of deaths in the cohort that occurred during each of the three (3) International Classification of Diseases (ICD) classification periods in use from 1950 to 1986: seventh [1950-1967], eighth [1968-1978], and ninth [1979-present].

IV. EVALUATION CRITERIA

Environmental

Environmental criteria traditionally used by NIOSH for the evaluation of the workplace industrial area are; (1) NIOSH Criteria Documents and recommendations; (2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's); and (3) U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) standards.

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 these health effects, even if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, pre-existing medical conditions, and/or hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medication or personal habits of the workers, to produce health effects, even if the occupational exposures are controlled at the level set by the evaluation criteria. These combined effects are often not considered in the evaluation criteria.

For indoor environments, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) have developed general air quality standards which are applicable for the general population, continuously exposed for up to a 24-hour day without known toxic effects. Indoor air should not contain concentrations of contaminants known to impair health, or to cause discomfort to a substantial majority

of the occupants. Ambient air quality standards/guidelines available from federal, state, or local authorities should be utilized. If the air is thought to contain any other contaminants, reference to OSHA, ACGIH, and NIOSH recommendations should be made. For application to the general population, the concentration of these contaminants should not exceed one-tenth of the limits which are utilized in industry.

Acceptable exposure levels applicable to chemicals used in this evaluation are as follows:

Substance	Evaluation Criteria*	Source
Benzene	1 ppm	OSHA
	5 ppm (15-min. ceiling)	OSHA
	0.1 ppm	NIOSH(a)
	1 ppm (15-min. ceiling)	NIOSH
	10 ppm	ACGIH
Toluene	200 ppm	OSHA
	300 ppm (ceiling)	OSHA
	100 ppm	NIOSH
	200 ppm (10-min. ceiling)	NIOSH
	100 ppm	ACGIH
Xylene	100 ppm	OSHA
	100 ppm	NIOSH
	100 ppm	ACGIH
n-Heptane	500 ppm	OSHA
	85 ppm	NIOSH
	440 ppm (15-min. ceiling)	NIOSH
	400 ppm	ACGIH
n-Hexane	500 ppm	OSHA
	100 ppm	NIOSH
	510 ppm (15-min. ceiling)	NIOSH
	50 ppm	ACGIH

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* - All air concentrations are expressed as time-weighted average (TWA) exposures for an 8-10-hour workday, 40-hour week, except where otherwise noted.

(a) - Lowest feasible level, Carcinogen

ppm - parts of contaminant per million parts of air sampled, at 25 degrees Centigrade and 760 millimeters of mercury pressure

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Toxicological

Benzene

Acute benzene exposure causes central nervous system depression. Human exposure to a very high concentration (20,000 ppm) is fatal in 5-10 minutes. Brief exposure to concentrations above 3000 ppm is irritating to the eyes and respiratory tract; continued exposure may cause euphoria, nausea, staggering gait, and coma. Inhalation of lower concentrations (250-500 ppm) causes vertigo, drowsiness, headache, and nausea. The most significant toxic effect of benzene exposure is an insidious and often irreversible injury to the bone marrow. Long term exposures to benzene have been observed to have an initial stimulant effect on the bone marrow, followed by aplasia and fatty degeneration. As a result, changes to the blood occur which initially begins as an increase followed by a decrease of the erythrocytes (red blood cells), leucocytes (white blood cells), and platelets with progression to aplastic anemia, leukopenia, pancytopenia, and thrombocytopenia. Epidemiologic studies have demonstrated that benzene is also leukemogenic.

NIOSH considers benzene to be a human carcinogen and, as such, recommends that exposures be maintained at the lowest feasible level (LFL), but should never exceed 0.1 ppm as an 8-hour time-weighted average (TWA), or 1 ppm as a 15-minute ceiling concentration.

Toluene

Toluene is a colorless liquid with an odor threshold reported to be 2.5 ppm. It is used as a solvent in many paints and coatings. Occupational exposures to toluene are normally through inhalation of toluene vapors and skin absorption of toluene liquid. Unlike benzene, chronic exposure to toluene does not produce the severe injury to the bone marrow. As a result, toluene has been widely substituted for benzene in many products and industrial processes. The predominant effect from exposure to toluene is depression of the central nervous system. Controlled exposures of human subjects to 200 ppm of toluene for eight (8) hours has produced mild fatigue, weakness, confusion, watery eyes, and a tingling sensation of the skin. Prolonged reaction times, decreased pulse rates, and decreases in systolic blood pressure have been detected among human subjects exposed to 200 ppm for seven (7) hours. At higher concentrations, effects include nervousness, muscle fatigue, and insomnia. Workers exposed to less than 200 ppm have complained of headaches, lassitude, and nausea. In 1973, NIOSH recommended the occupational exposure limit be reduced to 100 ppm as an 8-hour TWA. Repeated or prolonged skin contact with liquid toluene has a defatting action, causing drying, fissuring, and dermatitis. Toluene causes some irritation to the eyes at 300-400 ppm.

Xylene

Xylene vapor may cause irritation of the eyes, nose, and throat. Repeated or prolonged skin contact with xylene may cause drying and defatting of the skin which may lead to dermatitis. Liquid xylene is irritating to the eyes and mucous membranes, and aspiration of a few milliliters may cause chemical pneumonitis, pulmonary edema, and hemorrhage. Repeated exposure to the eyes to high concentrations of a xylene vapor may cause reversible eye damage. Acute exposure to xylene vapor may cause central nervous system depression and minor reversible effects upon the liver and kidneys. At high concentrations xylene vapor may cause dizziness, staggering, drowsiness, and unconsciousness. Workers exposed to concentrations above 200 ppm complain of loss of appetite, nausea, vomiting, and abdominal pain. Brief exposure of humans to 200 ppm has caused irritation of the eyes, nose, and throat.

The current OSHA standard for xylene is 100 ppm averaged over an 8-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to 100 ppm, averaged over a work shift of up to 10 hours per day, 40 hours per week, with an acceptable ceiling level of 200 ppm averaged over a 10-minute exposure. The ACGIH TLV first adopted in 1967 is retained with a short term exposure limit (STEL) of 150 ppm for a fifteen (15) minute exposure and a 100 ppm time-weighted average TLV for an 8-hour exposure.

n-Heptane

n-Heptane can effect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. Overexposure to heptane may cause a slight irritation of the eyes, nose, and throat, lightheadedness, vertigo, giddiness, incoordination and semi-consciousness. It may also cause loss of appetite and nausea. Higher concentrations may cause unconsciousness.

The liquid is a defatting agent, and prolonged exposure may cause irritation of the skin. Aspiration may also cause a chemical pneumonia. No chronic systemic effects have been reported in humans.

n-Hexane

Normal hexane is a mild upper respiratory irritant and causes central nervous system depression. In industry, symptoms such as dizziness have been observed when concentrations exceeded 1000 ppm but not when below 500 ppm. Until recently, chronic effects from hexane and similar hydrocarbons had rarely been reported. However, in 1967, seventeen cases of polyneuritis were reported among workers exposed to n-hexane at concentrations of 500 - 1000 ppm. Subsequent animal studies demonstrated functional disturbances of the peripheral nerves of mice at 250 ppm but not at 100 ppm. Other studies have reported n-hexane nuropathy among furniture workers and among workers exposed to n-hexane used as a solvent in plastic cements. It has been postulated that 2,5-hexanedione, a metabolite of n-hexane, is the neurotoxic agent.

V. RESULTS AND DISCUSSION

Environmental

Total hydrocarbon, benzene, toluene, xylene, n-heptane, and n-hexane levels were measured at various locations within the laboratory on December 16, 1986. Nine (9) personal breathing-zone (PBZ) and three (3) general area (GA) air samples were collected by using battery-operated personal monitoring pumps, calibrated at 50 cubic centimeters per minute (cc/min), with standard charcoal tubes. Sections of the charcoal tubes were separated and analyzed by gas chromatography according to NIOSH Methods 1500/1501, with modifications.

Table 1 shows that airborne concentrations of benzene, toluene, xylene, n-heptane, and n-hexane were all below the OSHA, 8-hour TWA standard, and concentrations of toluene, xylene, n-heptane, and n-hexane were below NIOSH's recommended 10-hour, TWA exposure limits. Five (5) PBZ samples and one (1) GA sample exceeded the NIOSH recommended 10-hour exposure limit for benzene.

A Kurz air velocity meter, Model 441, was utilized to perform the laboratory hood evaluation(s). Thirteen laboratory hoods evaluated had face velocities less than 100 feet per minute (fpm) when open to a convenient work height between 24 32 inches. Five (5) hoods were found to have face velocities of less than 100 fpm when opened to a height of only 16 inches. While face velocity is not the only criterion by which to judge the effectiveness of laboratory hoods, the results shown in Table 2 suggests that, based on usage, some hoods are deficient in meeting minimum requirements to maintain contaminant concentrations below exposure limits, and are, therefore, operating with less than optimal effectiveness.

It is likely that adjusting and maintaining the hoods for optimal operation, and encouraging the use of good work practices when handling hazardous chemicals (e.g., benzene) may decrease laboratory workers chemical exposure(s). Guidelines defining the classification of contaminants, and minimum requirements for air contaminant control, are shown in Table 3 and Table 4, respectively.

Medical

Results of the proportional mortality analysis are shown in Table 5. Overall, deaths due to all malignant neoplasms were not elevated, (31 observed -vs- 31.16 expected). While two (2) specific varieties of malignant tumors were elevated, namely, digestive (11 observed -vs- 9.13 expected), and malignancy of unspecified and all other sites (5 observed -vs- 3.64 expected), neither excess was statistically significant. It is of note that one (1) of the five (5) malignancies of unspecified and all other sites was a malignant brain tumor. (191-8th revision). It is also of note that five (5) of the eleven (11) digestive malignancies were rectal cancer (154.1-8th revision). Only 1.19 such tumors would have been expected and this excess of rectal cancer is

statistically significant. The workers succumbing to this cancer died in the following years: 1955 (age 55, in laboratory 1924-1929), 1976 (age 77, in laboratory 1927-1945), 1977 (age 84, in laboratory 1916-1920), 1980 age 61, in laboratory 1937-1943), and 1984 (age 61, in laboratory 1942-1984).

The occurrence of three (3) cases of benign neoplasms or neoplasms of unspecified nature was also statistically significant. One (1) of these cases was a case of polycythemia vera (238.4-9th revision). The employee with polycythemia vera worked in the laboratory from 1934-1973, and died in 1980 at age 68. The other two (2) cases were brain tumors of unspecified nature (238.1-8th revision). The occurrence of this type of brain tumor in two (2) employees was statistically significant at the $p = 0.05$ level (only 0.233 such tumors would have been expected in the deceased cohort). One (1) of the two (2) employees succumbing to this type of brain tumor worked in the laboratory from 1925-1945, and died in 1971 at age 63. The other worked in the laboratory from 1937-1940, and died in 1976 at age 59. Also of interest was the occurrence of two (2) hematopoietic malignancies [a case of multiple myeloma (203-8th revision], and a case of chronic myeloid leukemia (205.1-8th revision). The man who died of multiple myeloma worked in the laboratory from February 1939 - August 1940, and died in 1969 at age 59. The employee who succumbed to myeloid leukemia worked in the laboratory from 1941 until he died in 1971 at age 49.

The meaning of the excess of rectal cancer in relation to employment in the laboratory is unclear. Four (4) of the five (5) workers succumbing to rectal cancer worked in the laboratory only prior to 1946, and three (3) of these workers worked there six (6) years or less. Since conditions were reported to be considerably different in the laboratory prior to 1950, this increase in rectal cancer, even if related to the laboratory, may have no relation to present laboratory conditions. In a mortality study of the entire Port Arthur Chevron Refinery, rectal cancer, was not elevated [19 observed -vs- 31.62 expected, American Journal of Epidemiology 1983;118(4):526-541)]. In addition, a recent mortality study of workers in a sample of petroleum refineries did not find a notable elevation in cancer of the rectum [27 observed -vs- 25.78 expected, (Journal of Occupational Medicine 1986; 28(7):514-516)].

The occurrence of two (2) cases of brain tumor of unspecified nature in the cohort of deceased former laboratory workers, combined with the occurrence of a malignant brain tumor in another deceased laboratory employee is of concern. The worker who succumbed to the malignant brain tumor had worked in the laboratory from 1933 until 1957, when he died at the age of 45. As discussed above, the two (2) workers with the brain tumors of unspecified nature had ceased working in the laboratory by the mid 1940's, and had subsequently worked in other parts of the plant; thus, if there is any occupational cause of their tumors, it may be exposures received in places other than the laboratory. Previous studies have found increases in deaths due to brain tumors among chemical workers.

Of particular interest is a study concerning Oil, Chemical and Atomic Workers (OCAW) union members employed at three refineries in the Beaumont/Port Arthur area of Texas (one was the Chevron Refinery) that found a statistically significant elevation in the relative frequencies of benign and malignant brain tumor deaths (33 observed -vs- 15.6 expected). No strong associations for brain tumor risk were seen with any specific work category (Journal of Occupation Medicine 1982; February; 24(2):135-141). It should be noted that the mortality study of all male employees at the Port Arthur Chevron Refinery conducted by corporate epidemiologists did not find an excess of brain tumor deaths [30 observed -vs- 30.43 expected, American Journal of Epidemiology 1983; 118 (4): 526-541)]. However, another study conducted at a Texas City, Texas, petrochemical plant found an excess of benign and malignant brain tumors among hourly workers (22 observed -vs- 10.7 expected). While no chemical exposures could be associated with the excess, the authors felt that although non-occupational etiologies cannot be dismissed, these data suggest an occupational etiology for certain brain tumor deaths in petrochemical workers (Journal of National Cancer Institute 1983; January;70(1):75-81).

Also of concern are the three (3) deaths due to hematopoietic disorders [one (1) due to chronic myeloid leukemia, one (1) due to multiple myeloma, and one (1) due to polycythemia vera]. The etiology of polycythemia vera has not been established, but a study of refinery workers did note an increased frequency of polycythemia vera [4 observed -vs- 1 expected, (Journal of Occupational Medicine 1986;28(7):514-516)]. Increased relative frequencies of leukemia and multiple myeloma have been found in previous studies of workers exposed to petrochemicals (Journal of Occupational Medicine 1980, February; 22(2):pp. 97-102) and especially to benzene (New England Journal of Medicine 1987;316:1044-1050). While the occurrence of three (3) hematopoietic disorders may not be in excess in this cohort, and the occurrence of these illnesses, along with the excess in brain tumors, may have no relation to the deceased employees work in the plant laboratory, the occurrence of these illnesses does raise concern about possible health effects of chemical exposure in the laboratory and underlines the importance of keeping chemical exposures -- especially to known hazardous chemicals like benzene -- at the lowest feasible level.

VI. RECOMMENDATIONS

The following recommendations are offered as a possible means for reducing/minimizing employee exposures to chemicals used in laboratory operations:

1. Ventilation equipment (exhaust hoods, etc.) should be operated continuously while the air contaminant-generating operations are in progress, and at all other times when the potential for employee exposure to excessive contaminant concentrations exist.

2. Where deficient face velocities exist, and based on minimum exhaust volume requirements/hood usage, corrective action should be taken. Normally, for laboratory-type hoods, an average face velocity of 125-200 fpm, and a minimum face velocity of 100 fpm, would be necessary to insure that a minimum amount of contaminant would escape into the workroom.

   In addition, face velocities of laboratory hoods with adjustable fronts should be controlled within reasonable limits in order to reduce the disturbances of airborne materials within the hood. This velocity control can be accomplished by either proportional bypass (constant volume) or controlled face velocity (variable volume).

3. Adequate quantities of make-up air should be furnished by the mechanical supply system and distributed with relation to exhaust points. Supply air distribution must be arranged to provide general air flow from clean areas toward more contaminated areas.

4. Ensure strict enforcement of Chevron U.S.A., General Safety Procedure Number 11-52 for benzene-designated areas.

VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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VIII. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 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 through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been distributed to:

1. Confidential Requestor
2. Chevron U.S.A., Inc., Port Arthur, Texas
3. OSHA, Region VI

For the purpose of informing employees, a copy of this report shall be posted in a prominent place, accessible to the employees, for a period of thirty (30) calendar days.

Hydrocarbon Concentrations

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

December 16, 1986

Sample Number	Location	Sampling Period	Concentrations					
			Total Hydrocarbons (mg/M^3)*	Benzene (ppm)**	Toluene (ppm)**	Xylene (ppm)**	n-Heptane (ppm)**	n-Hexane (ppm)**
1	Flash Point Room Personal	0738-1416	<9.4	<0.1	<0.3	<0.2	ND	<0.3
2	Distillation Room Personal	0745-1418	19.8	0.3	0.5	<0.5	<0.1	0.6
3	Main Area - Viscosity Aisle 3 Personal	0747-1420	29.8	<0.2	1.2	1.5	<0.1	1.0
4	Main Area - Analytical Aisle 2/5 Personal	0801-1424	28.3	<0.2	1.0	<0.9	<0.1	1.5
5	Main Area - Heavy Oil Aisle 4 Personal	0757-1423	97.5	<0.3	3.9	5.3	<0.3	1.4
6	Main Area - Light Oil Aisle 1 Personal	0755-1421	23.9	0.3	0.5	0.6	<0.1	0.8
7	Gas Chromatography Room Personal	0809-1439	<14.4	0.5	<0.3	<0.1	ND	1.1
8	Mass Spec/Room Chromatograph Room Personal	0830-1442	<5.1	0.3	<0.1	ND	ND	1.2

Hydrocarbon Concentrations

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

December 16, 1986

Sample Number	Location	Sampling Period	Concentrations					
			Total Hydrocarbons (mg/M^3)*	Benzene (ppm)**	Toluene (ppm)**	Xylene (ppm)**	n-Heptane (ppm)**	n-Hexane (ppm)**
9	Octane Room Personal	0817-1443	24.6	0.4	0.9	<0.5	<0.5	<0.4
10	Distillation Room East Wall General Area	0832-1432	<14.4	<0.2	0.5	<0.4	ND	<0.3
11	Main Area-Heavy Oil Aisle 4 General Area	0830-1428	<19.2	ND	<1.5	1.3	ND	ND
12	Gas Chromatography Room General Area	0823-1440	<10.0	0.5	0.3	<0.1	ND	1.4

*mg/M^3 = Milligrams of contaminant per cubic meter of air sampled

**ppm = Parts of contaminant per million parts of air sampled, at a pressure of 760 millimeters of mercury and 25 degrees Centigrade

ND = None detected

< = Less than the limit of quantification (LOQ)

TABLE 1A

Hydrocarbon
Environmental Criteria

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

December 16, 1986

Recommending Organization/Standard	Sampling Period	Concentrations (ppm)*				
		Benzene	Toluene	Xylene	n-Heptane	n-Hexane
U.S. Department of Labor, OSHA, standard time-weighted average (TWA)	8-hr.	1	200	100	500	500
U. S. Department of Labor, OSHA, ceiling standard	15-min.	5	300	--	--	--
NIOSH, time-weighted average (TWA) recommendation	8-hr.	0.1	--	--	--	--
	10-hr.	--	100	100	85	100
NIOSH, ceiling recommendation	10-min.	--	200	--	--	--
	15-min.	1	--	--	440	510
American Conference of Governmental Industrial Hygienists (ACGIH), time-weighted average (TWA) recommendation	8-hr.	10	100	100	400	50

*ppm = Parts of contaminant per million parts of air sampled, at a pressure of 760 millimeters of mercury and 25 degrees Centigrade

TABLE 2
Laboratory Hood Face Velocity Measurements

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

December 16, 1986

Hood Identification Number	Location	Size of Opening (height x width, inches)	Measured Face Velocity (feet per minute)
1	Section I -- Main testing room -- Table 1	28 x 82 16 x 82 6 x 82	40-70 85-120 110-135
2	Section I -- Main testing room -- Table 2	26 x 82 16 x 82 6 x 82	50-70 80-120 110-130
3A	Section I -- Main testing room -- Table 3	26 x 82 16 x 82 6 x 82	40-60 70-80 80-120
3B	Section I -- Main testing room -- Table 3	24 x 82 16 x 82 6 x 82	40-60 50-60 50-75
5	Section I -- Main testing room -- Table 5	28 x 82 16 x 82 6 x 82	30-50 100-130 (a)
6A	Section I -- Main testing room -- Table 6	24 x 82 16 x 82 6 x 82	80-100 140-150 140-150
6B	Section I -- Main testing room -- Table 6	25 x 82 16 x 82 6 x 82	30-60 70-85 80-90

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

December 16, 1986

Hood Identification Number	Location	Size of Opening (height x width, inches)	Measured Face Velocity (feet per minute)
8	Section I -- Main testing room -- Table 8	28 x 82 16 x 82 10 x 82	30-50 30-60 70-90
8W	Section II -- Chemical testing room	32 x 42 16 x 41 6 x 41	(a) 80-120 (a)
11W	Section II -- Chemical testing room	- (Inoperative)	-
20E	Section II -- Chemical testing room	- (Inoperative)	-
11E	Section II -- Chemical testing room	32 x 41 16 x 41 6 x 41	20-30 30-55 90-130
3W	Section II -- Chemical testing room	32 x 41 16 x 41 6 x 41	60-90 100-130 400-415
4W	Section II -- Chemical testing room	32 x 41 16 x 41 8 x 41	40-70 80-110 (a)

TABLE 2
Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

December 16, 1986

Hood Identification Number	Location	Size of Opening (height x width, inches)	Measured Face Velocity (feet per minute)
13W	Section II -- Chemical testing room	32 x 41	50-60
		16 x 82	100-110
		6 x 41	250-270
12E	Section II -- Chemical testing room	32 x 41	60-80
		16 x 41	90-110
		8 x 41	(a)
37	POD room	26 x 45	60-90
		16 x 45	100-120
		6 x 45	250-280
22	Lead mixing	9 1/2 x 14 (small opening)	400-450
		12 1/2 x 35 (large door)	150

(a) Obstruction -- unable to measure face velocity at height indicated

TABLE 3

Classification of Contaminant Substances (a)

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

December 16, 1986

Contaminant Class	Contaminant Substances	
	Gases & Vapors	Dusts, Fumes & Mists
I	Substances with exposure limits of 100 ppm and above	Substances with exposure limits of 10 mg/M^3 and above
II	Substances with exposure limits of 1-100 ppm	Substances with exposure limits of 0.1 mg/M^3 and (up to 10 mg/M^3)
III	Substances with exposure limits below 1 ppm; also, radioisotopes, carcinogens, and cancer-suspect agents	Substances with exposure limits below 0.1 mg/M^3; also, radioisotopes, carcinogens, and cancer-suspect agents

Note: This classification does not include biological agents.

(a) Recommended Industrial Ventilation Guidelines, NIOSH, January 1976

TABLE 4

Hood Applications and Minimum Exhaust Volume Requirements (a)*

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

December 16, 1986

Contaminant Class	Glove Hood	Laboratory Hood	Open Hood
I	50 cfm/sq ft open door area; 0.3 in H_2O static pressure closed	Face velocity: 100 fpm avg. 50 fpm min.	Capture velocity: 100 fpm
II	(same as for Class I)	Face velocity: 100 fpm avg. 75 fpm min.	Not allowed
III**	(same as for Class I)	Face velocity: 150 fpm avg. 125 fpm min.	Not allowed

(a) Recommended Industrial Ventilation Guidelines, NIOSH, January 1976

* Minimum exhaust volumes or face velocities shall be based on the maximum hood face area.

** For cancer-suspect agents, these requirements supplement (are in addition to) control requirements prescribed for specific materials in 29 CFR 1910.1000.

TABLE 5

Observed and Expected Numbers of Selected Causes of Deaths
(Expected Numbers Based on Proportional Mortalities for United States White Males)

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

February 5, 1986

Total Deaths	Observed	Expected	Observed/Expected	Statistically Significant (P=0.05)
Infection	1	1.64	0.61	---
All malignant neoplasms	31	31.16	0.99	---
Malignant disease of:				
Buccal cavity	0	0.23	---	---
Digestive	11	9.13	1.20	---
Respiratory	9	10.95	0.82	---
Breast	0	0.05	---	---
Genital organs	2	2.50	0.80	---
Uninary system	1	1.75	0.57	---
All other and unspecified sites	5	3.65	1.37	---
Leukemia	1	1.19	0.84	---
Other malignancies of lymph and blood	2	1.71	1.17	---
Benign neoplasms and neoplasms of an unspecified nature	3	0.42	7.14	Yes
Major cardiovascular (Including central nervous system)	86	78.70	1.09	---
Pneumonia and influenza	1	3.41	0.29	---
Bronchitis and asthma	1	3.69	0.27	---

TABLE 5
Observed and Expected Numbers for Selected Causes of Deaths
(Expected Numbers Based on Proportional Mortalities for United States White Males)

Chevron U.S.A. Refinery Laboratory
Port Arthur, Texas
HETA 85-432

February 5, 1986

Total Deaths	Observed	Expected	Observed/Expected	Statistically Significant (P=0.05)
Hernia	1	0.48	2.08	---
Nephritis	1	0.67	1.47	---
Kidney infection	1	0.52	1.92	---
Ill-defined conditions	3	1.55	1.94	---
Accidents	10	6.37	1.57	
Suicide	1	2.64	0.38	---
Other external causes	2	0.23	8.70	---
All other causes	6	16.52	---	---
Total	148			