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. 78-57-579

AMOCO TEXAS REFINING COMPANY
TEXAS CITY, TEXAS

APRIL 1979

I. TOXICITY DETERMINATION

The following determinations have been based upon the: (a) results of environmental air samples collected on May 2, 1978; (b) review of medical records obtained from the private physician(s) of the nine laboratory personnel who completed the "release of medical information" forms; (c) a May 2, 1978, review of relevant plant medical records of the nine employees; (d) review of hematologists'/pathologists' reports of six employees having had marrow biopsies performed; (e) consultation with a University of Cincinnati Medical School hematologists; (f) personal observation by NIOSH investigators; and (g) available toxicity information.

Results of fifteen (15) personal breathing-zone samples and one(1) general area sample, resulting in forty-eight analyses (16 each for benzene, toluene, and xylene) showed workroom concentrations to be below both the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) and the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) standards. However, nine (9) samples exceeded the NIOSH recommended standard of 1 p.p.m. for exposure to benzene.

Management-conducted blood screening tests on seven (7) employees (six in Quality Control Laboratory, one in styrene unit) revealed that three (3) of the subjects were within normal limits, two (2) showed slight anemia, and two (2) indicated an increase in circulating lymphocytes. The results of marrow biopsies performed on six (6) employees exposed to benzene revealed two (2) employees had normal biopsies while four (4) employees had biopsies indicating minor abnormalities not consistent with benzene toxicity.

During the conduct of the NIOSH evaluation, all available persons who had participated in the blood screening tests/marrow biopsies were interviewed, their alleged health hazards discussed with them, and they were reassured that, in the light of current knowledge, they were not suffering any adverse health effects associated with over-exposure to benzene. Although eight (8) workers showed exposure to benzene in excess of the NIOSH recommended standard (1 p.p.m.), no medical evidence of benzene toxicity was found in this work-force.

II. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this Determination Report are currently available upon request from the National Institute for Occupational Safety and Health (NIOSH), Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (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, Ohio, address. Copies have been sent to:

(a) Amoco Texas Refining Company
(b) Authorized Representative of Employees
(c) U.S. Department of Labor, Region VI
(d) NIOSH, Region VI

For the purpose of informing the approximately sixty (60) "affected employees", the employer shall promptly "post" the Determination Report in a prominent place near where exposed employees work, for a period of thirty(30) calendar days.

III. INTRODUCTION

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 receipt of a written request from 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.

NIOSH received such a request from an authorized representative of employees (Oil, Chemical and Atomic Workers International Union) regarding the exposure of workers in the Quality Control Laboratory to benzene. Although the original request also indicated a possible hazard in the styrene operation, said unit was inoperative at the time of the survey and could, therefore, not be evaluated. Plant officials also indicated that there were no immediate plans to place the unit back in operation.

IV. HEALTH HAZARD EVALUATION

A. Description of Process - Conditions of Use

This petroleum refinery, commencing operations in 1933, currently employs a total of 1842 employees. Approximately sixty (60) persons are employed in the specific area of the request - - namely, the quality control laboratory.

B. Evaluation Design

1. Environmental/Medical Survey

On May 2, 1978, an environmental/medical evaluation of the facility was conducted by NIOSH representatives, W. Elva Elesh, M.D., Medical Officer, and Mr. H.L. Markel, Jr., Regional Industrial Hygienist.

In order to more fully and adequately evaluate employee exposures to benzene, toluene and xylene, environmental air samples were collected in the various areas within the Quality Control Laboratory.

From a medical standpoint, interviews were conducted, and relevant medical records reviewed, of nine (9) employees performing duties within the area in question.

C. Evaluation Methods

1. Environmental

Benzene, Toluene and Xylene

Fifteen (15) personal breathing-zone samples and one (1) general area sample, resulting in forty-eight (48) analyses - 16 each for benzene, toluene and xylene - were collected by using low-flow SIPIN*, Model SP-1 personal sampling pumps with standard charcoal tubes at a rate of approximately 50 cubic centimeters per minute. Six (6) of the samples, collected at 200 cubic centimeters per minute, were the "short-term" type to determine "ceiling"concentrations.

All samples were analyzed in accordance with NIOSH Physical and Chemical Analysis Branch Analytical Method #127 -- namely, adsorption on charcoal, desorption with carbon disulfide, and use of a gas chromatograph with a flame ionization detector. The limit of detection was calculated to be 0.01 milligrams of each compound per tube.

2. Medical

On March 16, 1978, the NIOSH physician telephoned the Medical Director of Standard Oil of Indiana (Amoco Texas Refining Company) to obtain further information on the reported blood abnormalities in the six (6) Quality Control Laboratory employees and one (1) styrene unit employee at the Texas City, Texas Refinery. He did not have any specific information at hand, but informed the medical investigator that all workers potentially exposed to benzene had been screened for some fifty years on a quarterly

basis. Hemoglobins and hematocrits have been recorded, but no white cell counts were made unless there were indications for this procedure - - such as pyrexia. The Medical Director further stated that differential white cell counts have been carried out on the above referenced workers on a quarterly basis, or more frequently where indicated, since the promulgation of the OSHA Emergency Temporary Standard in May, 1977.

All workers showing any persistent blood abnormality were referred by the plant medical officer to their private physicians, or to Galveston Community Hospital. The Medical Director also informed the NIOSH physician that no serious blood disorders had been reported in the work force for as long as he could remember, and promised to forward any further medical information which he personally could obtain from the Texas City Refinery

On March 17, 1978, the NIOSH Regional Industrial Hygienist furnished the Secretary-Treasurer of the Oil, Chemical and Atomic Workers International Union, Local #4-449 with NIOSH standard forms authorizing release of medical information from the workers' physicians to NIOSH. Nine (9) workers completed these forms, which were forwarded to the NIOSH medical officer in April, 1978.

In the meantime, the local union had requested from management, and received, the results of blood tests on six (6) Quality Control Laboratory employees and one (1) styrene unit employee, as well as the results of environmental monitoring for air concentrations of benzene in both of the above areas. Management provided the NIOSH physician with the same information. With respect to the results of the blood tests, all identifying material, such as name, age, sex, etc., had been removed.

After thorough evaluation of this material, and following consultation with a blood specialist at the University of Cincinnati, it was determined that three (3) of the results were within normal limits, two (2) indicated slight anemia, and two (2) indicated an increase in circulating lymphocytes. After receiving the nine (9) completed medical release forms, the NIOSH medical investigator wrote to the workers' physicians listed on the forms, requesting all relevant medical information. Said information was eventually received on all workers directly involved in this health hazard evaluation. Of these nine (9) workers, six (6) had marrow biopsies performed, with the local hematologists'/pathologists' reports being forwarded to the NIOSH physician.

D. Evaluation Criteria

The evaluation standards and criteria considered to be applicable to this evaluation are as follows:

a. The Occupational Health Standards as promulgated by the U.S. Department of Labor, Federal Register, May 28, 1975, Title 29, Chapter XVII, Subpart G, Table Z-1 (29 CFR Part 1910.1000),

b. American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) Committee, 1977, and

c. NIOSH Criteria Documents recommending occupational standards.

	*8-hr. TWA,ACGIH TLV Committee	*NIOSH 8 or 10-hr.TWA Recommended Standard	*OSHA 8-hr.TWA Standard
Substance	mg/M^3 (p.p.m.)	mg/M^3 (p.p.m.)	mg/M^3 (p.p.m.)
Benzene	30 (10)	3 (1) ceiling	30 (10)
Toluene	375 (100)	375 (100)	750 (200)
Xylene	435 (100)	435 (100)	435 (100)

* Eight or ten-hour time-weighted-average concentrations in milligrams of substance per cubic meter of air sampled and parts of contaminant per million parts of air sampled.

Note: Occupational health exposure limits for individual substances have generally been established at levels designed to protect workers occupationally exposed on an eight (8) hours per day, forty (40) hours per week basis over a normal working lifetime.

2. Toxic Effects

a. Benzene

Benzene (C_6H_6) is a clear, colorless, non-corrosive, highly flammable liquid with a strong, rather pleasant odor. Benzene's low boiling point and high vapor pressure cause it to evaporate rapidly under ordinary atmospheric conditions, giving off vapors nearly three times heavier than air.[1]

Industrial benzene poisoning results almost exclusively from the inhalation of benzene in the atmosphere. Absorption of high concentrations of benzene may cause exhilaration followed by drowsiness, fatigue, dizziness, nausea and headache. If exposure to high concentrations of benzene is prolonged, loss of consciousness may result. High concentrations of benzene are irritating to the mucous

membranes of the eyes, nose and respiratory tract. Skin contact with liquid benzene can cause defatting, with redness, dry scaling and even secondary infection.[2]

Over a number of years, evidence has accumulated that benzene is leukemogenic. Because of the possibility of benzene-absorption causing leukemia, a malignant disease of the blood, NIOSH recommends that for regulatory purposes, benzene be considered carcinogenic to man. NIOSH also recommends that exposure to benzene be kept as low as possible and that no worker be exposed to a concentration greater than 1 p.p.m. in air. One p.p.m. represents the lowest level at which a reliable estimate of occupational exposure to benzene can be determined at the present time. This concentration is a ceiling value and as such, should never be exceeded.[3] The ACGIH level (1978) is 10 p.p.m. and is expressed as an 8-hour TWA exposure. It should be noted, however, that the ACGIH has classified benzene as a suspected human carcinogen, and suggests that worker exposure be carefully controlled to levels consistent with animal and human data.[4,5] The present Federal Standard, as promulgated by OSHA is 10 p.p.m. as an 8-hour TWA with an acceptable ceiling concentration of 25 p.p.m. A maximum peak concentration of 50 p.p.m. is permitted, provided that the duration is 10 minutes or less, for an 8-hour shift.[6] On May 3, 1977, OSHA promulgated an Emergency Temporary Standard for benzene, and adopted the NIOSH recommended ceiling concentration of 1 p.p.m. The proposed permanent standard published May 27, 1978, has never become effective as a result of procedural legal motions.

b. Toluene

Toluene vapors can be a direct cause of narcosis. Controlled exposure of human subjects to 200 parts per million (p.p.m.) for eight hours has produced mild fatigue, weakness, confusion, lacrimation, and numbness/tingling; at 600 p.p.m. for eight hours, there was also euphoria, headache, dizziness, dilated pupils and nausea; at 800 p.p.m. for eight hours, symptoms were more pronounced, and after-effects included nervousness, muscular fatigue, and insomnia persisting for several days.[7]

Most of the toluene absorbed from inhalation is metabolized to benzoic acid, conjugated with glycine in the liver to form hippuric acid, and excreted in the urine. Repeated or prolonged skin contact with liquid toluene has a defatting action, causing drying, fissuring and dermatitis. [8,9]

c. Xylene

Xylene vapor is an irritant to the eyes, mucous membranes and skin; at a high concentration it causes narcosis. In animals, xylene causes blood changes reflecting mild toxicity to the hematopoietic system.

In humans, exposure to undetermined but high concentrations caused dizziness, excitement, drowsiness, incoordination and a staggering gait. Workers exposed to concentrations above 200 ppm complain of anorexia, nausea, vomiting and abdominal pain. Brief exposure of humans to 200 ppm caused irritation of the eyes, nose and throat.[10]

There are reports of corneal vacuolization in workers exposed to xylene, or to xylene plus other volatile solvents. The liquid is a skin irritant and causes erythema, dryness and defatting; prolonged contact may cause the formation of vesicles.[11]

E. Evaluation Results and Discussion

1. Environmental

With one exception, results of fifteen (15) personal breathing-zone samples and one (1) general area sample, resulting in forty-eight (48) analyses (16 each for benzene, toluene, and xylene) showed workroom concentrations to be below both the ACGIH TLV's and the OSHA standards. However, nine (9) samples exceeded the NIOSH recommended standard of 1 p.p.m. for exposure to benzene. One excessive personal breathing-zone sample (number 30) was declared invalid as a result of the employee leaning into the laboratory hood during the performance of the benzene distillation procedure in the inspection laboratory.

2. Medical

Of the six (6) marrow biopsies performed, none of the hematologists reported any evidence of blood disorders of serious consequence. Two (2) were undertaken for medical reasons unrelated to benzene exposure. Two (2) were normal, and the remaining four (4) showed minor abnormalities, not consistent with benzene toxicity. These abnormalities are found in the public at large. When questioned as to why this procedure had been performed when the blood tests had shown only minor, if any, abnormalities, the plant physician stated that there had been much publicity about the leukogenic properties of benzene over-exposure at the time, and the workers became anxious. At the same time, local physicians became alerted to this potential health hazard.

The plant physician then informed the NIOSH doctor that any workers with persistent blood abnormalities were removed from exposure to any toxic chemical, including benzene.

All workers who were available were interviewed, their alleged health hazards were discussed with them, and they were re-assured that, in the light of current knowledge, they were not suffering any adverse health effects associated with over-exposure to benzene. Although eight (8) workers showed exposure to benzene in excess of the NIOSH recommended standard (1 p.p.m.),no medical evidence of benzene toxicity was found in this work-force. One of the original nine (9) workers was currently hospitalized with a serious disease unrelated to benzene over-exposure.

a. Medical Facilities

This plant has a well-equipped medical unit staffed by a full-time physician, and a nurse who is present during the day shift (7:30 a.m. - 4:30 p.m.). Comprehensive medical examinations are performed on all workers, with specific tests, such as audiometry and spirometry where indicated. A pre-employment blood screen and liver profile are administered to all workers potentially exposed to benzene. With respect to the blood tests, many show slight abnormalities as found in the general public.

V. RECOMMENDATIONS

1. All exposure to benzene, and any other toxic chemical(s) should be kept to a minimum, and the workers instructed in the continued observation of good hygiene and health practices.

2. Those workers showing persistent, though non-work related blood abnormalities should be observed by both plant and private physicians.

VI. REFERENCES

1. Federal Register, Vol.43, No. 29, February 10, 1978, Part II, "Occupational Exposure to Benzene."

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol.II - Toxicology (2d ed., revised), Interscience Publishing Company, New York, 1967, pp. 1220-1225.

3. National Institute for Occupational Safety and Health (NIOSH), Update -- Criteria and Recommendations for a Revised Benzene Standard, Cincinnati, Ohio, 1976.

4. American Conference of Governmental Industrial Hygienists: Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Enrironment with Intended Changes for 1978, Cincinnati, Ohio, 1978.

5. American Conference of Governmental Industrial Hygienists: "Benzene", Documentation of the Threshold Limit Value for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 355-356.

6. Title 29, Federal Code of Regulations, Part 1910.1000, Revised January, 1976. U.S. Department of Labor/Occupational Safety and Health Administration, Section 1910.1028.

7. American Conference of Governmental Industrial Hygienists: "Toluene". Documentation of the Threshold Limit Value for Substances in Workroom Air (3d ed., 3d printing), Cincinnati, 1976, pp. 348-349.

8. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed., revised), Interscience Publishing Company, New York, 1967, pp. 1226-1229.

9. National Institute for Occupational Safety and Health U.S. Department of Health, Education and Welfare: Criteria for a Recommended Standard...Occupational Exposure to Toluene, HSM 73-11023, U.S. Government Printing Office, Washington, D.C., 1973.

10. Hygienic Guide Series: "Xylene", American Industrial Hygiene Association Journal, 32:702-705, 1971.

11. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, Amsterdam, 1965, pp. 77-89.

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Table 1
Benzene, Toluene, Xylene, Air Concentrations
Standard Oil of Indiana
Texas City, Texas
April, 1979

Sample No.	*Type of Sample	Location	Sampling Period	**Concentration, mg/M^3 (p.p.m.)		
				Benzene	Toluene	Xylene
1A	P	Gas Chromatography	4:21 pm - 7:52 pm	2.0(0.6)	4.0(1.1)	2.0(0.5)
1B	P	Gas Chromatography	7:53 pm -10:20 pm	3.0(0.9)	4.0(1.1)	3.0(0.7)
1C(1)	P	Gas Chromatography	5:35 pm - 5:50 pm	3.3(1.0)	XX	XX
2A	P	Analytical Lab (Freeze Point)	4:25 pm - 7:45 pm	5.5(1.7)	5.5(1.5)	3.6(0.8)
2B	P	Analytical Lab (Freeze Point)	7:46 pm -10:19 pm	2.3(0.7)	2.3(0.6)	2.3(0.5)
2C(1)	P	Analytical Lab (Freeze Point)	6:08 pm - 6:23 pm	XX	12.5(3.3)	5.0(1.1)
3A	P	Inspection Lab (Benzene Distillation)	4:03 pm - 7:35 pm	3.0(0.9)	7.0(1.9)	2.0(0.5)
3B	P	Inspection Lab (Benzene Distillation)	7:36 pm -10:25 pm	4.2(1.3)	5.0(1.3)	3.3(0.8)
3C(1)	P	Inspection Lab (Benzene Distillation)	6:47 pm - 7:02 pm	3.0(0.9)	26.7(7.1)	3.0(0.7)
***3D(1)	P	Inspection Lab (Benzene Distillation)	10:15 pm -10:30 pm	103.3(32.4)	XX	XX
3E	P	Inspection Lab	10:15 pm -10:30 pm	10.0(3.1)	XX	XX

Table 1
Benzene, Toluene, Xylene, Air Concentrations
Standard Oil of Indiana
Texas City, Texas
April, 1979

Sample No.	*Type of Sample	Location	Sampling Period	**Concentration, mg/M^3 (p.p.m.)		
				Benzene	Toluene	Xylene
4A	P	Inspection Lab (Benzene Gravity)	4:07 pm - 7:31 pm	4.5(1.4)	5.5(1.5)	2.7(0.6)
4B	P	Inspection Lab (Benzene Gravity)	7:35 pm - 10:22 pm	3.6(1.1)	5.0(1.3)	2.1(0.5)
4C(1)	P	Inspection Lab (Benzene Gravity)	7:14 pm - 7:29 pm	30.0(9.4)	20.0(5.3)	10.0(2.3)
5A	P	Inspection Lab (Miscellaneous)	4:14 pm - 7:37 pm	4.4(1.4)	XX	4.4(1.0)
5B	P	Inspection Lab (Miscellaneous)	7:39 pm - 10:23 pm	3.6(1.1)	XX	2.7(0.6)

*P = Personal; GA = General Area
**mg/M^3 = milligrams of substance per cubic meter of air sampled.
***Sample not valid (see "Results and Discussion").
p.p.m. = parts of contaminant per million parts of air sampled.
(1) short-term sample collected to determine "ceiling" concentration.
XX - Below detection limit of 0.01 milligram of substance per charcoal tube.