

INDUSTRIAL HYGIENE WALK-THROUGH SURVEY REPORT

of

Union Carbide Corporation
Taft Plant
Taft, Louisiana

SURVEY CONDUCTED BY:
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Industrial Hygiene Section
Industrywide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
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Cincinnati, Ohio

DISCLAIMER

Mention of company or product names in this report does not constitute endorsement by NIOSH.

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PURPOSE OF SURVEY:

To perform a walkthrough industrial hygiene survey of a 1,3-butadiene monomer producing plant and determine the suitability for inclusion in an in-depth exposure survey regarding this substance.

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CONTACTED:

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Representative

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EMPLOYEE REPRESENTATIVES
CONTACTED:

Employees are not unionized.

STANDARD INDUSTRIAL
CLASSIFICATION OF PLANT:

2869 (Industrial Organic Chemicals,
not elsewhere classified)

ABSTRACT

A walk-through industrial hygiene survey was conducted at the Taft Plant of the Union Carbide Corporation in Taft, Louisiana, on June 13, 1984. The purpose of the survey was to obtain information on the 1,3-butadiene monomer manufacturing process and the potential for occupational exposure to this chemical.

The Taft Plant, which started operation in 1967, contains two ethylene production units. The first unit, which was shut down in 1979, produced 1,3-butadiene as an ethylene by-product. The second unit, which has operated since 1978, has a by-product crude C₄ stream containing 1,3-butadiene which is sold to another company. The company has conducted personal and area monitoring for 1,3-butadiene in the newer plant since 1978. Mean time-weighted average exposures were reported to be approximately 2 ppm or less for all job categories associated with butadiene.

The company maintains personnel records on all current and past employees.

INTRODUCTION

Inhalation exposure of rats and mice to 1,3-butadiene induced a carcinogenic response at multiple sites. Mammary fibroadenomas/carcinomas, uterine sarcomas, Leydig cell adenomas of the testes, thyroid follicular cell adenomas, exocrine tumors of the pancreas, and Zymbal gland carcinomas were identified in rats exposed at concentrations of 1,000 or 8,000 ppm of 1,3-butadiene. Mice exposed to 625 or 1,250 ppm of 1,3-butadiene developed a high incidence of malignant lymphomas; an increased incidence of other tumors, including hemangiosarcoma; and testicular and ovarian atrophy.^{1,2}

The offspring of pregnant rats exposed to 1,3-butadiene at 8,000 ppm had major skeletal defects. In addition, fetal toxicity was observed when pregnant dams were exposed at 200 ppm, 1,000 ppm, and 8,000 ppm.³

Epidemiological studies of workers employed in facilities producing styrene-butadiene rubber have indicated an increased, but not statistically significant, risk of mortality from neoplasms of the lymphatic and hematopoietic tissues and from leukemia.^{4,5}

Based on these data, the National Institute for Occupational Safety and Health (NIOSH) recommends that 1,3-butadiene be regarded as a potential occupational carcinogen and teratogen and as a possible reproductive hazard.⁶

Due to the number of workers potentially exposed to 1,3-butadiene and the resulting potential health risk, NIOSH researchers are conducting an extent-of-exposure study of the 1,3-butadiene producing industry.

EXPOSURE EVALUATION CRITERIA

The current legally allowable air concentration enforced by the Occupational Safety and Health Administration for 1,3-butadiene is 1000 ppm for an 8-hour TWA. The American Conference of Governmental Industrial Hygienists (ACGIH), has included 1,3-butadiene in their Notice of Intended Changes for the 1984-85 Threshold Limit Values, based upon reported animal carcinogenicity data. The Intended Change identified 1,3-butadiene as an A2 industrial substance suspected of carcinogenic potential for man. A numerical TLV of 10 ppm was proposed in connection with the notice.⁷

NIOSH in their Current Intelligence Bulletin recommends that 1,3-butadiene be regarded as a potential occupational carcinogen and teratogen and as a possible reproductive hazard.⁶

HISTORY AND DESCRIPTION OF THE PLANT

Union Carbide's Taft plant was constructed in 1966. At present, the plant produces an ethylene by-product (C₄) stream containing 40 to 50 percent 1,3-butadiene. Other products include ethylene oxide, glycols, amines, and a number of specialty chemicals.

The Taft facility has two ethylene production units. The older unit operated from 1967 to 1979. A refined butadiene by-product was produced in this unit via a dimethyl acetamide extraction process. The capacity of this unit was 75 million pounds of refined 1,3-butadiene per year. This unit was shutdown in 1979.

The newer ethylene unit was constructed in 1977-1978 and does not contain facilities for refining the crude butadiene by-product stream. This crude by-product stream is sold to customers at a concentration of 40-50% 1,3-butadiene.

Nearly all of the crude butadiene stream produced at the facility is shipped by marine barge. Very minor quantities are occasionally shipped by rail car. There are no facilities for shipment of 1,3-butadiene via pipeline or truck.

PROCESS DESCRIPTION

Figure 1 is a flow diagram of the Taft Ethylene Unit. The feeds to the Unit are liquid petroleum gas (LPG) and naphtha containing about one percent 1,3-butadiene. In the Ethylene Unit the feed is passed through furnaces and then into a gasoline fractionator where fuel oil is separated out the bottom. The vapor flow out the top of the fractionator contains the 1,3-butadiene and also passes overhead from the Quench Tower downstream. The stream is then compressed with some of the 1,3-butadiene being condensed and passed out the bottom of the Condensate Stripper to the C3 Column. The major flow is into the Methane Column where the 1,3-butadiene flows out the bottom to the C3 Column.

The stream from the bottom of the C3 Column contains the 1,3-butadiene and is fed to the C4 Column. The overhead stream from the C4 Column contains the 1,3-butadiene. This crude butadiene is stored in spheres for customer sales.

DESCRIPTION OF THE WORKFORCE

As of June 1984, the Taft plant had 1,212 employees categorized as follows:

Day	122
Shift	364
Maintenance	302
Exempt (Professional)	332
Clerical	92

The employees are not represented by any union.

A total of 76 employees are assigned to the production of hydrocarbons; of this total 55 are in the process, laboratory, maintenance, or shipping areas where there are potential exposures to 1,3-butadiene. There are four females in the production area and two in the laboratory. An additional 42 workers may be reassigned as necessary from other plant areas to assist the

workers in the ethylene unit. Workers often move from one area to another as a result of promotions or lateral transfers. Some contract service employees enter the ethylene unit.

The daily work schedule for shift workers is comprised of two 12-hour shifts. Maintenance personnel and other staff work an 8-hour day, 5-day week. The workforce is very stable and the average age is about 35 years.

The job descriptions for the 1,3-butadiene production, handling, and loading activities are as follows:

Production Specialist	Observes and documents daily operating conditions and dictates how the equipment is to be run.
Staff Engineer	Performs same functions as production specialist. Also responsible for engineering design and collection of technical data.
Shift Supervisor	Has supervisory responsibility for the production technicians.
Production Technician	Operates the process equipment. Collects quality control samples.
Maintenance Supervisor	Supervises the maintenance workers at each unit.
Laboratory Supervisor	Supervises laboratory technicians.
Laboratory Technician	Analyzes samples in the laboratory and voids sample bombs following analysis.
Distribution Technician	Responsible for spheres and marine loading.

DESCRIPTION OF PAST POTENTIAL WORKER EXPOSURES

During the 17 years of operation at the Taft plant, the ethylene by-product process has been used. From 1967 to 1979, refined 1,3-butadiene was recovered using a dimethyl acetamide solvent. Since 1979, only a C₄ stream containing crude 1,3-butadiene has been produced. This stream is sold to another company for recovery of 1,3-butadiene.

Table 1 is a summary of industrial hygiene personal monitoring data collected by Union Carbide from 1981 to 1984. Table 2 summarizes area monitoring data. These samples were analyzed by the company using a method which had been validated by Union Carbide in the range of 45.6 to 424.5 ppm (Union Carbide has since developed a new analytical method which the company claims has been validated over the range of 0.58 to 424.5 ppm). The

reported personal monitoring data show that the means of the time-weighted average (TWA) exposures for workers in the ethylene unit, marine distribution area, and laboratory were approximately 2 ppm. The reported means of the TWA's for the workers involved with the BTX unit, maintenance operations, and product distribution were equal to or less than 0.35 ppm. The reported area monitoring data show maximum concentrations (less than 2 feet from source) of 14.6 and 59.0 ppm of 1,3-butadiene in the spheres storage and marine vessel loading areas, respectively.

Maintenance on the columns in the ethylene unit is normally performed when the entire process is shut down. The system is isolated and the contents are vented to the flare. Columns are then steamed and nitrogen purged. If entry into columns is necessary, the columns are isolated and ventilated to insure a safe atmosphere. Initial entry is made using fresh air equipment until gas tests prove that the atmosphere is safe for work. After work is complete, the columns are purged with nitrogen again before start up.

Before maintenance operations, pumps are decontaminated by blocking off and venting to the process. The pump is purged with nitrogen after there has been a sufficient drop in pressure.

Quality control samples are taken in the unit with a closed loop sample system. The samples are only taken at the end of the process where the stream concentration of 1,3-butadiene is in the range of 40 to 50 percent. In the laboratory, the bomb is grounded and, under a hood, is fitted to a manifold leading to a gas chromatograph. Any excess is vented to the outside air through the hood. Two samples per day are taken at the production unit. One sample per week is taken at each storage sphere.

Slip-tube gauges are used during the loading of the C₄ stream containing 1,3-butadiene into marine vessels. One barge is normally shipped per month. A gauge is located on each compartment in the barge. The dead air space in the barge is filled with methane to prevent oxidation of the 1,3-butadiene. Excess vapor is vented to the process or to a flare. Union Carbide is currently investigating the use of magnetic gauges in this operation to reduce the potential exposures. Two quality control samples are taken from each compartment of the barge.

Engineering Controls

All of the pumps in the ethylene unit have single mechanical seals backed up by a packing gland. The cavity between the seal and the gland is nitrogen purged to the flare system. Instruments are used to monitor each cavity for leaks, and alarm on low temperatures. Union Carbide believes this system to be equivalent to double mechanical seals, with a 7 year history of satisfactory performance.

DESCRIPTION OF THE MEDICAL, SAFETY, AND INDUSTRIAL HYGIENE PROGRAMS

Medical Programs

The company conducts preemployment physicals on all its employees. These physicals include hearing, vision, lung function, blood, urine, and EKG tests. These tests are repeated at two-year intervals or more frequently at the Taft Plant. In addition, workers in certain departments are given physical examinations every year; the employees in the ethylene plant are included in this category.

Union Carbide has a full-time physician, a registered nurse, and an emergency nurse practitioner at the Taft plant. In addition, there are 3-4 emergency medical technicians on each shift trained in first aid. The company has an agreement for emergency care with a hospital located six miles from the plant.

The company has stored its employee medical records in a Corporate computer system since 1977. The company reported, however, that it would be difficult to relate these records to an employee's job history. There should be notations in the records for 1,3-butadiene workers employed during or since 1977. Collection of records on these individuals occurred because they fell into one of several surveillance categories (benzene) tracked by the company.

Safety Program

Union Carbide has a safety program for the Taft plant. Each employee has the responsibility for identification of potential hazards. The department heads, each of whom is responsible for his area, meet monthly to review safety problems. Each unit also has an area trainer. Maintenance personnel have a daily safety meeting. There has not been a lost-time accident in the past 3.5 million man-hours.

The standard personal protective equipment required by the company includes safety glasses and hard hats. Ear protection is required in designated areas, and respirators are required in the vessel loading area. Respirators are not routinely used in the ethylene production area. Leather gloves are used to protect against abrasion, and decontamination workers wear PVC gloves. The workers pay \$2.00 per pair for the leather gloves; rubber gloves are provided free of charge by the company.

Showers and change areas are available but reportedly not in frequent use. The technician shelter has a kitchen area separate from the work area.

Industrial Hygiene Programs

The plant has a full-time industrial hygienist. Also, there is an industrial hygiene coordinator at each production unit. The latter determines sites and personnel to be monitored. Routine samples are taken

for 1,3-butadiene, benzene, and other products and contaminants. The samples are analyzed at the facility's quality assurance laboratory. The company's internal health standard for 1,3-butadiene is 100 ppm. (Lowered to 10 ppm in October, 1984). Industrial hygiene technicians perform the sampling, and the analytical results are distributed to the shift coordinators and all unit personnel to recommend and implement corrective measures. The company has an internal proficiency analytical testing (PAT) program.

DESCRIPTION OF PERSONNEL RECORD SYSTEM

Union Carbide maintains personnel records on terminated as well as current employees. These records date to 1965 when hiring began for the new plant. Records are maintained for 2,326 current and former nonexempt employees. The records do not contain a direct work history or job description but information concerning these items can be inferred from these records. The records system was computerized in 1983. The personnel records contain the following information:

1. Name
2. Date of birth
3. Social Security number
4. Date of employment
5. Dependents
6. Medical coverage
7. Emergency contact

The corporation obtains death certificates for former employees in order to certify death benefits. Twenty-six death certificates have been registered since 1968.

CONCLUSIONS

Union Carbide manufactures a crude C₄ stream containing 1,3-butadiene as a by-product of the ethylene process at its Taft, Louisiana plant. The production occurs in a closed system, tightly maintained for economic, fire, and health hazard reasons. Virtually all of the product is shipped by marine barge.

The company has conducted personal and area industrial hygiene sampling for 1,3-butadiene since 1978. Mean TWA exposures to 1,3-butadiene are approximately 2 ppm or less for all job categories. The exposures occur in the ethylene unit, the laboratory, and during marine loading operations. The process technicians, maintenance personnel, and lab personnel are exposed to concentrations of 1,3-butadiene (see Table 1). The concentration of 1,3-butadiene in the C₄ product is approximately 40-50%. The plant employs closed-loop sampling techniques for quality control sampling which reduces worker exposure to 1,3-butadiene. Higher concentrations for the workers at the marine loading operation may be the result of the use of slip-tube instead of magnetic gauging for monitoring filling operations.

On the basis of information gathered and observations made during this survey, this facility is suitable for consideration as a possible in-depth survey site.

RECOMMENDATIONS

Consideration should be given to installation of a closed loop quality control sampling system that would reduce the potential for worker exposure during quality control sampling activities in the distribution area.

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TABLE 1.

SUMMARY OF UNION CARBIDE'S PERSONAL AIR MONITORING DATA
FOR 1,3-BUTADIENE, 1981 - 1984

JOB LOCATION/TITLE	NO. OF EMPLOYEES	NO. OF SAMPLES	MEAN TWA* PPM	RANGE PPM	SHORT-TERM EXPOSURE LIMIT PPM
BTX unit/technician	8	11	0.35	0.3-0.6	1.0
Olefins/technician	74	12	2.02	0.3-34.9	0.3
Laboratory/technician	14	2	2.06	3.5	156.0
Maintenance/technician	29	5	0.3	0.3	-
Distribution (spheres)/ technician	5	6	0.3	0.3-0.6	2.4
Distribution (marine)/ technician	17	10	1.9	0.3-3.7	55.9

*Time-weighted average (time period not specified).

TABLE 2 SUMMARY OF UNION CARBIDE'S AREA MONITORING DATA
FOR 1,3-BUTADIENE, 1981 - 1984

LOCATION	GENERAL AREA		SOURCE (2 feet)	
	AVERAGE, PPM	RANGE, PPM	AVERAGE, PPM	RANGE, PPM
BTX Unit	0.4	0.3 - 0.7	10.4	-
Olefins	0.9	0.3 - 3.4	1.3	0.3 - 3.8
Laboratory	0.3	0.3	0.7	0.3 - 0.1
Distribution (spheres)	0.3	0.3	14.0	0.3 -59.0
Distribution (marine)	18.0	0.3-46.0	8.0	1.4 -14.6

NOTE: Number of samples and sample duration was not reported .