INDUSTRIAL HYGIENE WALK-THROUGH SURVEY REPORT

of

TEXACO CHEMICAL COMPANY
Neches Butane Products Plant
Port Neches, Texas

SURVEY CONDUCTED BY:
John M. Fajen

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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
Centers for Disease Control
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DISCLAIMER

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

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PURPOSE OF SURVEY:	To perform a walk-through 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.
EMPLOYER REPRESENTATIVES CONTACTED:	Kathy Amanollahi, Senior Industrial Hygienist, Safety Department
	R. G. Brown, Plant Manager
	Walter Chatelain, Jr. Safety Department
	Larry Howard, Safety Department
	Louis M. Matthews, Superintendent, Planning and Shipping
	Jan McCown, Safety Department
	Dave R. Sheil, Attorney
	M. M. Simer, Manager, Safety Department
	Val Soter, Supervisor, Labor Relations
	Patti Wilson, Safety Department
EMPLOYEE REPRESENTATIVES CONTACTED:	Davie Hutto, Committeeman, Technician Control Union
	Cecil Oubre, Shop Steward, Carpenters Local 610
	Ronald Robinson, Assistant Steward Pipefitters Local 195
	John Tuohy, Shop Steward, Instruments, IBEW Local 390
	D. Williams, Shop Steward, Boilermakers Local 305
	Dennis Wills, Committeeman, OCAW Local 4-228
STANDARD INDUSTRIAL CLASSIFICATION OF PLANT:	2869 (Industrial Organic Chemicals, not elsewhere classified)

ABSTRACT

A walk-through survey was conducted at Texaco Chemical Company's Neches Butane Products Plant in Port Neches, Texas, on June 12, 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 compound.

The plant, which opened in 1945, began producing 1,3-butadiene by dehydrogenation of a butane/butylene feed. In 1970, the plant switched to the ethylene coproduct recovery process using a betamethoxy propylnitrile (BMOP)/furfural extraction solvent.

The company has conducted extensive sampling for 1,3-butadiene over the last four years. In 1984, Texaco Chemical Company adopted a voluntary internal exposure limit of 10 ppm for eight hour time-weighted averages (TWA). Reported monitoring data for twelve different job categories show arithmetic mean 8-hour time-weighted averages at 5 ppm or below for ten job categories. The arithmetic mean TWAs for pipefitters and machinists are 47 ppm and 23 ppm, respectively. These higher means appear to be due primarily to two high measurements. Geometric means for all job categories are 2 ppm or below.

The company maintains personnel records from 1943 to the present 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 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 workers exposed to the 1,3-butadiene monomer.

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 the 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

The Neches Butane Products Co. began production of 1,3-butadiene in 1945 by the dehydrogenation of butane and butylene feedstocks. The facility in Port Neches was one of the plants developed by the Reconstruction Finance Corporation during World War II. The company received management and

engineering assistance from five area refineries: Socony-Vacuum Oil Company, Atlantic Refinery Company, Texaco, and Pure Oil (Union Oil of California). Texaco, Gulf, U.S. Rubber Co., B.F. Goodrich Chemical Company later bought the company as a partnership. By January, 1981, Texaco had bought out all other partners.

In March, 1980, the dehydrogenation process was shut down and the plant began recovering 1,3-butadiene from ethylene coproduct C_4 feedstocks purchased from outside producers. The nameplate capacity of the plant is 600 million pounds per year of 1,3-butadiene. The production rate at the time of the survey was 300 million pounds per year of 1,3-butadiene. Methyl tertiary butyl ether (MTBE) is also produced. No other major products are produced at the facility. The 1,3-butadiene facility covers 10 acres of the 200-acre plant.

The C_4 feedstock is received from other generators by pipe, marine vessel, rail, and truck. The majority is received via ship or barge. The 1,3-butadiene monomer product is shipped primarily by pipeline to other plants in Orange and Port Neches, Texas. Small quantities are shipped by barge and rail. None of the 1,3-butadiene is consumed at the plant.

PROCESS DESCRIPTION

Figure 1 is a simplified flow diagram of the 1,3-butadiene production process. The crude ethylene product (C_4) feed is a blend of C_4 streams from several plants. The extraction solvent used is betamethoxy propylnitrile (BMOP) with furfural. The finished 1,3-butadiene has a purity greater than 99 percent, and is stored in pressurized storage tanks. Storage capacity for 1,3-butadiene is 106,000 barrels.

The process includes on-line gas chromatographs for quality control determinations. In addition, manual open loop bombs samples are taken of the feed, intermediates, and product to ensure quality.

DESCRIPTION OF THE WORKFORCE

The Neches Butane Products Co. operates 24 hours a day, 7 days a week, on a 8-hour rotating shifts. Maintenance personnel work during the day shift 5 days a week. Laboratory personnel work 7 days a week two shifts per day.

The operation workforce consists of A and B Operators, Shift Superintendents, File Inspectors and Shift Foremen. A Operators are responsible for unit operation and process sampling. B Operators have the same responsibility as A Operators, except they have less training and seniority.

DESCRIPTION OF PAST POTENTIAL WORKER EXPOSURES

For the first 25 years of the plant's operation, 1,3-butadiene was produced by dehydrogenation of a butane/butylene feed. For the last 14 years, 1,3-butadiene has been produced from ethylene coproduct C_4 streams received from outside producers.

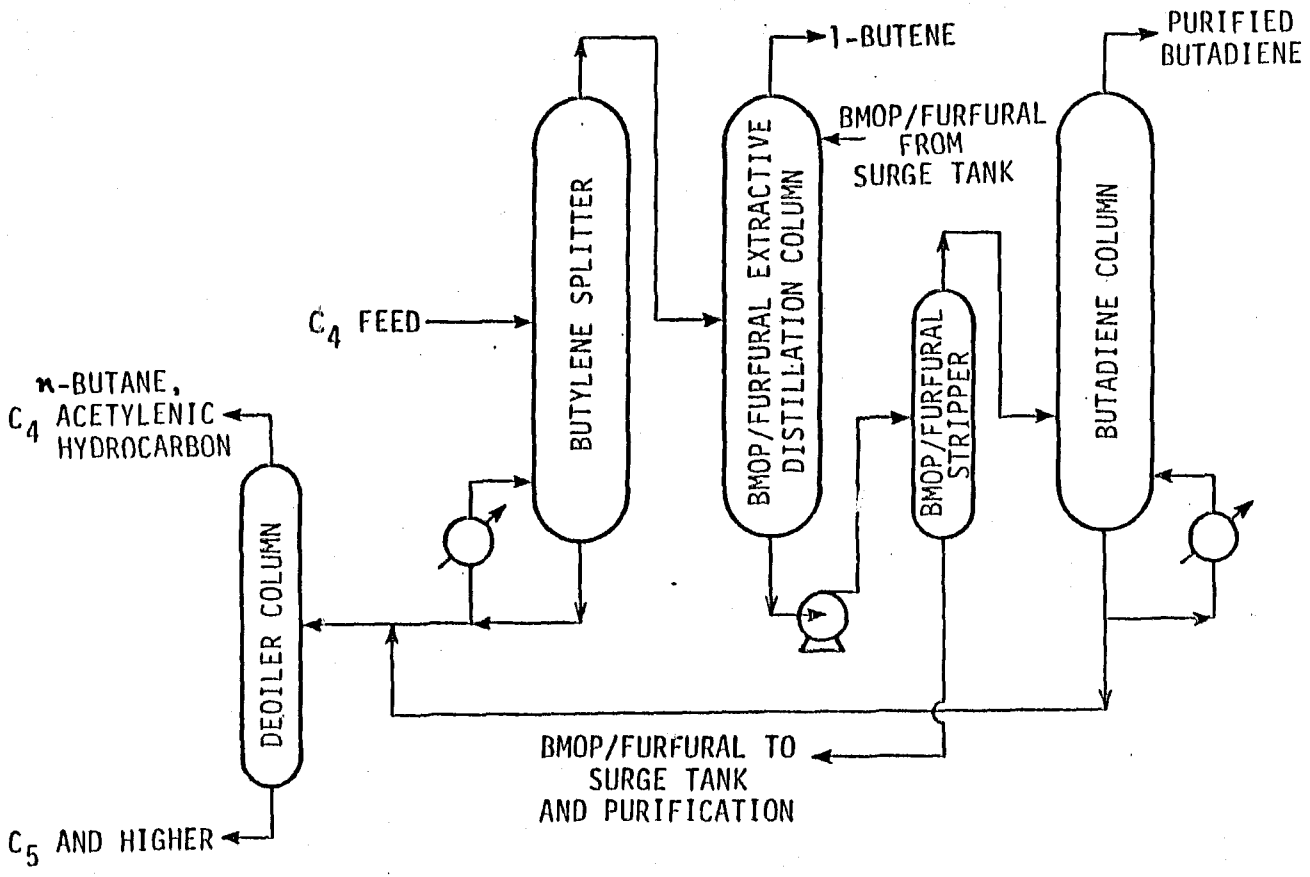

Figure 1. Simplified flow diagram for production of 1,3-butadiene monomer by ethylene coproduct process at Texaco's Port Neches, Texas plant.

Industrial hygiene data on 1,3-butadiene is available for the period 1981 through 1984. Personal monitoring data is also collected for benzene. Other chemicals which have been sampled include various C_4's, total hydrocarbons, styrene, acrylonitrile, and furfural. Table 1 presents Texaco's 1,3-butadiene personal air monitoring data for different job categories. The reported arithmetic mean 8-hour TWAs for 10 of the 12 job categories are at or below 5 ppm. Arithmetic mean 8-hour TWA exposures above 5 ppm are observed for pipefitters and machinists. These higher means appear to be due primarily to a few high measurements. Geometric mean TWA's for all job categories are at or below 2 ppm.

The sampling and analytical method used was NIOSH Method S91. Samples were taken using charcoal tubes in line with low flow pumps. After collection, the samples were refrigerated and analyzed at Texaco's Port Arthur Research Laboratory. There is reportedly interference from C_4 compounds in the analytical procedure.

The method used by Texaco for obtaining quality control samples at the time of the survey was the open-loop sampling technique. This technique involves releasing some of the 1,3-butadiene from the sampling bomb to the atmosphere. However, the company reported that they were planning on implementing a closed-loop sampling system which would circulate the 1,3-butadiene to the process. After laboratory analyses of quality control samples, samples are purged under a hood in the laboratory.

Steam cleaning is used for decontamination of pumps and other equipment. Waste material, removed during tower maintenance operations, is treated as hazardous waste and taken to a certified waste site for disposal.

Monitoring of the rail tank car loading process is performed with magnetic gauges. The magnetic gauge is a sealed metering system which prevents the release of 1,3-butadiene from the tank cars, and eliminates the potential for worker exposure. Closed rotametric gauges are used for monitoring tank truck filling operations.

Engineering Controls

All pumps have single mechanical seals to prevent leakage, with the exception of one new pump which employs the more effective dual mechanical (tandem) seal.

DESCRIPTION OF MEDICAL, SAFETY, AND INDUSTRIAL HYGIENE PROGRAMS

Medical Program

The company conducts pre-employment physicals on all its employees. Periodic physical examinations are available to all employees. These examinations are voluntary, with the exception of annual hearing tests. Other tests available include vision, lung function, blood, urine, and EKG.

The plant has a part-time physician on site 1/2 day, five days a week. In addition, there are 2 full-time registered nurses and one part-time registered nurse at the plant. There is at least one employee in each shift trained in emergency first aid. The company has an agreement with a local hospital for emergency care.

Safety Program

The company has an organized safety program. The program is periodically reviewed by the Occupational Safety and Health Administration (OSHA). The company has established a safety committee where union and management can discuss safety related problems. The chairman of the safety committee reports directly to the plant manager. Safety meetings are held monthly. The safety group also has responsibility for issuing work permits.

The personal protective equipment required by the company include hard hats, safety goggles, and PVC/neoprene gloves. Supplied air respirators are located throughout the unit. The employees are required to wear organic vapor canister respirators and gloves only during decontamination, maintenance, and sampling activities. Supplied air respirators are required for some maintenance activities. Showers and change areas are available, but reportedly not in frequent use.

Industrial Hygiene Program

The industrial hygiene program is responsible for keeping up to date toxicity information on the chemicals handled in the plant. Personnel monitoring is conducted for 1,3-butadiene and benzene. Sampling for 1,3-butadiene began in 1981. Other sampling has included various C_4's, total hydrocarbons, styrene, acrylonitrile, and furfural.

DESCRIPTION OF PERSONNEL RECORD SYSTEM

Texaco maintains personnel records on all terminated as well as current employees. The records include the department and pay classification for each employee, but do not provide job descriptions. Illnesses lasting more than 5 days are recorded with the reason, but not the employee's name. The company keeps records on employees' relatives who file for death benefits. A morbidity and mortality report is given to the Oil, Chemical and Atomic Workers Union. Five of the six unions which represent workers at the plant have death benefits and maintain records on deaths of members. Death certificates are filed with the company with a copy sent to the insurance company for all who file for benefits. Death benefits began in 1962.

CONCLUSIONS

The Texaco Chemical Company's Neches Butane Products Plant manufactures 1,3-butadiene from ethylene coproduct C_4 streams received from off-site plants. Extraction is done with BMOP and furfural. The production occurs in a closed system, tightly maintained for both economic and fire hazard reasons.

The company has conducted industrial hygiene sampling for 1,3-butadiene from 1981 through 1984. Reported arithmetic mean TWA exposures to 1,3-butadiene are at 5 ppm or below for all job categories except pipefitters and machinists. These groups have mean TWAs of 47.4 ppm and 23 ppm, respectively. Geometric mean TWA exposures to 1,3-butadiene for all job categories are at or below 2 ppm.

Texaco employs a number of controls to reduce worker exposure during various activities. The laboratory is equipped with exhaust hoods. All pumps have single mechanical seals, except one new pump which has a tandem seal. Rail tank car loading is monitored using magnetic gauges while tank truck loading is monitored via closed rotametric gauges. In addition, installation of closed-loop sampling systems is planned for obtaining quality control samples.

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

RECOMMENDATIONS

Texaco, after the closed loop sampling system has been designed into the process, should continue to monitor for 1,3-butadiene to determine the effectiveness of the closed system.

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TABLE 1. SUMMARY OF TEXACO'S MONITORING RESULTS FOR 1,3-BUTADIENE, 1981-1984

Job title	No. of samples	8-hour TWA*, ppm Range	Geometric mean	Arithmetic mean
Pipefitter	44	0.01 - 606.56	1.7	47.44
Boilermaker	52	0.01 - 16.46	0.17	1.54
Operator	77	0.01 - 159.49	1.06	5.06
Operator helper	13	0.16 - 34.40	0.71	3.89
HD operator	41	0.13 - 22.00	1.26	3.65
Instruments	2	1.67 - 2.32	1.97	2.00
Electric instruments	7	0.14 - 1.90	0.47	0.78
Machinist	7	0.12 - 159.63	0.71	23.19
Technical lab	14	0.01 - 6.30	0.23	1.18
Non-technical lab (includes yard)	40	0.16 - 22.49	1.80	4.24
Foreman	11	0.01 - 7.23	0.43	1.01
Laborer	4	0.01 - 3.69	0.32	1.48

* Time-weighted average.