

INDUSTRIAL HYGIENE WALK-THROUGH SURVEY REPORT

of

El Paso Products Company  
Corpus Christi Butadiene Plant  
Corpus Christi, Texas

SURVEY CONDUCTED BY:  
John M. Fajen

DATE OF SURVEY:  
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<b>15. Supplementary Notes</b>					
<b>16. Abstract (Limits 200 words)</b> A walkthrough survey of El Paso Products Company (SIC-2869), Corpus Christi, Texas, was conducted in July, 1984. The purpose of the survey was to obtain information on the 1,3-butadiene (106990) monomer manufacturing process and to assess the potential for exposure to 1,3-butadiene. The company recovered 1,3-butadiene from crude ethylene coproduct C4 streams supplied by outside facilities. The production process was enclosed. The process line contained on line gas chromatographs for quality control. Some manual samples of the feed, intermediate, and products were also taken. Engineering controls consisted of single or dual mechanical seals on all pumps. The company did not have a medical program. Preemployment physicals were required for all non office employees. All employees were trained in first aid. Personal protective equipment required by the company included safety glasses, hard hats, and polyvinyl-chloride gloves. The company conducted industrial hygiene sampling for 1,3-butadiene in 1982 and 1984. The data showed time weighted average butadiene concentrations of 0.23 to 8.5 parts per million (ppm). Short term samples showed a 50ppm exposure in the dock area. The author concludes that a potential for 1,3-butadiene exposure exists at the facility. Installation of a quality control sampling system that can reduce 1,3-butadiene exposure is recommended.					
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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:

Ray Finch, Director of Environmental  
and Regulatory Affairs

Arnold Pettijohn, Plant Director

W.N. Whittaker, Production Manager

Ralph Clark, Technical Manager

Bob McNeely, Safety Manager

EMPLOYEE REPRESENTATIVES  
CONTACTED:

Employees 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 Corpus Christi Butadiene Plant of El Paso Products Company in Corpus Christi on July 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 chemical.

The plant, which opened in 1980, recovers 1,3-butadiene monomer from crude ethylene coproduct  $C_4$  streams supplied by other petrochemical plants. Most of the feedstock comes from the ethylene units at the neighboring Corpus Christi Petrochemicals plant.

The company has a total of 29 employees, including administrative and supervisory personnel. Limited personal monitoring data, obtained in 1984 show that the mean of the time-weighted average (TWA) exposures to 1,3-butadiene for all job categories is 3.8 ppm. The monitoring data ranged from 0.23-8.5 ppm.

## 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.<sup>1,2</sup>

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.<sup>3</sup>

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.<sup>4,5</sup>

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.<sup>6</sup>

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 monomer 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.<sup>7</sup>

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.<sup>6</sup>

## HISTORY AND DESCRIPTION OF THE PLANT

The Corpus Christi Butadiene Plant is a relatively new plant compared with other 1,3-butadiene monomer producing plants. The plant was built in 1980

over a total area of approximately 60 acres. The plant has a nameplate capacity of 200 million pounds per year of 1,3-butadiene. 1,3-butadiene is the only chemical produced at the plant.

El Paso Products Company is the owner of the plant. Until January 1, 1984, the El Paso Products Company was a subsidiary of the El Paso Company. The headquarters of El Paso Products Company is located in Odessa, Texas.

The Corpus Christi Butadiene Plant receives most of its ethylene coproduct (C<sub>4</sub> crude) feedstock via pipeline from the Corpus Christi Petrochemicals plant located adjacent to the butadiene plant. Phillips is another supplier of crude C<sub>4</sub> feedstock. The 1,3-butadiene product is transferred by pipeline to a loading facility 11 miles away. At the loading facility it is shipped via rail tank cars to several customers.

#### PROCESS DESCRIPTION

Figure 1 is a flow diagram of the 1,3-butadiene production process. The licensed Nippon-Zeon Japanese process has been adopted for production of 1,3-butadiene. The crude C<sub>4</sub> feed to the process is a blend of C<sub>4</sub> streams from the neighboring Corpus Christi Petrochemicals plant's ethylene unit and other producers. The 1,3-butadiene content of the feed stream varies from 40 to 70 percent. As shown in Figure 1, the process equipment consists of extractors, strippers, recovery/refining columns, and fractionators. Dimethyl formamide (DMF) is the extraction solvent used. The raffinate stream from the first extractor is composed mainly of butanes and butylenes, and is returned to the Corpus Christi Petrochemicals plant. The DMF solvent extracts 1,3-butadiene and acetylenes and this stream is processed for further purification. The second extractor is a smaller extraction system designed to pick up less saturated compounds which are recovered for use as fuel. The solvent, which has a tendency to pick up water, is regenerated in the solvent refining column. The first fractionator in the butadiene purification section purges low boiling materials, whereas heavies are rejected for use as fuel in the second fractionator. Tertiary butyl catechol is used as a polymerization inhibitor. The 1,3-butadiene product has a purity of greater than 99 percent, and is stored in tanks. The towers used for processing 1,3-butadiene are equipped with safety relief valves which vent to flares, thus minimizing the potential for worker exposure. Relief valves on storage tanks vent to the atmosphere, and have rupture discs sealing the inlets to prevent leakage.

The process includes on-line gas chromatographs for quality control. In addition, manual quality control samples are also taken of the feed, intermediates, and products on a routine basis.

EXTRACTIVE DISTILLATION SECTION

DISTILLATION SECTION

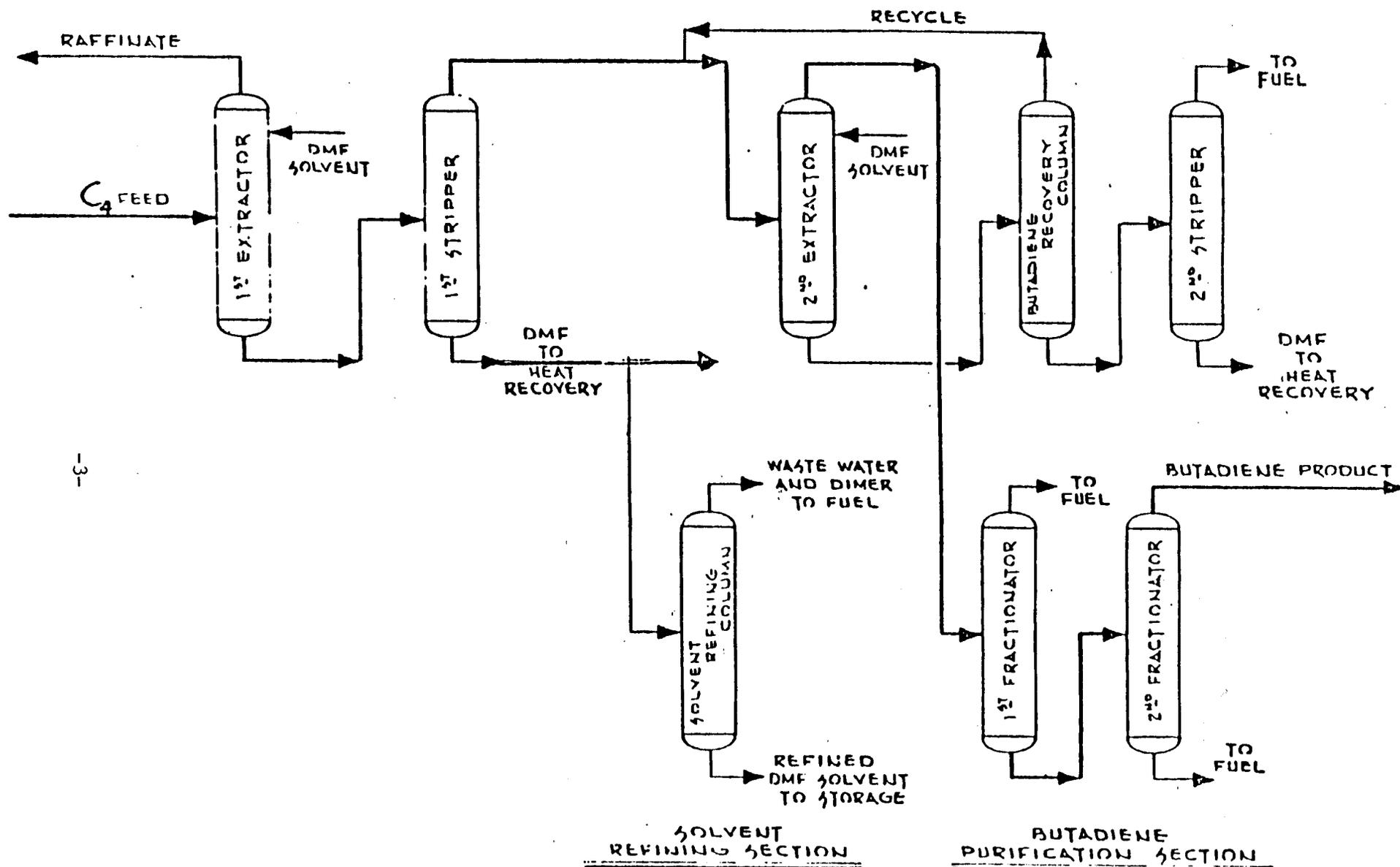


Figure 1. Flow diagram for production of 1,3-butadiene at El Paso Products Company's Corpus Christi, Texas, plant.

## DESCRIPTION OF THE WORKFORCE

The Corpus Christi Butadiene Plant of the El Paso Products Company opened in 1980 with 37 employees. As of June 1984, the plant had a workforce of 29 employees. In addition, there is a contract electrician on site. Job titles for administrative and support personnel include Plant Director, Technical Manager, Production Manager, Maintenance Supervisor, Area Engineer, Secretary, and Storekeeper.

The production employees work an 8-hour rotating shift with 4 people on each shift. In addition, there are two pump mechanics and an instrument man on the day shift. The job descriptions for the production activities are as follows:

Lead Operator	Directs the production crew and fills in during crew members' vacations or illnesses. Manages the Volatile Organic Compounds (VOC) emissions program at the plant.
A Board Operator	Oversees control room activities.
B Lab Operator	Takes quality control samples and analyzes them.
C Process/Utility Operator	Monitors process operation, decontaminates process equipment, voids sample bombs, and collects data for VOC emissions program.

El Paso Products Company practices an Operator Progression Program, wherein the A Board Operator, B Lab Operator, and C Process/Utility Operator rotate jobs once every 3 months. Thus, an individual is capable of performing all three jobs.

In addition to the four job categories described above, there are two loading dock operators and one relief operator. These operators, who work during the day shift only, also rotate jobs periodically.

The company has a total of four maintenance personnel on the day shift. Contract maintenance personnel are brought in on a temporary basis for cleaning and/or repair of major process equipment.

The average age of employees at the Corpus Christi Butadiene Plant is 30 years. The employees are not represented by any union.

## DESCRIPTION OF PAST POTENTIAL WORKER EXPOSURES

During the 4 years of 1,3-butadiene production at the plant, there have been no modifications to the Japanese DMF extraction process which recovers 1,3-butadiene from C<sub>4</sub> ethylene coproduct streams.

Industrial hygiene data on 1,3-butadiene is available from two sampling surveys conducted by the El Paso Products Company in September 1982 and February 1984. In addition to 1,3-butadiene, monitoring was also conducted for DMF. The first survey consisted of 3-minute grab samples taken in the plant and dock areas using a Bendix Gastec pump. The limit of detection of the method was 50 ppm. No 1,3-butadiene concentrations of 50 ppm were detected near the pumps on the product storage spheres. The 1984 survey consisted of personal monitoring on five different operators using 3M diffusion monitor badges. Table 1 presents the limited results of the 1984 sampling survey. The 8-hour TWA's are below 10 ppm of 1,3-butadiene for all job categories. The lab operator has the highest exposure to 1,3-butadiene (8.5 ppm).

The method used for collecting quality control samples consists of 1) attaching a sample bomb to a fitting in the 1,3-butadiene line, 2) filling the bomb, and 3) releasing some of the pressure in the bomb to the atmosphere. The third step could result in high exposure to the lab operator in charge of obtaining the samples. Three samples each of 1,3-butadiene product and the C<sub>4</sub> feed stream are taken every day at the plant. In addition, one sample of the product is obtained daily from the loading dock. Following analysis, the sample bombs are voided outdoors by the process/utility operator by flushing with steam for 15 to 20 seconds and purging to a flare.

Decontamination and maintenance of process equipment are major activities in the 1,3-butadiene plant area. The towers were designed for a 4-year turnaround maintenance schedule, but are required more frequent maintenance because of "popcorn" polymer contamination problems. Pumps and valves are checked for leaks on a monthly basis. Pumps are decontaminated by blocking off and purging with nitrogen to a flare (for C<sub>4</sub> streams) or to a closed drain system (for DMF). Steam cleaning is employed only for the towers.

Approximately one-third of the rail tank cars in the loading facility are equipped with magnetic gauges for monitoring filling operations. The rest are monitored via slip tube gauges which have the potential for direct release of 1,3-butadiene to the atmosphere.

### Engineering Controls

Dual mechanical seals, with glycol as the circulating fluid, are used for pumps handling DMF. These dual seals provide excellent protection from leakage. The pumps on the two butadiene purification fractionators have single mechanical seals.

DESCRIPTION OF THE MEDICAL, SAFETY, AND INDUSTRIAL  
HYGIENE PROGRAMS

Medical Program

The plant does not have a medical program. Pre-employment physicals are required on employees other than office staff. No periodic physicals are required. There is a physician on call who responds to injuries or job-related illnesses of employees. Employees on all shifts are trained in first aid. Copies of all medical records of the employees are maintained with the on-call physician, the plant, and the company headquarters at Odessa, Texas. Urine monitoring for DMF levels has been conducted on production employees.

Safety Program

The company has a safety program, although there is no safety manager at the plant. The company's safety manager is located in Bayport, Texas. Monthly safety meetings are held for production as well as maintenance personnel. Periodically, the employees are shown safety films. Employees are advised of new safety procedures either during the meeting or through a memorandum. The company has safety manuals for entry into equipment and for hot work and other activities. Weekly safety checks are conducted for each shift. Training programs are conducted annually for educating employees in cardiopulmonary resuscitation, first aid, and fire fighting.

The personal protective equipment required by the company includes safety glasses, hard hats, and PVC gloves for handling DMF. Self-contained Scott respirators are available but seldom needed. Employees are not allowed to wear tennis shoes or sleeveless shirts in the plant. Beards are also not acceptable. Showers and change areas are available. Smoking is permitted in designated areas only.

Industrial Hygiene Program

The plant does not have a specific industrial hygiene program. Product safety is handled by the Director of Environmental and Regulatory Affairs for the company, who is located in Odessa, Texas.

Two industrial hygiene surveys for 1,3-butadiene and DMF were conducted by the company in 1982 and 1984. These were designed and carried out by the Safety Manager from the Bayport, Texas location. The first survey consisted of short-term area samples, whereas the second survey consisted of 8-hour TWA exposure monitoring for various job categories. There is also a monthly VOC emissions monitoring program which is designed to limit total hydrocarbons fugitive emissions at the plant.

## DESCRIPTION OF PERSONNEL RECORD SYSTEM

El Paso Products Company maintains personnel records on terminated as well as current employees. The records are forwarded to the company headquarters in Odessa, Texas. There are records of about 40 employees. Records of employees who have been terminated or laid off prior to January 1, 1984, are available from the El Paso Company which previously owned the plant. Job titles have recently been eliminated from the personnel records.

Shift schedules prepared for each employee contain the work history for that employee. Every time the classification of an employee changes, a new schedule is generated. The shift schedules also include the following information:

1. Name
2. Seniority date
3. Date of employment
4. Date of change to a different classification

Benefits offered by the company include life and accidental death insurance. Death certificates are handled at the Odessa, Texas, headquarters.

## CONCLUSIONS

The Corpus Christi butadiene plant of the El Paso Products Company recovers 1,3-butadiene from crude C<sub>4</sub> ethylene coproduct streams supplied by outside plants. The production occurs in a closed system, tightly maintained for both economic and safety reasons.

The company has conducted industrial hygiene sampling for 1,3-butadiene in 1982 and 1984. Short-term samples taken in the plant and dock areas showed detectable concentrations (50 ppm) of 1,3-butadiene only at one location in the dock area. TWA exposures to 1,3-butadiene were below 10 ppm for all job categories. There is some concern regarding exposure to lab operators who collect quality control samples using open-loop sampling procedures. Monitoring of the rail tank car loading operation is done by either slip-tube or magnetic gauges; the former could result in high exposure to 1,3-butadiene for the dock operators.

## RE COMMENDATIONS

Consideration should be given to installation of a quality control sampling system that works to reduce the potential for 1,3-butadiene exposure during sampling activities.

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TABLE 1

SUMMARY OF EL PASO PRODUCTS COMPANY'S  
 AIR MONITORING RESULTS FOR 1,3-BUTADIENE, 1984\*

<u>JOB TITLE</u>	<u>8-hour TWA **PPM</u>
Process/Utility operator	0.71
Lab Operator	8.5
Dock Operator	2.7
Dock Operator	6.8
Lead Operator	0.23

\* Sampling Method - Passive Dosimeters

\*\* Time-weighted average