PB86-225398

Industrial Hygiene Walk-Through Survey Report of Firestone Synthetic Rubber and Latex Company Lake Charles, Louisiana

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Dates of Survey:
July 31, 1985

Date of Report:
March, 1986

Report Number:
147.28

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
Cincinnati, Ohio

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	PB86-225398

4. Title and Subtitle

Industrial Hygiene Walk-Through Survey Report Of Firestone Synthetic Rubber And Latex Company, Lake Charles, Louisiana

5. Report Date 85/03/00

6.

7. Author(s) Fajen, J. M., and L. J. Ungers

8. Performing Organization Rept. No. IWS-147-28

9. Performing Organization Name and Address

Division of Surveillance, Hazard Evaluations and Field Studies, NIOSH, U.S. Department of Health and Human Services, Cincinnati, Ohio

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.

(C)

(G)

12. Sponsoring Organization Name and Address

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

A walk through survey was conducted at the Firestone Synthetic Rubber and Latex Company (SIC-2822), Lake Charles, Louisiana in July, 1985 The purpose of the survey was to obtain information on the 1,3-butadiene (106990) polymer manufacturing process and evaluate exposure potential. Bulk samples of vinylpyridine latex (VPL), styrene/butadiene rubber (SBR), and polybutadiene rubber (PBR) were analyzed for residual 1,3-butadiene. SBR and PBR were produced by solution polymerization. VPL was produced by reacting styrene, 1,3-butadiene, and a soap solution. Engineering controls included single mechanical seals on 1,3-butadiene pumps and slip/tube gauges to monitor 1,3-butadiene on barges and in tank cars. No 1,3 butadiene was detected in bulk samples of PBR. The SBR samples contained 0.04 to 0.2 nanogram per milligrams (ng/mg). The VPL sample contained 16.5ng/mg 1,3-butadiene. Company air sampling data showed mean time weighted average 1,3-butadiene exposures for all job categories to be 0 14 part per million. The company maintained personnel records on both current and terminated employees. The authors conclude that the work environment at the facility presents a potential for exposure to 1,3-butadiene. An in depth survey is recommended. The open loop sampling systems used in quality control analyses should be replaced by closed loop systems.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

NIOSH-Publication, NIOSH-Author, NIOSH-Survey, Field-study, Rubber-industry, Breathing-zone, Air-sampling, Monitoring-systems, Exposure-levels, Hazardous-materials, Chemical-composition, IWS-147-28

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages 22
	20. Security Class (This Page)	22. Price

(See ANSI-Z39.18) OPTIONAL FORM 272 (4-77)

DISCLAIMER

Mention of company or product name in this report does not constitute endorsement by the National Institute for Occupational Safety and Health (NIOSH).

ACKNOWLEDGEMENTS

This report was prepared in cooperation with PEI Associates, Inc. The prinicipal PEI authors were Mark Nutter, Radha Krishnan, and Les Ungers. Their responsibilities during this investigation were completed under the scope of work of Contract No. 68-02-3976, Task 24 with the U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, D.C.

The analysis of the bulk samples was conducted by Ardith A. Grote, Chemist, Division of Physical Sciences and Engineering, National Institute for Occupational Safety and Health.

PURPOSE OF SURVEY:	To perform a walk-through industrial hygiene survey of a 1,3-butadiene polymer producing plant and determine the suitability for inclusion in an in-depth exposure survey regarding this substance.
EMPLOYER REPRESENTATIVES CONTACTED:	Leonard Burge, Plant Manager Jim McAdoo, Environmental Coordinator Ben Trahan, Personnel Manager Bill E. Slade, Quality Manager John Perrodin, Safety Engineer Colin K. Ringle, Plant Engineer
EMPLOYEE REPRESENTATIVES CONTACTED:	C.O. McGuire, Insulator, Lake Charles Metal Trades Robert Gremillian, Machinist, International Association of Machinists
STANDARD INDUSTRIAL CLASSIFICATION (SIC) CODE:	2822 - (Synthetic Rubber [Synthetic Elastomers])

ABSTRACT

A walk-through industrial hygiene survey was conducted at Firestone Synthetic Rubber and Latex Company in Lake Charles, Louisiana, on July 31, 1985. The purpose of the survey was to obtain information on the 1,3-butadiene polymer manufacturing process and assess the potential for occupational exposure to 1,3-butadiene. This information will be used in determining the suitability for inclusion of this facility in an in-depth survey regarding this substance.

The plant, which opened in 1943, began producing styrene butadiene rubber (SBR) by the emulsion process. The plant currently produces SBR and polybutadiene rubber (PBR) by solution polymerization. Vinyl pyridine latex (VPL) has also been produced at Firestone since 1981. The SBR/PBR end-product is a flake or crumb which is baled and packaged in crates for shipment. The VP latex is piped to tank cars or tank trucks from storage facilities.

The company has conducted personal air sampling for 1,3-butadiene since January 1976. Results of personal air monitoring by job categories showed the arithmetic mean time-weighted average (TWA) exposure for 56 personal samples to be approximately 0.14 ppm. The company maintains personnel records on both current and terminated employees.

The NIOSH analytical results of the analysis of the bulk samples of VPL, PBR, and SBR for residual 1,3-butadiene were non-detectable for polybutadiene at 30°C, 100°C, and 180°C. Trace amounts (0.04-0.2 ng/mg by weight) were found in the SBR samples at the same three temperatures. 1,3-butadiene was also detected at 16.5 ng/mg by weight at 30°C in the VPL bulk sample.

Firestone is considered a potential candidate for an in-depth industrial hygiene survey for the determination of the extent of exposure to 1,3-butadiene. The consideration is based on the historical industrial hygiene data.

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 1000 to 8000 ppm of 1,3-butadiene. Mice exposed to 625 or 1250 ppm of 1,3-butadiene developed a high incidence of malignant lymphomas; and 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 8000 ppm had major skeletal defects. In addition, fetal toxicity was observed when pregnant dams were exposed at 200 ppm, 1000 ppm, and 8000 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 workers potentially exposed to the monomer during production of 1,3-butadiene based products.

EXPOSURE EVALUATION CRITERIA

The current Permissible Exposure Limit (PEL) enforced by the Occupational Safety and Health Administration (OSHA) for 1,3-butadiene is 1000 ppm for an 8-hour time-weighted average (TWA).[7] The American Conference of Governmental Industrial Hygienists (ACGIH) has included 1,3-butadiene in their Notice of Intended Changes for the 1985-1986 Threshold Limit Values (TLVs) based upon reported animal carcinogenicity data.[8] The intended change identified 1,3-butadiene as an "A2" industrial substance suspected of carcinogenic potential in man. A numerical TLV of 10 ppm was proposed in connection with the notice.

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

Firestone Synthetic Rubber and Latex Company, owned by Firestone Tire and Rubber Company, began operation in 1943 at Lake Charles, Louisiana, producing styrene butadiene rubber (SBR) by an emulsion process. This operation has been shut down since February, 1983. The Lake Charles plant currently produces three polymers from 1,3-butadiene via solution polymerization process: SBR, polybutadiene rubber (PBR), and vinyl pyridine latex (VPL) via emulsion polymerization. Current production processes are: a SBR/PBR solution process which came on-line in 1968, and a VPL process installed in 1981. The facility occupies 79.2 acres and is capable of producing 120,000 metric tons of SBR/PBR and 1,800 metric tons of VPL annually. The plant has not been operating at capacity over the preceding 12 month period (July 1984 to June 1985).

All three 1,3-butadiene polymers are captively used by Firestone in their tire production plants. SBR is used primarily in tire treads. PBR is used to produce tire carcasses and sidewalls. The VPL is used as a binding material for tire cords.

PROCESS DESCRIPTION

Production of SBR and PBR is carried out on the same process line; the major difference is that PBR production does not use styrene. The 1,3-butadiene is received via pipeline from barge loading docks. In the production process (see Figure 1), 1,3-butadiene and the solvent (paraffinic hydrocarbon) are purified in fractionating columns, then blended with styrene and polymerized in the presence of a catalyst in a reaction vessel. After a reaction period, the resulting slurry (cement) may be treated with an extender oil depending on the desired end product. In the solvent recovery area, the paraffinic hydrocarbon solvent is driven off by steam and recovered. The rubber cement product is sent to finishing where it is dried into a sheet or crumb, and compressed into 75 pound bales wrapped in film and crated for shipping.

In the production of VP latex (see Figure 2), styrene, 1,3-butadiene, catalyst, and soap solution are combined with vinyl pyridine monomer in a reaction vessel. After the reaction period, the unreacted 1,3-butadiene is flashed off and recovered, and the VPL product stabilized for storage. Shipment of latex is either by tank truck or rail tank car.

Quality Control

Quality control (QC) samples are obtained for raw materials, reactants, and end products. QC samples for 1,3-butadiene are taken of the incoming stock and at two in-process locations by sample cylinders in an open-loop mode. One QC sample of the polymer is also taken as it exits the reactor. Samples are analyzed in the laboratory by gas chromatography.

DESCRIPTION OF THE WORKFORCE

The company employs a total of approximately 300 personnel; of these 101 are potentially intermittently exposed in the production process where 1,3-butadiene may be present.

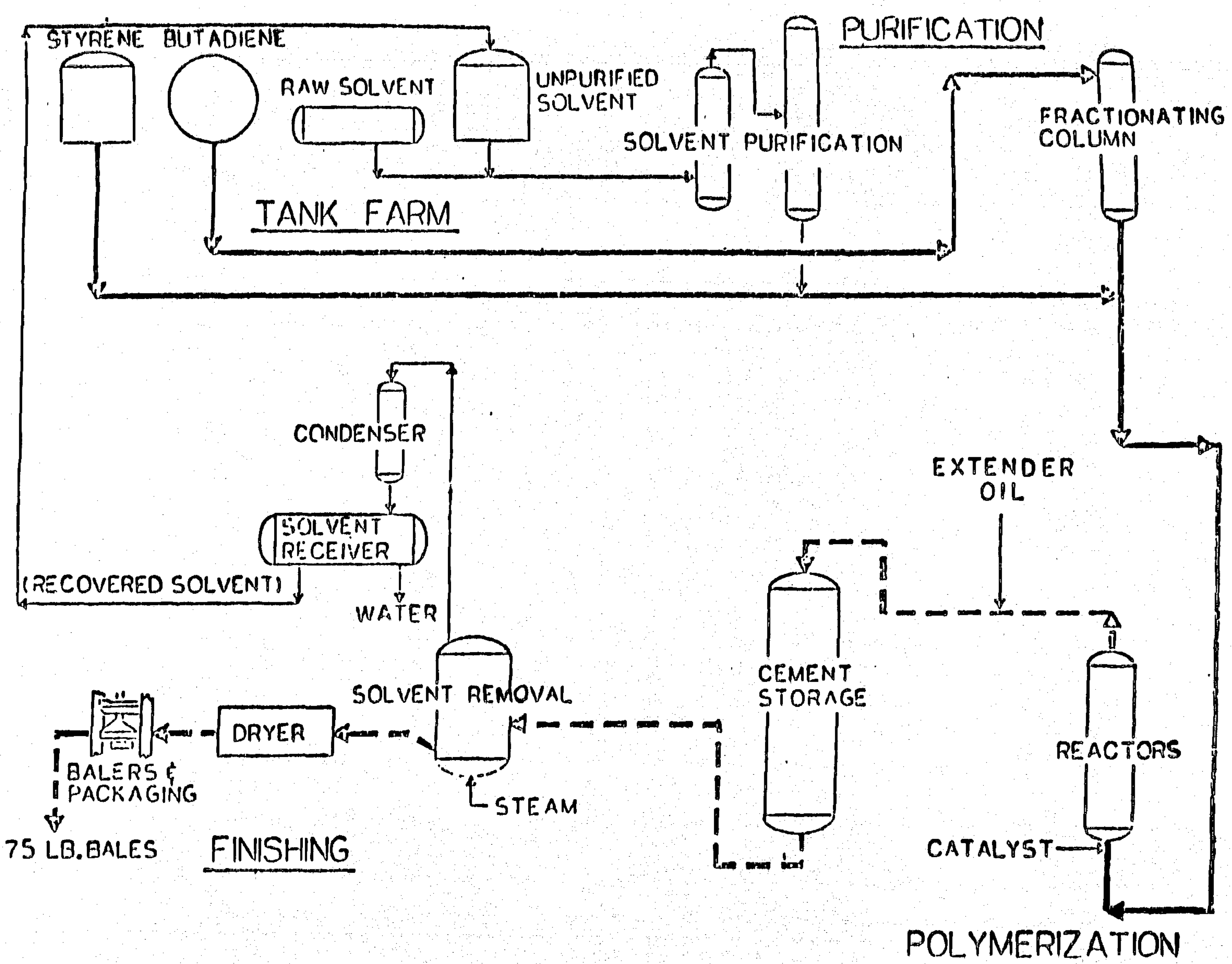

Figure 1. Process flow diagram for production of SBR at Firestone's Lake Charles, Louisiana facility.

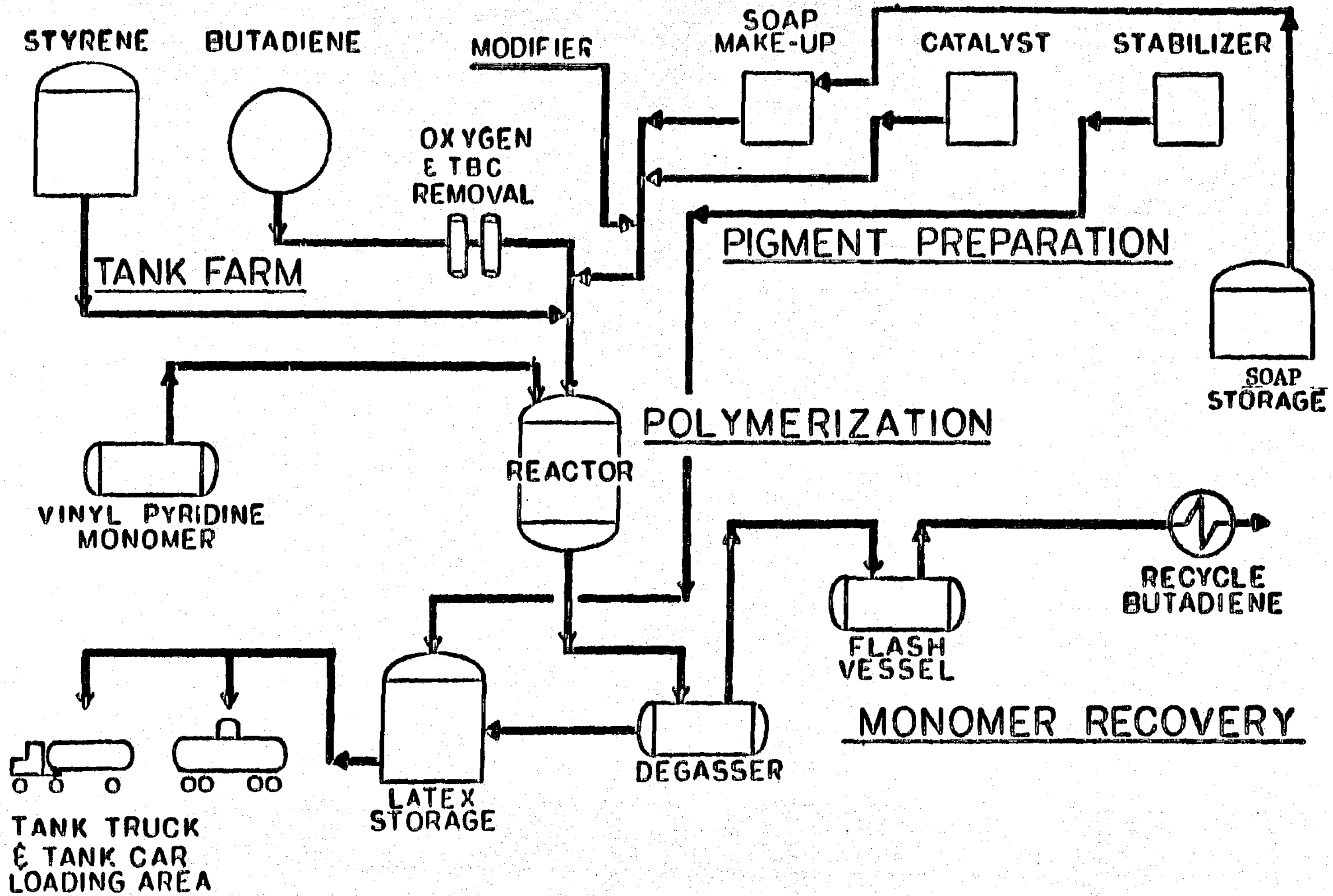

Figure 2. Process flow diagram for production of vinyl pyridine latex at Firestone's Lake Charles, Louisiana facility.

Production of SBR and PBR rubber is carried out 24 hours/day, 365 days/year. Production of VP latex is carried out 24 hours/day, 136 days/year. Four work crews rotate on a 28-day cycle, covering 3 (8-hour) shifts per day. Maintenance personnel work only on the day shift.

Job descriptions for employees potentially exposed to 1,3-butadiene are as follows:

Operator A	Oversees the total production operation. Works in control room and assists Operator B.
Operator B	Control room operator and works in the unit monitoring gauges and valves.
Operator C	Works in finishing department. Responsible for baler and wrapping machine.
Rover Relief Operator	Qualified to work as an A, B, or C Operator.
Instrument workers	Responsible for maintaining the electronic instruments.
Cleaners	Clean vessels using high pressure water.

DESCRIPTION OF PAST WORKER EXPOSURE

Personal exposure monitoring for 1,3-butadiene was conducted by Firestone in 1985 using the 3M 3500 organic vapor monitor (passive dosimeter). These monitors are not specific to 1,3-butadiene; however in the evaluation of the results it has been assumed by Firestone that all compounds identified as containing a four carbon chain (C_4) are 1,3-butadiene since the purity of the butadiene, as received, is greater than 99.5 percent pure. Table 1 presents a summary of Firestone's personal air monitoring conducted in 1985. All time-weighted average (TWA) exposures (not 8-hour) are below 1 ppm. The mean for the 56 samples is 0.14 ppm. The passive dosimeters were reportedly analyzed according to NIOSH Method #P&CAM 127[9] via gas chromatography.

Maintenance on the reactors occurs frequently, and offers a potential for exposure to 1,3-butadiene. Pump cleaning and maintenance exposes maintenance employees to 1,3-butadiene and other chemicals if proper decontamination procedures are not followed.

Quality control samples are collected of the incoming stock and at several points in the production process. Sample cylinders are used to collect process samples. The sample cylinder is attached in an open-loop system by

TABLE 1 SUMMARY OF FIRESTONE'S PERSONAL MONITORING DATA FOR C_4 COMPOUNDS (1,3-BUTADIENE) AT LAKE CHARLES, LOUISIANA, 1985

Job Category	No. of samples	TWA[a] exposures Range, ppm	Arithmetic mean, ppm
A operator, process area	3	ND[b] - 0.54	0.21
B operator, process area	12	ND - 0.67	0.19
Finishing operator	6	ND - 0.80	0.17
Laboratory technician	4	ND	ND
Supervisor, all areas	4	ND - 0.08	0.05
Tank and vessel cleaner	7	ND - 0.07	0.03
Tank farm pipefitter	5	ND - 0.12	0.07
Yard keeper	3	ND - 1.0	0.50
Mechanic	3	ND - 0.11	0.06
Boilermaker	3	ND - 0.11	0.04
Sumpman	3	0.05 - 0.35	0.17
Belt cleaner	1	0.01	0.01
Painter	1	0.07	0.07
Janitor	1	0.87	0.87
Total	56		0.14

[a] Time-weighted average; sampling time varied from 4 to 6 hours.

[b] Not detectable; assumed by Firestone to be as 0 ppm for computing means.

fittings and hoses to the high pressure side of a point in the process; valves are then opened to fill the cylinder. The trapped material is analyzed by gas chromatography in the lab. Three quality control analyses are done regularly:

1. Purity of 1,3-butadiene (stored at the tank farm);
2. Percent conversion of monomer (after reaction); and
3. Percent 1,3-butadiene in paraffinic hydrocarbon solvent (in the purification area).

Cylinder sampling has the greatest potential for exposure to 1,3-butadiene. Open-loop sampling permits the escape of 1,3-butadiene to the atmosphere thereby potentially exposing the employee via inhalation and skin contact. The sample cylinders are cleaned and purged at a central area in the process unit. The sample cylinders are connected to vacuum and the 1,3-butadiene is recycled into the process. The sample cylinders are steam cleaned and color coded so that only 1,3-butadiene is collected in the same sample cylinder.

Engineering Controls

Engineering controls at the plant include single mechanical seals on 1,3-butadiene pumps to prevent leakage. Figure 3 is a schematic diagram of a single mechanical seal. The rotating seal rings and stationary elements are lapped to a high degree of flatness to maintain contact throughout their mutual surface area. The faces are held together by a combination of pressures: pressure exerted by a mechanical spring and pump pressure transmitted through the liquid being pumped. Single mechanical seals represent an improvement over packed seals.

Slip-tube gauges are used to monitor the level of 1,3-butadiene on barges and in tank cars. The slip-tube gauge indicates the level of 1,3-butadiene by releasing a plume of 1,3-butadiene vapor to the ambient air. The vapor acts as a visual signal to to the loading area technician that the 1,3-butadiene in the tank car (or vessel) has reached a predetermined level. This type of gauge can be considered an engineering control to the extent that it negates the need for the process technician to be in close proximity to the tank port.

DESCRIPTION OF MEDICAL, SAFETY, AND INDUSTRIAL HYGIENE PROGRAMS

Medical Program

The plant employs one part time physician who is at the plant one day per week and one full time nurse. The company conducts pre-employment and annual physicals for all employees. The annual physical is a general exam by the plant physician and includes an eye exam, hearing test, and blood pressure test. Other tests are conducted in addition to the physicals for certain job categories: painters, insulators, and others who use respirators receive pulmonary function tests and chest x-ray; those

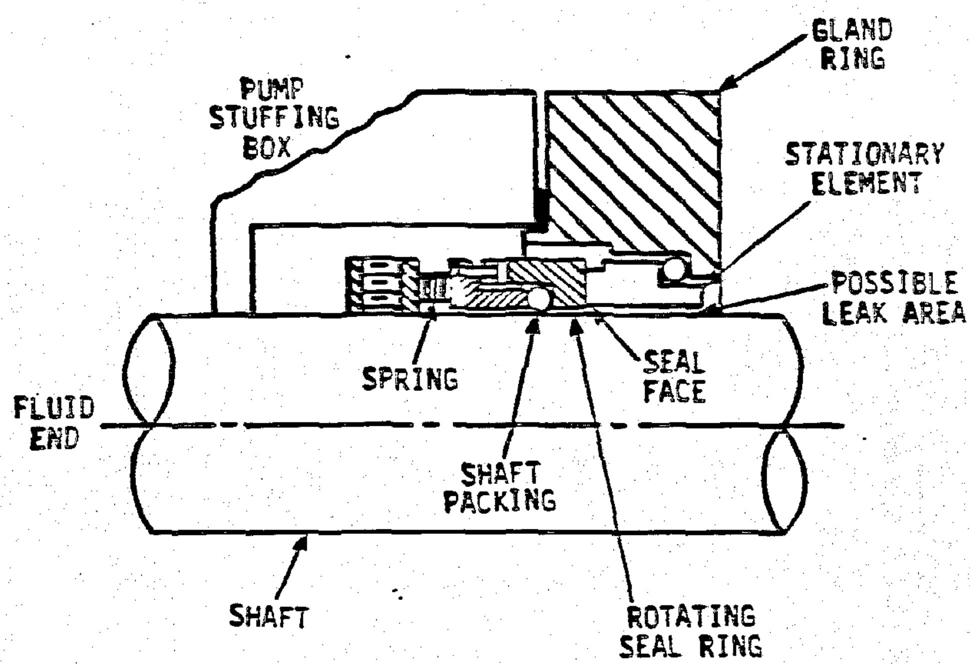

Figure 3. Diagram of a single mechanical seal.

personnel exposed to solvents have annual urine and blood tests. All personnel receive a blood and urine test every two years as part of their physical.

Safety Program

The personnel manager maintains an organized safety program. A central safety committee, composed of top management and general foremen, meets monthly. This committee also meets with the union committee once a month at which time safety issues are discussed.

The personnel manager supervises the safety engineer as well as 10 plant employees responsible for plant protection (security) and fire safety. Plant safety personnel also issue permits for hazardous operations such as vessel entry, valve blinding, stack line repair, etc. Quarterly safety audits are conducted by the safety manager and plant safety personnel.

Use of protective equipment is extensive at Firestone. Hard hats, safety glasses, and gloves are issued to all production personnel. Rubber, cotton, and vinyl gloves are used, depending on the job performed. Safety shoes are not required but are provided by the company at wholesale cost to the employees. Respirators are required for two job categories: field lab samplers and maintenance personnel. Half-face organic vapor respirators are used. Scott air-pacs and dust respirators are also available. The employees are instructed in the proper use of the respirator. A respirator fit test program is available for those jobs requiring respirators.

Showers and clothing change areas are provided. Smoking is permitted only in designated areas.

Industrial Hygiene Program

The plant conducts a semi-annual assessment of paraffinic hydrocarbon solvent, benzene, styrene, 1,3-butadiene, acetone, toluene, asbestos, and noise exposures. The 3M passive dosimeter is used for personal samples (except asbestos). Ventilation measurements of the laboratory hoods are taken with a velometer. Noise measurements are conducted with a sound level meter and noise dosimeters. Industrial hygiene samples are taken by the safety engineer.

The company reportedly contracts S&B Engineering Laboratories for analysis of 1,3-butadiene samples by NIOSH P&CAM 127. No exposures in excess of 1 ppm have been reported for 1,3-butadiene.

DESCRIPTION OF PERSONNEL RECORD SYSTEM

Firestone maintains personnel records on both current and terminated employees. Original records dating back to 1943 are stored on microfilm and available through John Hopkins University in Baltimore, Maryland.

Personnel records describe the job category and work history for each employees. The following information is recorded on each record:

1. Name
2. Social Security Number
3. Date of birth
4. Age
5. Race
6. Job class (updated)
7. Pay scale (updated)

Employees are unionized; however, the union does not maintain membership or death benefits records.

SAMPLING AND ANALYTICAL METHOD FOR BULK POLYMER SAMPLES

Because polymers are further processed into finished products, it was one of the intentions of this study to analyze the polymer(s) produced at the survey site to determine the potential for release of 1,3-butadiene monomer at temperatures typical of various fabrication processes employed in the manufacture of finished products which used the polymer. Therefore, a bulk polymer sample(s) was obtained at each site and then analyzed for emanation of free monomer at three predetermined temperatures: 1) ambient, 2) highest polymer process temperature, and 3) highest estimated end use temperature.

The method for analysis of the bulks was developed by the Measurement Research Support Branch of the Division of Physical Sciences and Engineering at NIOSH.

Sampling System Description

A Tekmar Model 4000 Automatic Dynamic Headspace Concentrator combined with the Model 4100 Heated Sampler Module and Model 1000 Capillary Interface was used throughout this study for the bulk sample analysis. The basic operating principle of this system is as follows: residual organic compounds diffusing from the bulk matrix (placed in an enclosed sampling tube) are removed by purging the enclosed sampling tube with inert gas (helium) followed by subsequent analysis in a gas chromatograph. The Heated Sampler Module allows the bulk matrix to be heated at a specified controlled temperature variable from ambient to 200°C. The organics removed from the sampling tube are next swept to a porous polymer adsorbent (Tenax) and trapped. The adsorbent is then heated and backflushed to release the organics, which are then swept onto the head of a capillary column via the Capillary Interface Unit. This capillary interface operates on the principle of cryofocusing. The interface freezes (using liquid nitrogen) the desorbed sample from the Concentrator into a narrow band on the injection end of a fused silica precolumn. The focused sample is then flash heated and injected into a gas chromatograph.

Sampling System Conditions

The system described involves the setting of numerous temperature and time parameters that had to be predetermined before any analytical work could be accomplished. After preliminary work with the 1,3-butadiene standard the settings listed in Table 2 were chosen and used throughout the study.

TABLE 2
SAMPLING TIME AND TEMPERATURE VARIABLES
USING THE DYNAMIC HEADSPACE CONCENTRATOR, TEKMAR MODEL 4000

Sample Chamber Temperature	Variable 30°C (ambient) to 200°C
Sample Transfer Lines & Valves	150°C
Sample Chamber Preheat Time	0 min (ambient); 5 min (heated samples)
Sample Wet Purge Time	5 min
Purge Flow	40 cc/min
Trap Desorb Temperature	200°C
Trap Desorb Time	4 min
Trap Bake Out Temperature	220°C
Trap Bake Out Time	15 min

Due to the high sensitivity of this system, sample size, especially with heated samples, had to be kept small to avoid overloading or contaminating the Tenax trap irreversibly with generated organic compounds. Twenty to 30 mg portions of the bulk polymers were weighed and used for sampling. (Even with these small amounts the system was often found to be heavily contaminated with higher boiling organic material after analysis of a sample.)

Analytical Instrumentation and Conditions

All bulks were initially screened using the Dynamic Headspace Concentrator interfaced directly to an HP 5840 gas chromatograph (GC) equipped with a flame ionization detector (FID). A 30-meter DB-1 fused silica capillary column, 0.25 mm I.D., and 1.0 um film thickness was used for all analyses. The column was temperature programmed from 35°C to 260°C at a rate of 15°/min after an initial hold time of 2 minutes. 1,3-butadiene eluted at about 2.0-2.2 minutes under these analytical conditions.

Positive identification of the presence of butadiene in selected samples was accomplished by interfacing the headspace unit and GC column directly into an HP5982A mass spectrometer (MS). Samples were reanalyzed under the same concentrator conditions except that the GC effluent was passed into the mass spectrometer ion source rather than a FID. Samples were scanned from 35 to 200 atomic mass units (amus) to obtain the mass spectra. The presence of 1,3-butadiene was specifically looked for by monitoring for the m/e 54 ion. A 1,3-butadiene gas standard was run by mass spectrometry to obtain a standard reference spectrum and GS/MS retention time data for comparison. Standards in the same range as used for the GC/FID calibration were also analyzed by GC/MS.

Calibration and Standards

Quantitation of 1,3-butadiene released from the polymer bulks was performed by GC-FID. GC/MS was used for confirmation and identification only. Certified (± 2%) 37 liter Scotty IV cylinders of 1,3-butadiene in nitrogen were used for standards (obtained from Scott Specialty Gases). A one-liter Tedlar bag was filled from this cylinder for use in obtaining the standard aliquots. This bag was evacuated and refilled with new 1,3-butadiene standard every 2-5 days. The 1,3-butadiene standard appeared stable in the Tedlar bag for at least 5 days. Various 0.1-5.0 cc aliquots of 1,3-butadiene from the bag were taken using gas tight syringes and injected directly into the purge stream of the heated module sample tube. Standards were subjected to the same purge and trap conditions as the samples. An initial calibration curve was constructed using multiple runs of varying amounts of a 9.51 ppm calibrated 1,3-butadiene gas standard. Each day at least two standard runs were made and amounts calculated against this curve to make sure the system was performing satisfactorily.

At the lower range of an analytical method, it may not be possible to confidently attribute an instrument response to the substance in question. The point at which instrument response can confidently be attributed to the contaminant being measured is called the "limit of detection" (LOD). If an instrument response is attributed to the contaminant, it may be present at such low levels that the confidence interval for the results reported may be excessive. The point at which the range of possible values are within acceptable limits is called the "limit of quantitation" (LOQ). These limits were calculated from the statistics of the calibration curve.

Under the analytical conditions previously described the limit of detection (LOD) for butadiene was approximately 1 ng per injection. Based on an initial sample weight of 25 mg (actual weights used varied from about 20 to 30 mg for solids), the LOD per sample was about 0.04 ng/mg or 0.04 ppm by weight. The limit of quantitation (LOQ) was 0.2 ppm by weight.

Sample Analysis

The following general procedure was used for the bulk samples: One 20-30 mg portion of the bulk was weighed out and put into the sample tube. An initial ambient run was made on all samples at 30°C. If little or no butadiene was detected at this temperature, the same portion of the bulk was subjected to the next higher predetermined temperature and reanalyzed. The procedure was repeated for a third temperature if applicable.

If 1,3-butadiene was detected in the sample at a certain temperature, that same portion of the bulk was then reanalyzed at the same temperature again, two or three times if necessary, until little or no additional butadiene was evolved. The sample then progressed to the next higher temperature and the process repeated if necessary.

Only samples suspected of containing 1,3-butadiene at a level above the LOQ (0.2 ppm) were reanalyzed at a later date using GC/MS to positively confirm the presence of 1,3-butadiene.

Analytical Results

NIOSH researchers obtained bulk samples of the polymers produced at Firestone to determine if the product was a potential source of exposure to 1,3-butadiene. The analytical results of the bulk analysis of the styrene butadiene rubber, polybutadiene, and vinyl pyridine latex samples are shown in Table 3.

Table 3. Bulk Analysis of 1,3-Butadiene Polymer
Samples from Firestone Synthetic Rubber and Latex Company
Lake Charles, Louisiana

Sample	Sample Heating Temperature(^{o}C)	Bulk Sample Analysis (ng/mg)
SBR	30	Trace*
	100	Trace
	180	Trace
PBR	30	ND**
	100	ND
	180	ND
VPL	30	16.5***

* Trace 1,3-butadiene present but at low levels, i. e. range of 0.04-0.2 ng/mg by weight
** ND = Non-Detectable <0.04 ng/mg
*** Mass Spectrometry Confirmation

Figure 4 is the mass spectra of the VPL bulk at 30^{o}C which indicates a 16.5 ng/mg by weight of 1,3-butadiene and Figure 5 is the mass spectra of the SBR bulk at 180^{o}C which indicates a trace of 1,3-butadiene.

DISCUSSION

Firestone Synthetic Rubber and Latex Company, manufactures styrene butadiene rubber, polybutadiene rubber, and vinyl pyridine latex at the Lake Charles, Louisiana, facility.

The company has conducted personal and area monitoring using passive dosimeters. All monitored TWA concentrations, as reported by Firestone, are below 1.0 ppm. The weighted mean TWA exposure for all job categories monitored was 0.14 ppm. The samples were not time-weighted to 8 hours.

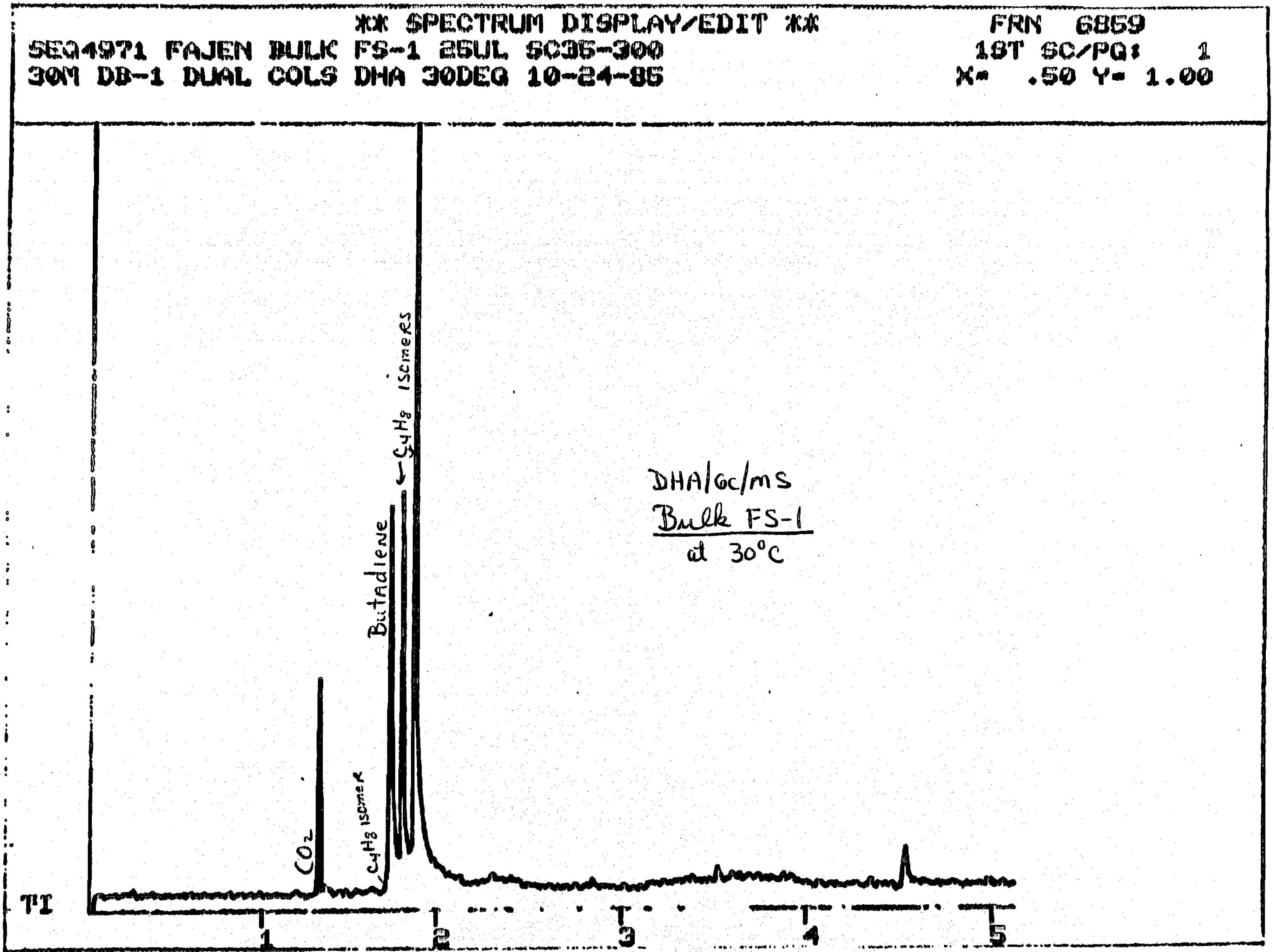

Figure 4. Mass Spectra of VPL Bulk at 30°C

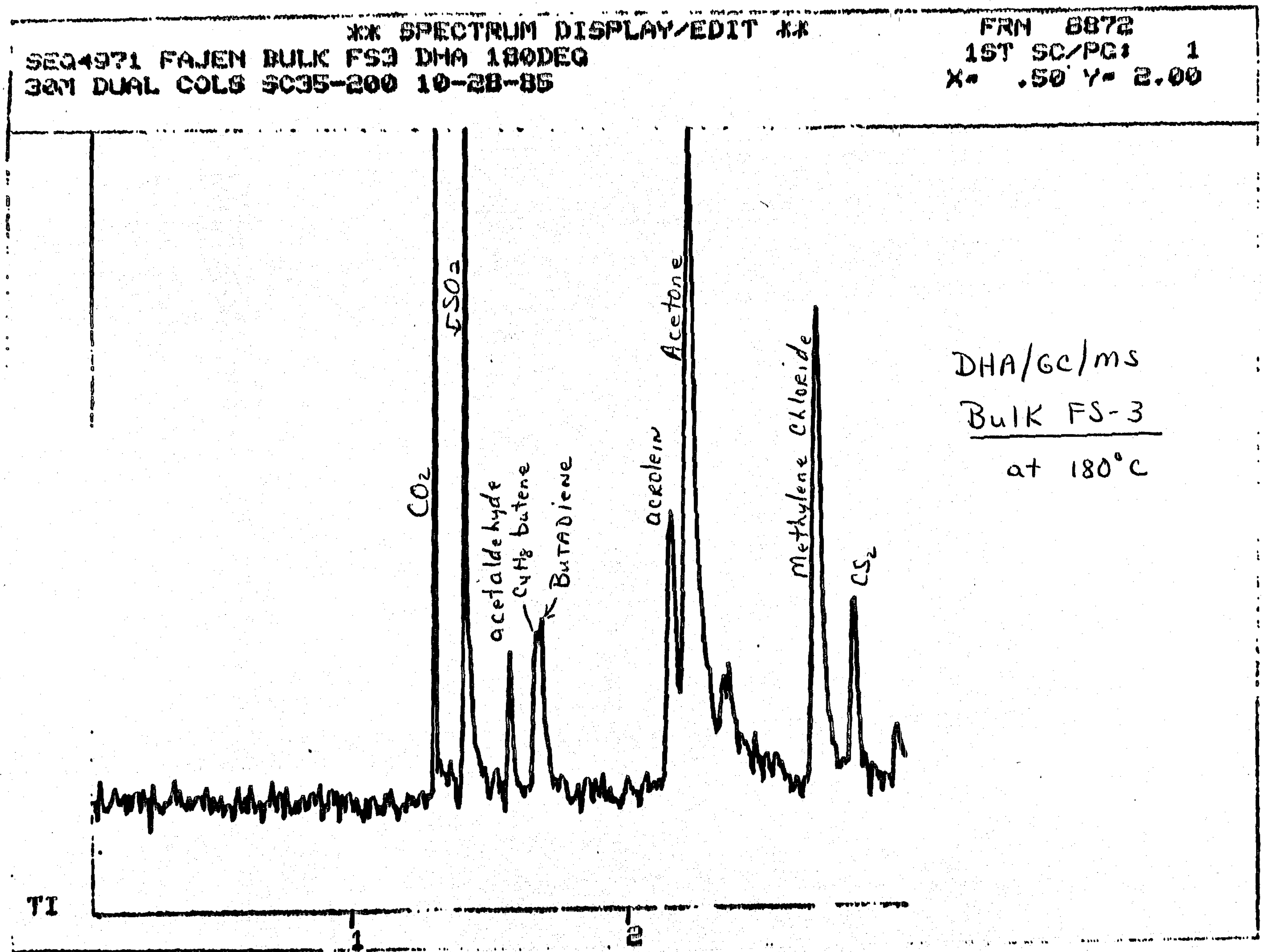

Figure 5. Mass Spectra of SBR Bulk at 180°C

Open-loop sampling techniques are used for collection of quality control bomb samples. Adequate personal protective equipment is used during sampling and maintenance activities.

All 1,3-butadiene pumps have single mechanical seals and slip tube gauges are used to monitor the levels of 1,3-butadiene in barges and in tank cars.

CONCLUSIONS

Based on the analytical results of the analysis of styrene butadiene rubber, polybutadiene, and the vinyl pyridine latex samples, Firestone meets the requirement established by NIOSH for consideration as a candidate for an in-depth industrial hygiene survey. (One of the criterion requires that 1,3-butadiene be detected in the bulk sample analysis.) The analytical results (see Table 5) indicate detectable levels of 1,3-butadiene in the vinyl pyridine latex samples (16.5 ng/mg by weight) and trace amount of SBR (0.04 - 0.2 ng/mg by weight). The personal air monitoring data is not specific to the individual polymers and is reported by Firestone as total C_4 compounds but is assumed by Firestone to be 1,3-butadiene. It is difficult to directly associate potential for exposure with the individual polymer.

In summary, there is analytical evidence to indicate that the work environment at Firestone presents a potential for exposure to 1,3-butadiene. Thus Firestone is considered a potential candidate for an in-depth industrial hygiene survey for the determination of the extent of exposure to 1,3-butadiene.

RECOMMENDATIONS

The reported exposures to 1,3-butadiene at the Firestone, Lake Charles, Louisiana, plant are low. However, consideration should be given to installation of a closed-loop sampling system that would further reduce the potential for 1,3-butadiene exposure to operators collecting QC samples.

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