HEALTH HAZARD EVALUATION REPORT

HETA 93-0574-2365
CROWN, CORK, AND SEAL COMPANY, INC.
CINCINNATI, OHIO

HETA 93-0574-2365
NOVEMBER 1993
CROWN, CORK, and SEAL COMPANY, INC.
CINCINNATI, OHIO

NIOSH INVESTIGATORS:
Beth A. Donovan, M.H.S.
Edward J. Hoekstra, M.D.

I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a Health Hazard Evaluation (HHE) from employees at Crown, Cork, and Seal in Cincinnati, Ohio. Workers reported skin rashes, burning eyes, and mucous membrane irritations. Some employees were also concerned that there might be an elevated number of cancer deaths among their workforce. NIOSH investigators conducted a site visit on July 22, 1993. Air samples were collected for lime dust and solvents (n-butanol, ethylene glycol monobutyl ether (EGBE), isobutanol, and isopropanol) in various work areas, employees were interviewed, and the Occupational Safety and Health Administration (OSHA) 200 Injury and Illness log was reviewed.

The sampling results did not reveal any exposures above recommended standards. Since skin symptoms appear to be a problem, and many of the chemicals used in the facility are known skin irritants, recommendations are made regarding the enforcement of the use of protective gloves. Also, since the chemicals in the decorating area are skin and mucous membrane irritants and may become airborne, local exhaust ventilation should be considered in this area. Irritation from the lime dust should be alleviated when the local exhaust ventilation is added to the effluent treatment area.

KEYWORDS: SIC 3411 (metal cans, manufacturing), contact dermatitis, lime dust, n-butanol, ethylene glycol monobutyl ether (EGBE), isobutanol, and isopropanol

II. INTRODUCTION

On July 22, 1993, the National Institute for Occupational Safety and Health (NIOSH) conducted a Health Hazard Evaluation (HHE) at Crown, Cork, and Seal Company, Inc. in Cincinnati, Ohio. The survey was performed in response to a confidential employee request. Operators, also called maintainers, in the front end and back end areas of this aluminum can producing facility had been experiencing burning eyes, irritated nose and throat, and skin rashes. Lime dust from the water treatment process and solvents from the manufacturing process were suspected by employees as the cause of these symptoms. The requestors also expressed concern about the cancer deaths of a few of their co-workers.

An earlier NIOSH HHE was conducted in 1989 in response to similar complaints, particularly the skin symptoms. The 1989 investigators concluded that no monitoring was necessary and recommended that clean personal protective equipment be used following proper donning and doffing procedures. Apparently, the symptoms persisted, prompting the workers to submit a second request.

In March 1993, an Occupational Safety and Health Agency (OSHA) compliance officer inspected this plant and cited safety-related inadequacies, as well as inadequate enforcement of the use of personal protective equipment and insufficient education of the workers about the chemicals with which they work. Crown, Cork, and Seal has since abated the cited hazards, which should help to alleviate some of the skin problems and increase worker understanding of potential health hazards.

III. BACKGROUND

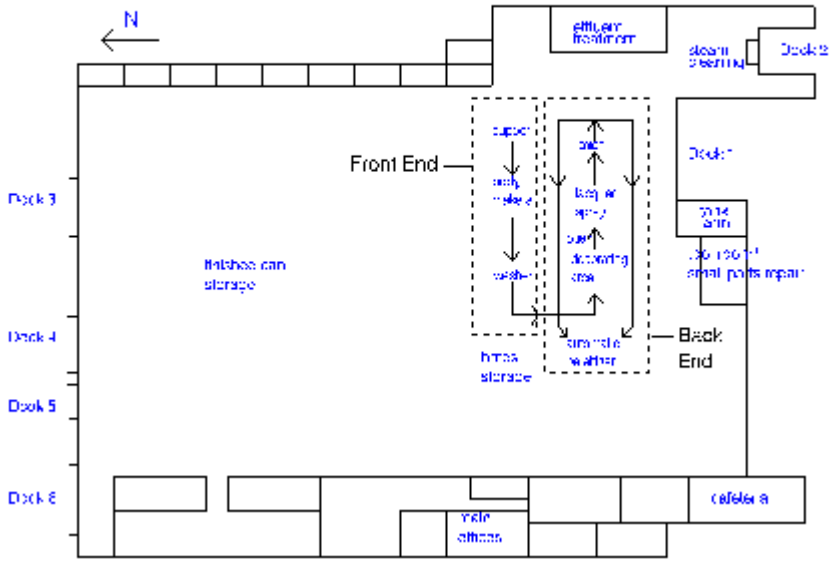
The Crown, Cork, and Seal plant in Cincinnati was built by Continental Can in 1958 to make food cans. In the late 1960's, the manufacturing process was changed to produce pop-top cans, and in the early 1980's the approximately 500-member workforce was down-sized to about 100 employees. In July 1990, Crown, Cork, and Seal Company, Inc. purchased Continental Can, retaining the employees and existing manufacturing operations.

The single-story, masonry building has windowed offices and a lunch/break room in the front (west side) of the building. The plant is approximately 4000 square feet, most of which is used for storage of finished cans. There are two loading docks, a tank farm containing bulk quantities of isopropyl alcohol and lubricant oils, and a tool room/small parts repair room on the south side of the building. A three-sided metal housing stands at the end of loading dock 2. Larger parts are placed within this housing and steam cleaned by certain back end maintainers. Figure 1 displays the plant layout and production line.

Aluminum is bought in 14,000-pound rolls, punched into small cups by the "cupper" machine, formed into the shape of a can by the body-maker machines, trimmed, and then washed, first in a sulfuric acid bath to remove the grease and eventually with deionized water. The unfinished cans, or "brites," are then painted and varnished in the decorating area and the inside is sprayed with lacquer. The neck and lip are formed on the cans, which are then stacked by an automatic palettizer. The first half of the production line (from the cupper through the washer) is called the front end, and the second half is called the back end. Front end seamless can line maintainers (FE SCLM), back end

seamless can line maintainers (BE SCLM), and lacquer spray maintainers (LSM) monitor the various machines.

Figure 1. Floor Plan and Production Flow Chart of Crown, Cork, and Seal Company, Inc., Cincinnati, Ohio. 7/22/93 HETA No. 93-574



The effluent from the manufacturing process is treated in the southeast corner of the building and then discharged into the sewer system. Lime is added to the water during the treatment process. The addition is usually automatic, but when the lime filters clog, the lime must be poured manually by the auxiliary maintainer. Apparently, this occurred more frequently in the past, but is still an issue of concern, especially in the summer months when high humidity can cause the filters to clog. During manual addition, large amounts of lime dust are released in the air and eventually migrate to the adjacent work areas.

IV. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ evaluation criteria for the assessment of a number of chemical (and physical) agents. The primary sources of environmental evaluation criteria for the workplace are the following: (1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), (2) OSHA Permissible Exposure Limits (PELs), and (3) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs).[1,2,3] The objective of these criteria for chemical agents is to establish levels of exposure to which the vast majority of workers may be exposed without experiencing adverse health effects.

Full-shift and shorter duration criteria are available depending on the specific physiologic properties of the agent. Full-shift limits are based on the time-weighted average (TWA) airborne concentration of a substance that workers may be repeatedly exposed to during an eight or 10 hour work day, up to 40 hours a week for a working lifetime, without adverse health effects. Some substances

have short-term exposure limits (STELs) or ceiling limits (CLs) which are intended to supplement the full-shift criteria where there are recognized irritative or toxic effects from brief exposures to high airborne concentrations. STELs are based on 15 minute TWA concentrations, whereas CL concentrations should not be exceeded even momentarily.

Occupational health criteria are established based on the available scientific information provided by industrial experience, animal or human experimental data, or epidemiologic studies. Differences between the NIOSH RELs, OSHA PELs, and ACGIH TLVs may exist because of different philosophies and interpretations of technical information. It should be noted that RELs and TLVs are guidelines, whereas PELs are standards which are legally enforceable. OSHA PELs are required to take into account the technical and economical feasibility of controlling exposures in various industries where the agents are present. The NIOSH RELs are primarily based upon the prevention of occupational disease without assessing the economic feasibility of the affected industries and as such tend to be very conservative. ACGIH is not a government agency, it is a professional organization whose members are industrial hygienists or other professionals in related disciplines and are employed in the public or academic sector. TLVs are developed by consensus agreement of the ACGIH TLV committee and are published annually. The documentation supporting the TLVs (and proposed changes) is periodically reviewed and updated if believed necessary by the committee. It is not intended by the ACGIH for TLVs to be applied as the threshold between safe and dangerous exposures.

Not all workers will be protected from adverse health effects if their exposures are maintained below these occupational health exposure criteria. A small percentage may experience adverse effects due to individual susceptibility, a pre-existing medical condition, previous exposures, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, or with medications or personal habits of the worker (such as smoking) to produce health effects even if the occupational exposures are controlled to the limit set by the evaluation criterion. These combined effects are often not considered by the chemical specific evaluation criteria. Furthermore, many substances are appreciably absorbed by direct contact with the skin and thus potentially increase the overall exposure and biologic response beyond that expected from inhalation alone. Finally, evaluation criteria may change over time as new information on the toxic effects of an agent become available. Because of these reasons, it is prudent for an employer to maintain worker exposures well below established occupational health criteria.

The specific standards used during this evaluation are summarized in Table 1. n-Butanol is a colorless liquid used as a lacquer solvent and in the manufacture of plastics and rubber cements. It is an irritant of the eyes and mucous membranes and may also cause central nervous system depression at very high concentrations. Contact dermatitis can occur due to defatting of skin tissue.[4] Ethylene glycol monobutyl ether (EGBE) is a solvent that is a eye and mucous membrane irritant, but it is not significantly irritating to the skin.[4] Lime, or calcium oxide, is a whitish-grey crystal or granular powder. It is an irritant of the eyes, mucous membranes, and the skin, probably because of its alkalinity. It can cause skin burns and fissures in the nails.[4] Isobutanol is a mild skin irritant and can cause erythema (redness) and hyperemia (an excess of blood). There is no evidence of eye irritation or any chronic systemic effects from exposure to isobutanol.[4] Isopropanol is a solvent used in the manufacture of lotions, cosmetics, pharmaceuticals, and acetone. It is an irritant to eyes and mucous

membranes, and at high doses can cause central nervous system depression. The potential for it causing dermatological problems is low, although it can cause an allergic rash.[4]

Table 1
Guidelines and Standards Relevant to Air Monitoring
at Crown, Cork, and Seal

Substance	OSHA PEL	NIOSH REL	ACGIH TLV
n-butanol	100 ppm	CL 50 ppm (skin)	CL 50 ppm (skin)
EGBE	50 ppm (skin)	25 ppm (skin)	25 ppm (skin)
calcium (lime dust)	5 mg/m^3	2 mg/m^3	2 mg/m^3
isobutanol	100 ppm	100 ppm STEL 125 ppm	50 ppm
isopropanol	400 ppm	400 ppm STEL 500 ppm	400 pp

EGBE - ethylene glycol monobutyl ether
CL - ceiling limit
STEL - short term exposure limit (not exceeded
ppm - parts per million
mg/m^3 - milligrams per cubic meter

V. MATERIALS AND METHODS

1. Environmental Evaluation

Area and personal breathing zone (PBZ) samples were collected in both the front and back end areas, as well as in the effluent treatment area. In the front end, a PBZ sample was taken on a seamless can line maintainer for volatile organic compounds (VOCs). Also, an area air sample for VOCs was taken for a qualitative analysis of VOCs in this area. Qualitative area and quantitative PBZ samples for VOCs were obtained in both the can decorating and lacquer spray areas of the back end. Samples were obtained on charcoal tubes attached to Gillian® low air flow pumps. The area samples were collected at a flow rate of 200 milliliters per minute (mL/min) and analyzed by gas chromatography/mass spectrometry (GC/MS). The PBZ samples were collected at a flow rate of 100 mL/min and analyzed by the NIOSH methods appropriate for the VOCs identified by the GC/MS analysis.

Since lime dust was of concern in the production areas, air samples were collected for calcium and other elements. A PBZ sample was obtained in the front end, and an area sample in the back end. Since the plant was not dusty on the day of the visit because the lime feeder was working properly in the effluent treatment area, a PBZ sample was also taken for elements on the auxiliary maintainer in the effluent treatment. While none of the lime dust samples will represent worse case scenarios (during the manual addition of lime), they should illustrate a typical work day exposure. These samples were collected with GilAir-5® pumps on mixed cellulose ester

filters (MCEFs) at a flow rate of 2.0 liters per minute (L/min) and analyzed by NIOSH Method 7300.

2. Medical Evaluation

The NIOSH medical officer selected 14 of the 24 first shift employees present on the day of the investigation to be interviewed. Those selected included all the seamless can line maintainers of the front and back ends, the auxiliary maintainer, the lacquer spray maintainer, all the electricians, and all the millwright machinists. They were chosen because of their potential for exposure to lime dust, paints, oils, and solvents. The Human Resources manager and the president of the local union were interviewed to gather information about workplace conditions, work practices, the frequency of medical symptoms that were possibly related to contact with lime dust or other chemicals, and the occurrence of cancer among employees. Also, personnel records were reviewed to determine whether additional information was available regarding the four cases of cancer at the facility during the last three years. In addition, the OSHA 200 Injury and Illness logs for 1990 through 1993 were reviewed.

VI. RESULTS AND DISCUSSION

1. Environmental

The PBZ air sampling results are displayed in Table 2. The levels of calcium, and thus lime dust, were low compared to the occupational exposure criteria. This was expected since no manual addition of lime to the effluent treatment tanks was necessary on the day of the survey. The qualitative air sampling results for VOC identification are included in Appendix A. As a result of the qualitative results, n-butanol, ethylene glycol monobutyl ether (EGBE), isobutanol, and isopropanol were chosen for quantitation. These results were also well below their respective exposure criteria. Of interest is that the analysis of a paint sample from one of the paints used in the decorating area (see Appendix A) did not reveal any of the same compounds as the qualitative sample. The components of the paint may not volatilize enough to be detected on the area air sample. Although these levels are low, it is important to note that most of the Material Safety Data Sheets (MSDSs) for the chemicals that are used in the plant mention skin irritation as an effect of exposure.

Table 2

Quantitative Air Monitoring Results from Crown, Cork, and Seal
July 22, 1993

Location	Analyte	Sample Time (min)	Sample Volume (L)	Result	Minimum Detectable Concentration
Back End Area	calcium	357	714	0.0025 mg/m^3	0.0014 mg/m^3
Auxiliary Maintainer	calcium	366	732	0.18 mg/m^3	0.0013 mg/m^3
Front End Maintainer	calcium	379	758	0.0014 mg/m^3	0.0013 mg/m^3

Back End Decoration Maintainer	isopropanol isobutanol n-butanol EGBE	367	36.7	2.0 ppm < 0.1 ppm < 0.3 ppm < 0.4 ppm	0.4 ppm 0.3 ppm 0.3 ppm 0.1 ppm
Back End Lacquer Spray Maintainer	isopropanol isobutanol n-butanol EGBE	359	35.9	0.9 ppm < 0.3 ppm 2.7 ppm 0.3 ppm	0.4 ppm 0.3 ppm 0.3 ppm 0.1 ppm
Front End Maintainer	isopropanol isobutanol n-butanol EGBE	376	37.6	< 0.4 ppm < 0.1 ppm 0.4 ppm < .04 ppm	0.4 ppm 0.3 ppm 0.3 ppm 0.1 ppm

ppm - parts per million
mg/m^3 - milligrams per cubic meter

2. Medical

The NIOSH medical investigator interviewed 14 employees working in the selected areas during the first shift (eight seamless can line maintainers of the front and the back end, one auxiliary maintainer, one lacquer spray maintainer, two electricians, and two millwright machinists). The average age of the interviewed employees was 50 years (range 35-60 years); all were male. They had been employed by this company at this and other similar facilities an average of 34 years (range 26 to 42 years), and were performing their current job an average of 10 years (range two to 20 years). The most common symptoms were short-term erythema (redness) on the neck and face, and dermatitis on the hands and arms. Six of the eight seamless can line maintainers of the front and the back end reported intermittent symptoms of skin irritation, although none of the employees were experiencing these symptoms on the day of the investigation. The remaining six interviewed employees working in other job functions had not experienced skin irritation. All skin symptoms began a few years ago and, although they have occurred with decreased frequency, they continue (approximately twice a year) despite recent changes in the types of solvents and paints used.

Three of the four seamless can line maintainers of the back end reported intermittent outbreaks of erythema on their faces and necks. This erythema usually resolved a few hours after leaving the workplace. The occurrence of this erythema could not be linked to one specific paint, but the descriptions from the employees were consistent with a contact and/or airborne irritant. The irritant could be a contaminant in the paints or solvents or could be related to other environmental factors such as dust and/or humidity.

A review of OSHA 200 Injury and Illness logs from 1990 through 1993 revealed only one reported case of contact dermatitis. All other incidents related to traumatic injury.

In the last three years, four male workers of the 105 (102 male and three female) total employees were diagnosed with cancer. The personnel records revealed that there were three cases of lung cancer and one of renal cell carcinoma. Two of the three workers with lung cancer were known smokers. Employment of the four men at the facility ranged from 27 to 36 years prior to the identification of their cancers, and their ages

ranged from 55 to 61 years at the time of diagnosis. All four men worked in different areas of the facility.

Over the years NIOSH has received many requests for assistance from people who are concerned about apparent excess cancer deaths in their workplaces. A cancer cluster is defined as an unusual concentration of cancer cases. The hallmark of a cancer cluster is a high number of cases of one or more types of cancer in a specific population during a certain time period. A cancer cluster may also consist of an unusual distribution of types of cancer, ages of cases, or gender. Typically, cancers of occupational origin require about 15 to 20 years to develop.

Cancer is a group of different diseases that share a common feature, the uncontrolled growth and spread of abnormal cells. It is common in the United States -- about one in three people will eventually develop the disease, and one of every five deaths is from cancer. Among adults, cancer occurs more frequently among men than among women, and the rate of occurrence increases with increasing age.[5]

The distribution of types of cancer cases reported among Crown, Cork, and Seal Company, Inc. employees is not unusual. Lung cancer is the most common type among men in the United States. In 1992, there were about 168,000 new cases of lung cancer in the United States, and lung cancer was diagnosed in about one of every five men with cancer.[6] The best-recognized cause of lung cancer is cigarette smoking.

Because of the long time between first exposure to a cancer-causing agent and the diagnosis of cancer, past exposures are of interest when looking for causes of cancer. The industrial hygiene sampling at the facility only reflects current conditions, thus the available MSDSs from the products used in the past three to 10 years were reviewed. The MSDSs did not list any chemicals that are known to be associated with lung cancer. The findings of this investigation provide no basis for concluding that the cases of cancer among Crown, Cork, and Seal employees are related to industrial chemical exposure in the workplace. Neither the distribution of cancer types nor the demographic characteristics of the persons with cancer appear to be unusual, and no past relevant exposure to potential occupational causative agents was determined.

VII. RECOMMENDATIONS

1. A local exhaust ventilation (LEV) system should be installed in the effluent treatment area that can be operated when lime is being added manually. The OSHA compliance officer had already informally recommended this additional ventilation, and Crown, Cork, and Seal was in the process of designing and installing a system at the time of the NIOSH investigation.

2. NIOSH investigators observed that employees who use gloves do not properly remove them so as to avoid contaminating the insides. Proper donning and doffing procedures should be emphasized. Covering a chemical exposure on the skin with a non-breathing barrier, such as a glove, can augment the permeability of the skin by more than 10 fold.[11] Also, barrier creams are allowed as a substitute for personal protective equipment at this

plant. Barrier creams are inferior to protective clothing because their efficacy is questionable and they must be reapplied frequently.[7]

Several decorating maintainers are experiencing dermal problems on their face and necks, especially when working up over where the inks are added. Since it does not appear that employees are touching their faces with contaminated hands, the irritation may be from airborne chemicals and the possibility of LEV should be explored. As a minimum, barrier creams should be applied to exposed skin areas that are affected. Although barrier creams are rarely a satisfactory replacement for gloves, they are fairly effective on the face to protect against airborne irritants.[7]

3. Employee education regarding properties and health hazards associated with the chemicals with which they work should be continued. The training should be performed at routine intervals, include discussions of any health and safety changes being implemented, and allow for employee input.

4. Environmental tobacco smoke (ETS) contributes to particulate and gaseous contaminants and increases the risk of developing lung cancer and respiratory illnesses.[9,10] These contaminants are also irritants and may cause short-term problems such as headaches, rhinitis, and sinus problems. For these reasons, exposures to cigarette smoke should be reduced to the lowest feasible concentration. The best method for achieving this is by eliminating smoking in the building. Until this can be accomplished, smoking should be restricted to a designated smoking area(s). The separate smoking area should be under negative pressure with respect to adjacent areas, have a dedicated exhaust system (room air directly exhausting to the outside), and provide 60 cubic feet per minute per person of outside air.[8]

VIII. REFERENCES

1. CDC [1993]. NIOSH recommendations for occupational safety and health standards 1993. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

2. Code of Federal Regulations [1993]. 29 CFR 1910.1000. Washington, DC: U.S. Government Printing Office, Federal Register.

3. ACGIH [1992]. Threshold limit values and biological exposure indices for 1992-1993. Cincinnati, OH: American Conference of Governmental Hygienists.

4. Procter NH, Hughes JP, Fischman ML [1988]. Chemical hazards of the workplace. 2nd ed. Philadelphia, PA: J.B. Lippincott Company.

5. American Cancer Society [1992]. Cancer Facts & Figures.

6. Holleb AI, Fink DJ, Murphy GP [1991]. Textbook of clinical oncology. Atlanta, GA: American Cancer Society.

7. Adams RM [1990]. Occupational skin disease. 2nd ed. Philadelphia, PA: W.B. Saunders Company. pp. 268-270.

8. ASHRAE [1990]. Ventilation for acceptable indoor air quality. Atlanta, GA: American Society of Heating, Refrigerating, and Air-conditioning Engineers. ANSI/ASHRAE Standard 62-1989.

9. Taylor A, Johnson D, Homayoun K [1992]. Environmental tobacco smoke and cardiovascular disease: a position paper from the council on cardiopulmonary and critical care, American Heart Association. Circulation 86(2):1-4.

10. NIOSH [1991]. Current intelligence bulletin 54: environmental tobacco smoke in the workplace: lung cancer and other health effects. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 91-108.

11. Scheuplein RJ [1978]. Permeability of the skin: a review of major concepts. Current problems in dermatology, Vol. 7, pp. 172-186.

IX. INVESTIGATORS AND ACKNOWLEDGEMENTS

Investigators:

Beth Donovan, M.H.S.
Industrial Hygienist
Industrial Hygiene Section

Edward Hoekstra, M.D., M.Sc.
Medical Officer
Medical Section

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies

X. DISTRIBUTION AND AVAILABILITY

Copies of this report may be freely reproduced and are not copyrighted. Single copies of this report will be available for a period of 90 days from the date of this report from the NIOSH Publications Office, 4676 Columbia Parkway, Cincinnati, Ohio 45226. To expedite your request, include a self-addressed mailing label along with your written request. After this time, copies may be purchased from the National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Crown, Cork, and Seal Company, Inc.
2. United Steel Workers Association, Local 5684
3. Confidential Requestor
4. OSHA Region V

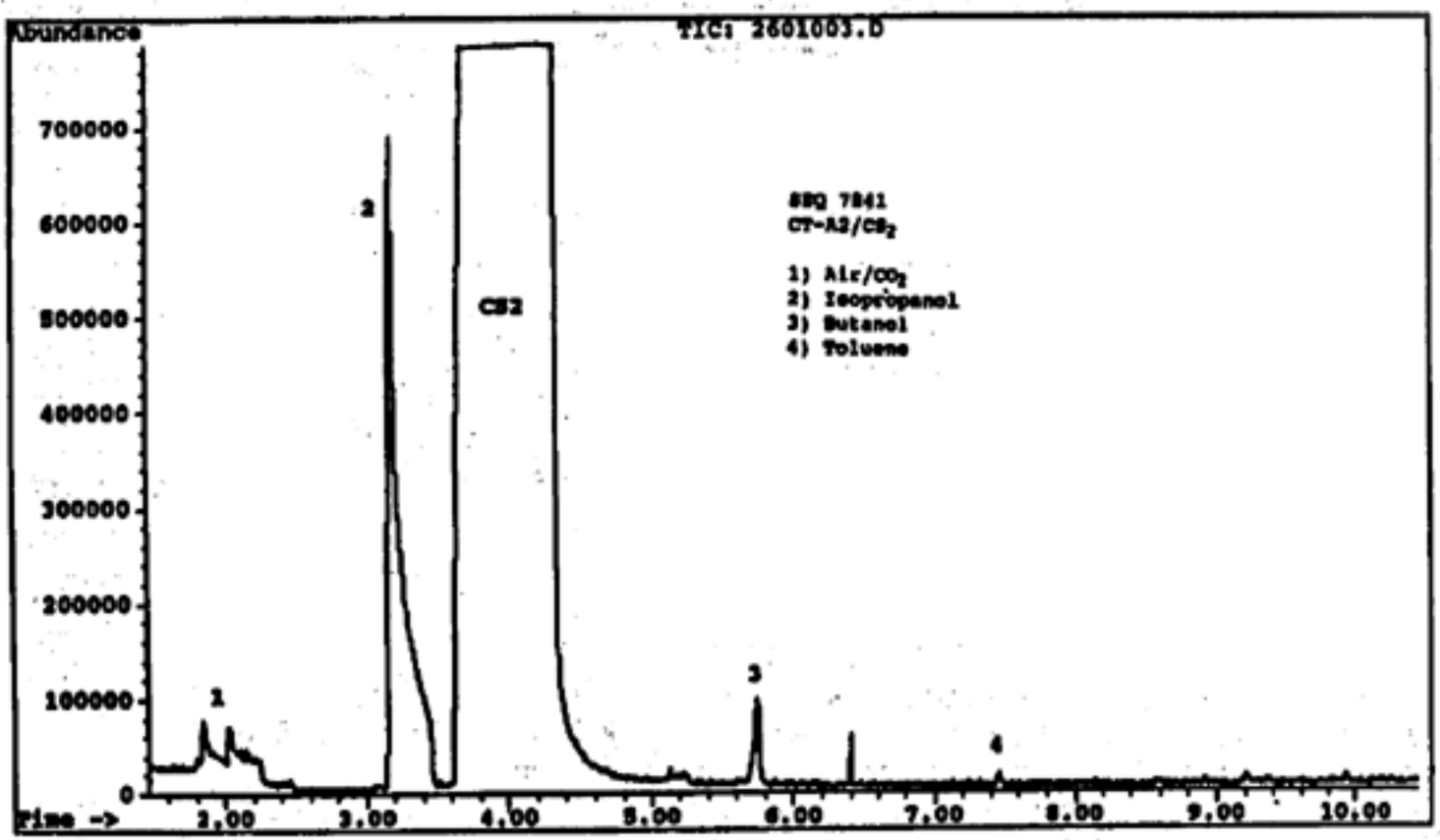
For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

APPENDIX A

QUALITATIVE AND BULK SAMPLING RESULTS

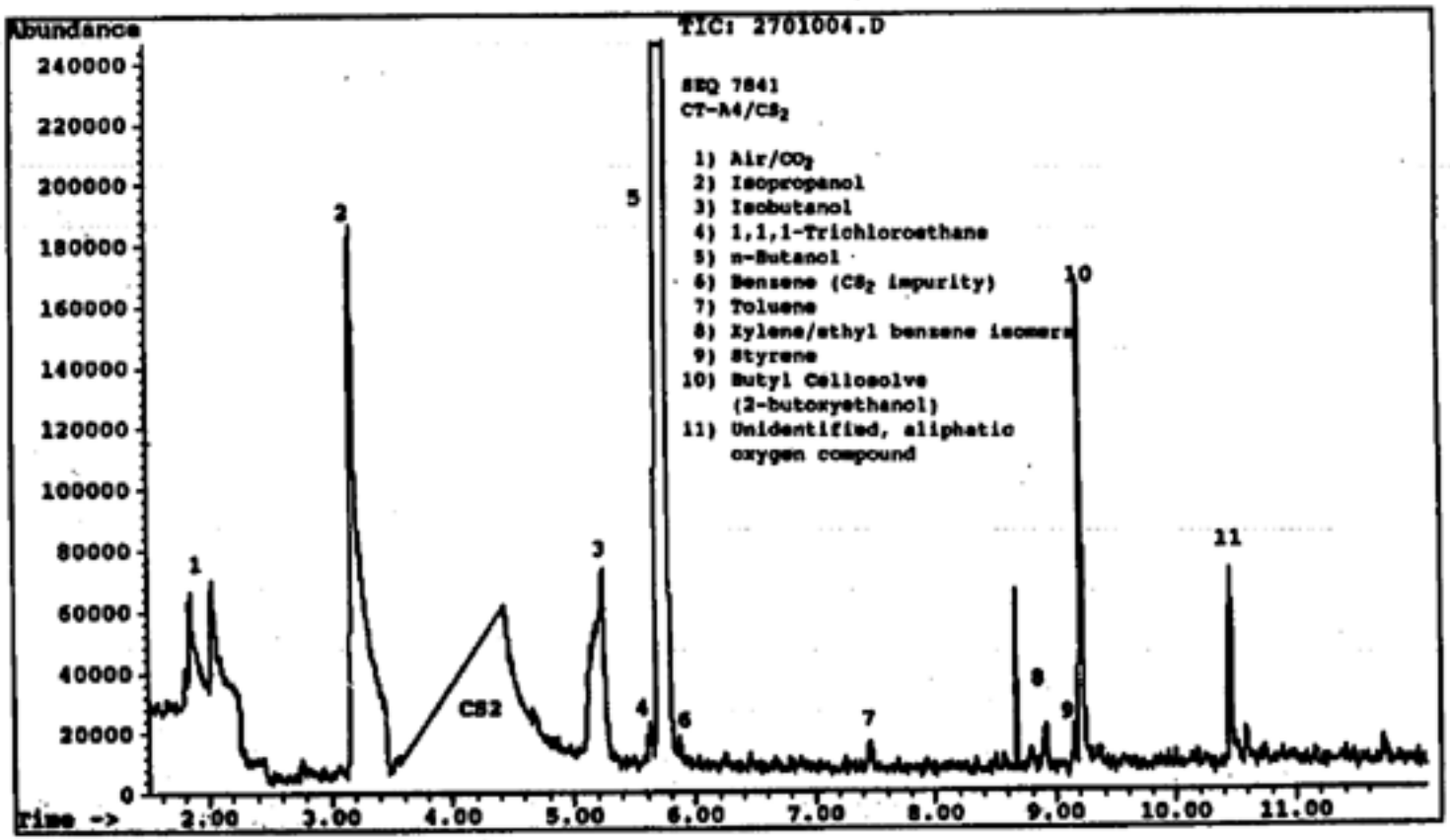
Gas Chromatography/Mass Spectrometry Analysis of an Area Air Sample in the Decorating Area
Crown, Cork, and Seal Company, Inc.
HETA 93-574
7/22/93

File: C:\CHEMPC\DATA\JULY\2601003.D
Operator: AAG
Date Acquired: 27 Jul 93 3:08 pm
Method File: CROTE.M
Sample Name: seq7841 CT-A2/CS2
Misc Info: 30 M DB-1 SC20-300 SPLITLESS TP35-250
ALS vial: 26



Gas Chromatography/Mass Spectrometry Analysis of an Area Air Sample in the Lacquer Spray Area
Crown, Cork, and Seal Company, Inc.
HETA 93-574
7/22/93

File: C:\CHEMPC\DATA\JULY\2701004.D
Operator: AAG
Date Acquired: 27 Jul 93 3:37 pm
Method File: GROTE.M
Sample Name: seq7841 CT-A4/CS2
Misc Info: 30 M DB-1 SC20-300 SPLITLESS TP35-250
ALS vial: 27



Gas Chromatography/Mass Spectrometry Analysis of a Bulk Paint Sample from the Decorating Area
Crown, Cork, and Seal Company, Inc.
HETA 93-574
7/22/93

File: C:\CHEMPC\DATA\JULY\2801005.D
Operator: AAG
Date Acquired: 27 Jul 93 4:05 pm
Method File: GROTE1.M
Sample Name: seq7841 PAINT/CS2 EXTRACT
Misc Info: 30 M DB-1 SC20-300 SPLITLESS TP35-250
ALS vial: 28