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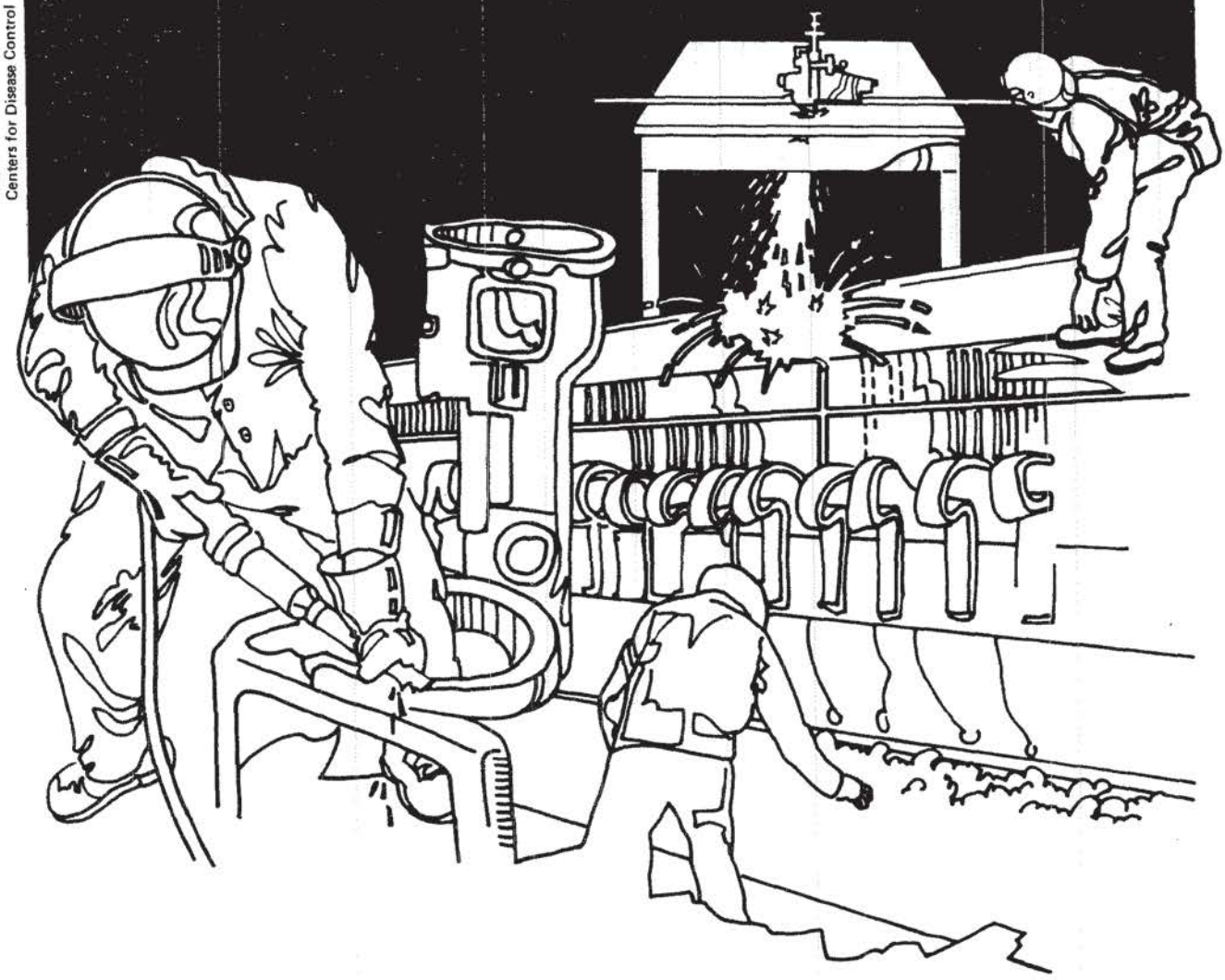

Health Hazard Evaluation Report

HETA 81-310-1039
KING-SMITH PRINTING COMPANY
DETROIT, MICHIGAN

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 81-310-1039
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King-Smith Printing Company
Detroit, Michigan

NIOSH Investigator:
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I. SUMMARY

In May 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation at the King-Smith Printing Company, Detroit, Michigan. The request, from the Graphic Arts International Union, Local 289, indicated that the single employee working in the Cyrel^{R} plate-making area was concerned about possible health effects from the solvents used.

On July 28, 1981, two 8-hour and two short term personal breathing zone samples were obtained in the Cyrel^{R} plate-making area. Analysis of one short term sample for 1,1,1-trichloroethane indicated a level of 67 milligrams per cubic meter (mg/M^3) which is less than 10% of the NIOSH 15-minute ceiling criteria of 1910 mg/M^3. Two 8-hour samples found n-Butanol at levels less than 5% (9.7 mg/M^3 and 13 mg/M^3) of the Occupational Safety and Health Administration 8-hour Time-Weighted Average standard of 300 mg/M^3. Perchloroethylene levels found on the two 8-hour samples were 22 mg/M^3 and 30 mg/M^3. Analysis of the second short term sample for perchloroethylene indicated a level of 58 mg/M^3. Because perchloroethylene has caused liver cancer in laboratory mice, NIOSH recommends that exposure to perchloroethylene be minimized while the carcinogenic potential of the compound is evaluated further.

A non-directed medical questionnaire administered to the one worker indicated that the worker had not in the past experienced any acute health effects from solvent exposures and did not during the survey experience any effects.

On the basis of the data obtained in this investigation, NIOSH has determined that a health hazard did not exist from airborne exposure to n-butanol or 1,1,1-trichloroethane on the day that NIOSH sampled. However, due to its carcinogenic potential, a possible health hazard could exist due to perchloroethylene exposure. Recommendations to improve work practices are contained in Section VII of this report.

Keywords: SIC 2752 (Lithographic printing); Cyrel^{R} plate making, n-butanol, perchloroethylene, 1,1,1-trichloroethane.

II. INTRODUCTION

On May 11, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Graphic Arts International Union, Local 289, to evaluate worker exposure to solvents used in the Cyrel^{R} plate-making process at the King-Smith Printing Company, Detroit, Michigan. The solvents used in this process were reported to be causing a concern about possible health effects in addition the worker was concerned about possible reproductive effects.

III. BACKGROUND

King-Smith Printing Company is a lithographic printing company located in Detroit, Michigan. The area evaluated was the Cyrel^{R} plate-making process, which employed one worker.

The Cyrel^{R} process consists of five sequential steps. The plate used in this process is composed of an unreacted monomer between two coatings of mylar for protection in handling, shipping, and storage. In step one (the curing process), the plate with both mylar coverings is exposed for approximately five minutes to Ultra-Violet (UV) light. This is done to react part of the monomer to a polymer, forming a hardened back with the mylar covering. Next, the plate is turned over and the top mylar coating is removed. A film negative to be imprinted on the plate is then positioned on the uncovered monomer. A vacuum is pulled on the plate/negative, followed by exposure to UV light for approximately 3-5 minutes, depending on the plate size.

After the plate/negative is removed from the curing process, the negative is discarded and the plate is placed on a revolving drum to be cleaned. The cleaning agent, a mixtue of 75% perchloroethylene and 25% n-butanol, washes the unreacted monomer off the plate. Two washes are performed, each lasting approximately three minutes, with the plate rotated 90^{o} between them.

Absorption of the cleaning agent causes the plate to swell. In order to reduce the size to proper specifications, the plate is placed in a drying oven for about 15 minutes. Because, the heat causes the plate to become sticky or tacky to the touch the plate is then washed in slightly acidic water.

Washing of the plate is done by submerging the plate in a solution of chlorinated water for a period of time (from several hours to overnight). After washing, the plate is wiped by hand with 1,1,1-trichloroethane to remove any remaining traces of monomer and is then cured again under UV light to complete the reaction of monomer to polymer. On an average, approximately 10-15 plates are made a day, with 12 made on the survey date.

The room in which this process is contained is approximately 10 feet by 10 feet by 18 feet. One glove, type unknown, was used by the worker in transferring the plate from process to process.

IV. EVALUATION DESIGN

Three personal air samples were taken in the plate-making area for perchloroethylene and n-butanol which were collected on charcoal tubes connected to sampling pumps operating at approximately 0.1 liters per minute (lpm). Analysis of these personal samples was performed by gas chromatography with flame ionization detector (GC/FID) according to NIOSH P&CAM S-66 (modified)[1]. The limit of detection for perchloroethylene and n-butanol is 0.01 milligrams per sample.

One air sample was taken in the plate-making area for 1,1,1-trichloroethane. The sample was collected on a charcoal tube connected to a battery operated sampling pump calibrated at approximately 0.1 lpm. Analysis of the sample by GC/FID was performed according to NIOSH P&CAM S-328 (modified), with a limit of detection of 0.01 milligrams per sample.[2]

Air velocity measurements were obtained on the processor and finishing machines using a constant temperature thermal anemometer.

A health questionnaire was administered to the one employee to elicit past and present occurrences of skin, eye, nose, and throat irritation, and other general symptoms associated with exposure to these solvents.

V. EVALUATION CRITERIA

Environmental standards and criteria considered applicable to this evaluation are shown below. These criteria and standards were established at levels to protect workers occupationally exposed to a substance on an 8-or 10-hour day, 40 hour per week basis over a normal working lifetime. Ceiling values are concentrations that should not be exceeded along with a corresponding time limit.[3,4,6,9]

	Criteria (mg/M3)*				
	NIOSH		OSHA	ACGIH-TLV	
	TWA[1]	C[2]	TWA	TWA	STEL[3]
n-Butanol	---	---	300	150	---
Perchloroethylene	A	A	670	670[B]	1000
1,1,1-Trichloroethane	---	1910	1900	1900	2450

* (mg/M^3) - milligrams of substance per cubic meter of air sampled
1 TWA - 8-or 10- hour time-weighted average exposure limit.
2 C - 15-minute ceiling value.
3 STEL - Short Term Exposure Limit - maximal concentration to which a worker can be exposed for a period up to 15-minutes.
A NIOSH Recommends that exposures be minimized and concentrations maintained as low as possible.
B Notice of Intended Changes (1981) -Proposed change of limit for substance to 335 mg/M^3.

n-Butanol:

n-Butanol is a colorless volatile liquid with a pungent odor. The liquid is a primary skin irritant with the vapor an irritant to the eyes and mucous membranes of the nose and throat. Inhalation can cause transitory and persistent dizziness. In addition, headaches and drowsiness may occur.(7,8)

1,1,1-Trichloroethane:

1,1,1-Trichloroethane is a non-flammable liquid with a sweet odor. The liquid and vapor are irritating to the eyes with a dry, scaly, and fissured dermatitis developing upon repeated skin contact. This substance also acts as a narcotic and depressant of the central nervous system. Increasing acute exposures include dizziness, uncoordination, drowsiness, increased reaction time, unconsciousness and death.(7,8)

Perchloroethylene:

Perchloroethylene is a clear, colorless, non-flammable liquid with an etheral odor. Repeated contact may cause a dry, scaly and fissured dermatitis, with high concentrations producing eye and nose irritation. Acute exposure has caused effects on the central nervous system, mucous membranes, eyes, lungs, liver, kidney, heart, and skin. Symptoms of overexposure include headache, dizziness, vertigo or light narcosis, and unconsciousness. Medical experimentation has indicated that animals exposed to high concentrations of perchloroethylene have possible congential abnormalities and also a significant increase of hepatocellular carcinoma (liver cancer).(7,8,9,10)

The current Occupational Safety and Health Administration (OSHA) standard and American Conference of Governmental Industrial Hygienists Thershold Limit Value is 670 mg/M^3 for perchloroethylene. The carcinogenic potential of perchloroethylene in the workplace is still being evaluated, therefore NIOSH recommends that occupational exposure to perchloroethylene be kept to a minimum.

VI. RESULTS AND DISCUSSION

Table I provides the results of the two 8-hour and two short term personal air samples taken in the Cyrel^R plate-making area. Results of analysis of the two 8-hour samples indicate that the airborne concentrations of n-butanol, 9.7 mg/M^3 and 13 mg/M^3, were less than 5% of the OSHA 8-hour Time Weighted Average standard of 300 mg/M^3. Perchloroethylene levels found on the two 8-hour samples were 22 mg/M^3 and 30 mg/M^3 with 58 mg/M^3 found on one short term sample. NIOSH recommendeds that levels of perchloroethylene, due to its carcinogenic potential, be kept to a minimum while the compound is evaluated further. Analysis of second short term air sample indicated a concentration of 1,1,1-trichloroethane, 67 mg/M^3, that was less than 10% of the NIOSH 15-minute ceiling value of 1910 mg/M^3. Airborne exposure to the single worker in the Cyrel^R plate making area to n-butanol or 1,1,1-trichloroethane did not constitute a health hazard.

Ventilation measurements obtained on the local exhaust systems attached to the various machines indicated that the processor ranged from 300 feet per minute (fpm) to 600 fpm, with values of 350 fpm to 1000 fpm taken on the finisher. Measurements of solvent levels indicated that the ventilation systems appear to be controlling the solvent exposures adequately.

From observing the worker during the survey, in addition to the responses given on the questionnaire, none of the symptoms indicated as being concerns of the worker were observed.

VII. RECOMMENDATIONS

1. During the plate making process, the workers' hands have the possibility of coming in contact with solvents as well as slightly acidic water used in the washing step. Due to the ability of these solvents to cause dermatitis upon repeated skin contact and the potential of perchloroethylene to cause congential abnormalities; gloves, which are impervious to these chemicals as well as slightly acidic water, should be used by the worker.

2. Maintain levels of perchloroethylene as low as possible to minimize employee exposures. If possible, the substitution of a less toxic chemical for perchloroethylene should be considered. Environmental monitoring should be conducted periodically to document exposure levels until a suitable substitute can be found.

VIII. REFERENCES

1. National Institute for Occupational Safety and Health. Manual of Analytical Methods, 2nd ed., Volume II, P&CAM S-66, 1977. (DHEW (NIOSH) Publication No. 77-157B).

2. National Institute for Occupational Safety and Health. Manual of Analytical Methods, 2nd ed., Volume III, P&CAM S-328, 1977. (DHEW (NIOSH) Publication No. 77-157C).

3. Occupational Safety and Health Administration. Occupational Safety and Health Standards for General Industry Section 1910.1000 (Tables Z-1, Z-2) 1980 (DOL (OSHA) 1980).

4. American Conference of Governmental Industrial Hygienists. Threshold limit values for chemical substances and physical agents in the workroom environment with intended changes for 1980. Cincinnati, Ohio: ACGIH, 1980.

5. IBID.

6. National Institute for Occupational Safety and Health. Criteria for a Recommended Standard...Occupational Exposure to 1,1,1-Trichloroethane. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1976. (DHEW Publication No. (NIOSH) 76-184).

7. National Institute for Occupational Safety and Health. Occupational Diseases-A Guide to Their Recognition, 1977. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW Publication No. (NIOSH) 77-181).

8. American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment, 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists ACGIH, 1980.

9. National Institute for Occupational Safety and Health. Criteria for a Recommended Standard---Occupational Exposure to Perchloroethylene. Cincinnati, Ohio: National Institute for Occupational Safety amd Health, 1976. (DHEW Publication No. (NIOSH) 76-185).

10. National Institute for Occupational Safety and Health. Current Intelligent Bulletin, Tetrachloroethylene (Perchloroethylene) #20. Cincinnati, Ohio: National Institute for Occupational Safety and Health, January 20, 1978. (DHEW Publication No. (NIOSH) 79-146).

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. King-Smith Printing Company, Detroit, Michigan.
2. Graphic Arts International Union, Local 289.
3. U.S. DOL, Region V.
4. NIOSH, Region V.

For the purpose of informing the one affected employee, a copy of this report shall be posted in a prominent place, accessible to the employees, for a period of thirty (30) calendar days.

Table I

Air Sampling Results of Organics
King Smith Printing Company
Detroit, Mighican
July 28-29, 1981

Sample Type	Sample Time (Minutes)	Sample Volume (Liters)	Results(mg/M3)* n-Butanol TWA[1]	Perchloroethylene TWA	Perchloroethylene Ceiling	1,1,1-Trichloroethane Ceiling
Personal(P)	0834-0837	0.3	--	--	--	67
P	0922-1112	5.16	9.7	22	--	--
P	0922-1112	4.53	13	30	--	--
P	1409-1420	1.14	--	--	58	--
	L.O.D.[2]		0.01	0.01	0.01	0.01
Environmental Criteria	NIOSH		--	(A)	(A)	1910
	OSHA		300	670	--	--
	ACGIH		150	670[B]	1000[3]	2450[3]

* Approximate milligrams of substance per cubic meter of air sampled.

1 TWA - NIOSH 8-to 10- hour/OSHA and ACGIH 8-hour day, 40-hours per week, time weighted-average.

2 L.O.D. - Laboratory limits of detection in millgrams per sample.

3 STEL - Short Term Exposure Limit - Maximal concentration to which workers can be exposed for a period up to 15-minutes.

(A) NIOSH Recommends that levels be minimized and to keep exposures as low as possible.

B ACGIH Notice of Intended Changes to a limit of 335 mg/M^3.