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CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 78-101-556

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I. TOXICITY DETERMINATION

A Health Hazard Evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) on July 12 and September 11, 1978 at the printing shop of Cambridge University Press, 510 North Avenue, New Rochelle, N.Y. 10801, to determine employee exposure to benzene. Methodology used in the evaluation included 1) environmental sampling, 2) laboratory determinations, 3) literature review, 4) inspection of workplace, 5) personal interview, and 6) review of personal medical records.

Results of the health hazard evaluation indicate that workers are not exposed to excessive concentrations of benzene in the print shop.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this report are currently available upon request from NIOSH, Division of Technical Services, Information 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 22161. Information regarding its availability from NTIS can be obtained from NIOSH's Publication Office at the Cincinnati address. Copies of this report have been sent to:

a) Cambridge University Press, New Rochelle, N.Y.
b) U.S. Department of Labor, OSHA, Region II
c) NIOSH, Region II

III. INTRODUCTION

Section 20 (a) (6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a) (6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an employer or authorized representative of employees, to determine whether any substance in the place of employment might have potentially toxic effects as it is used or may

be found.

NIOSH received such a request from Cambridge University Press regarding exposures of workers to benzene in their print shop. Specifically, one of the printers had developed an "anemic condition", and concern was expressed that this employee may be affected by "substances" used in the print shop.

IV. EVALUATION

A. PLANT PROCESS

This facility primarily is a warehouse and distribution center for books printed abroad. The offset print shop prepares high quality announcements of the availability of new books and textbooks. The print shop is approximately 40x30x10feet and houses two offset presses, one plate maker, a paper cutter, and a folding machine. The shop is heated and air conditioned, and has a small exhaust port located over one of the presses. The exhaust duct was extended to the roof in 1976. Prior to that time, the exhaust reportedly was fed into the false ceiling. The work force of the print shop consists of two full-time printers and a folding machine operator.

The shop produces quality announcements of scholarly books, and emphasis is on quality rather than production schedules.

B. EVALUATION DESIGN

The purpose of this Health Hazard Evaluation was to determine if occupational exposure to benzene exists in the print shop. With the realization that benzene is present as contaminant in many petro-chemicals, it was decided to collect both bulk and air-borne samples during the first plant visit. The only chemical solutions used in the print shop are "QS-525 Subtractive Plate Developer" and "Anchor R-228 Blanket and Roller Wash" Plate development takes place only once or twice daily and requires only a few minutes per each development. The blanket and roller wash is used to clean various rollers, etc of the press between runs and for general clean up. Mainly, it is dispensed from safety cans onto rags for clean-up operations. Neither solution lists benzene as a constituent. However, our analysis of bulk samples of the solutions determined that the Anchor R-228 Blanket and Roller Wash contained 2.6% benzene. No benzene was detected in the other solution. The limit of detection was 0.01%

Because small amounts of benzene were found in several of the air-borne samples collected on June 23rd, a return visit was made on September 12th. Additional air-borne samples were collected to obtain a more definitive picture of the extent of exposures to benzene. These samples also were analyzed for isopropanol, xylene, and toluene content.

Because the employees had no particular work station, area samples were collected with the exception of the first few samples in June.

The operating conditions were similar on both days-both presses were in operation approximately 50% of the time. At least one press was always in operation.

C. Evaluation Methods

The sampling and analytical methods of choice for air-borne benzene are described in methods 127 and S 311 of NIOSH's "Manual of Analytical Methods, Second Edition". Samples are collected by drawing air, at known, calibrated rates, through glass tubes containing activated charcoal. Benzene (as well as other organic solvents) will adsorb on the charcoal particles. The samples are then desorbed in carbon disulfide and analyzed by gas chromatography. The detection limits of this type of analysis is 0.005 milligrams of benzene per sample; 0.01 milligram of isopropanol, xylene, or toluene. Knowing the amounts of solvents determined per sample, and the quantity of air pumped through each sample, the concentration for each solvent may be calculated.

Table I lists the sample locations, sampling volumes and results of analyses.

D. Evaluation Criteria

Table II lists the four organic solvents which were sampled for, the exposure standard enforced by the Occupational Safety and Health Administration (OSHA), the exposure standard recommended by the National Institute for Occupational Safety and Health (NIOSH), and the main adverse physiological responses to exposures to each solvent.

In the case of benzene, OSHA has proposed to adopt the 1 ppm (or 3.2 mg/M^3) standard recommended by NIOSH, but the implementation of the reduced standard has been stayed by the courts.

Health standards are developed from experience and research which attempt to relate exposure to a chemical with physiological and pathological response. The pertinence of any standard is questionable when applied to an instance where there is an existing condition which may, in theory, be aggravated from exposure to the chemical.

E. Medical Review

The employee who has developed a blood dyscrasia has worked in printing for most of his adult life since 1936, and has performed similar tasks with similar materials in all of his jobs. The exact materials used in his previous jobs, their chemical composition, and the degree of his exposure cannot be determined at this time. He has worked as an offset printer at this facility since 1968. The materials used have remained essentially the same throughout his employment.

In late 1976, he had several episodes of epistaxis, treated by cautery. In December 1977, he experienced hematuria and was hospitalized at which time a diagnosis of pancytopenia was made. Hematological work-up at that time showed bone marrow dysplasia with pancytopenia. Although the employee has had no further hematuria and has experienced a decrease in bleeding tendencies, his blood count remains essentially unchanged.

From 1962 to 1967, this employee was maintained on colchicine for gout, and since 1967, he has received colchicine intermittently, the last time being about two years ago, when all medication was stopped because of bleeding tendencies. Colchicine, a phenanthrene derivative, is a recognized treatment for gout. Among its effects, the administration of colchicine may cause bone marrow depression with pancytopenia (PDR, 32nd edition, Medical Economics Company, 1978 page 994).

F. Evaluation Results

The purpose of this Health Hazard Evaluation primarily was to assess the exposure of one employee who had developed pancytopenia. There are 2 other employees in this operation both of whom have been employed for only a short period of time, with the maximum duration being 2 years.

In summary, therefore, this is a case of a patient with pancytopenia and a dysplastic marrow, the etiology of which is indeterminate at this time. This investigation disclosed 2 possible etiologic factors: the use of colchicine and exposure to benzene. The findings of this investigation in the present work area disclosed an exposure to benzene well below the proposed benzene limits of 1 part per million. The possibility of greater exposures in the past, both at this job and in previous jobs, cannot be evaluated at this time. However, the continued exposure of a worker with pancytopenia in a work environment where benzene is present is to be questioned, and should be predicated upon his medical follow-up and the progress of his hematological findings.

Table I

Benzene Concentrations

Sample Location	Date	Sampling Volume (liters)	Benzene (mg/M^3)
Press Operator #2, Breathing Zone	6-23	11.1	*
Folding Machine Operator, Breathing Zone	6-23	14.3	*
Folding Machine Operator, Breathing Zone	6-23	13.7	*
Press Operator #1, Breathing Zone	6-23	13.4	*
" " " " "	6-23	13.5	*
" " " " "	6-23	15.6	0.64
" " " " "	6-23	5	*
A. Aisle outside Press Room	9-12	381	0.05
B. South East Corner, Near First-Aid Kit	9-12	47	*
C. Ledge, Center of South Wall	9-12	389	0.07
D. South-West Corner	9-12	993	0.03
E. Ledge East Wall, over Plate Maker,	9-12	56	*
	6-23	102	0.26
	6-23	109	0.20
	6-23	10.2	*
	6-23	8.5	*
F. Ledge, near Desk	9-12	55	*
G. Desk	9-12	46.4	*
H. Workbench, North Side of Room.	9-12	48	*
	6-23	116	0.18
	6-23	95	0.20
I. Near Paper cutter	9-12	53.6	*
J. Near Folding Machine	6-23	29	*

Sample Location	Presses	Sampling Volume (liters)	Benzene (mg/M^3)
K. Between Presses	9-12	998	0.06
	9-12	399	0.12
	6-23	156	1.54
	6-23	29	0.77
	6-23	(Cleaning-Up)	*

* Less than the detectible limit of 0.005 milligram of benzene per sample

The OSHA standard for benzene exposure is 32 mg/M^3.

Table I

Solvent Concentrations

Location	Sampling Volume (liters)	Isopropanol[1] (mg/M^3)	Xylene[1] (mg/M^3)	Toluene[1] (mg/M^3)
A. Aisle Outside Press Room	381	0.31	0.08	0.16
B. South East Corner New First-Aid Kit	47	1.07	*	*
C. Ledge, Center of South Wall	389	0.39	0.13	0.36
D. South-West Corner	993	0.18	0.06	0.18
E. Ledge, East Wall	56	1.60	*	*
F. Ledge, Near Desk	55	1.8	0.18	0.18
G. Desk	46.4	1.10	*	*
H. Workbench, North Side	48	0.80	*	*
I. Near Paper Cutter	53.6	0.90	*	*
K. Between Presses	998	0.26	0.13	0.31
	399	0.60	0.30	0.75

1. Limit of detection = 0.01 milligram

*. Less than limit of detection

Table II

Compound	OSHA standard	NIOSH recommended standard	Possible pyysiological responses
Benzene	10 ppm (32 mg/M^3) 8 hour TWA; 25 ppm ceiling 50 ppm maximum for 10 minutes	1 ppm ceiling for 60 minutes	blood changes including leukemia and aplastic anemia
Isopropanol	400 ppm (984 mg/M^3) 8 hour TWA	100 ppm TWA; 800 ppm ceiling for 15 minutes	mucous membrane irritation
Xylene	100 ppm (434 mg/M^3) 8 hour TWA	100 ppm TWA 200 ppm ceiling for 10 minutes	Central nervous system depressant; airway irritation
Toluene	200 ppm (750 mg/M^3) 8 hour TWA 300 ppm ceiling 500 Maximim for 10 minutes	100 ppm TWA 200 ppm ceiling	Central nervous system depressant

ppm = parts of compound per million of air

V. REFERENCES:

Physician's Desk Reference, 32nd Edition; Medical Economics Company, 1978, page 994.

NIOSH Manual of Analytical Methods, Second Edition; U.S. Dept. of HEW, Cincinnati, Ohio, 1977 Volume I, Method 127; Volume III, Method S 311.

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