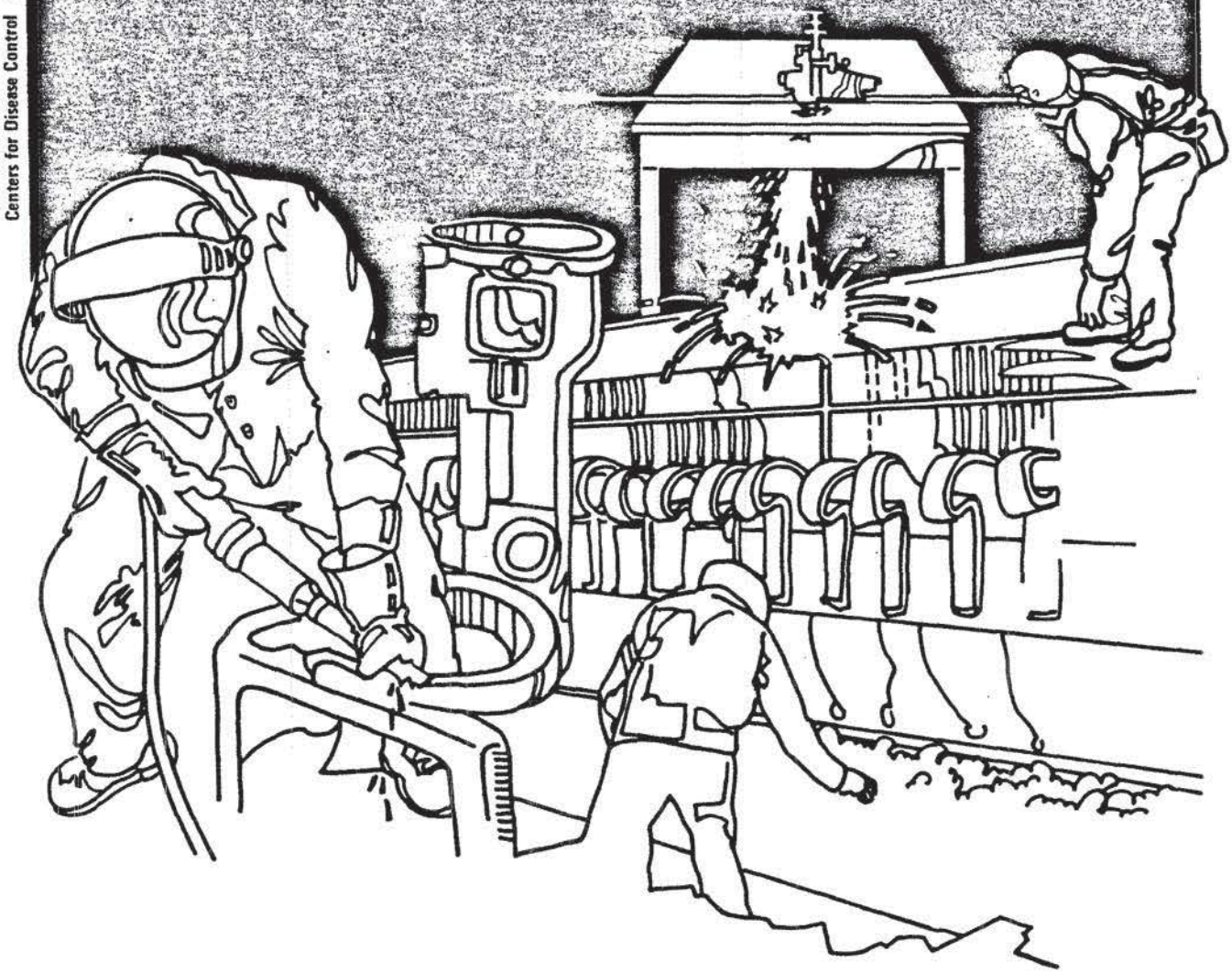
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

80-248-791

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. 699(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.

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January 1981
National Oceanic and
Atmospheric Administration
U.S. Dept. of Commerce
Washington, D.C.

NIOSH Investigators:
James D. McGlothlin, IH

I. SUMMARY

In September 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for technical assistance from the National Oceanic and Atmospheric Administration (NOAA) to evaluate anhydrous ammonia exposure among Ozalid operators, photographers, and plate makers in the Department of Commerce building, Washington, D.C. Symptoms of exposure included eye irritation, headaches, respiratory difficulty, and sinus irritation.

NIOSH conducted an environmental evaluation on November 3, 1980, in the Diazo printing room of NOAA, to evaluate anhydrous ammonia exposure among workers making copies of maps and charts on a GAF 1000.P Diazo Printer. Personal and area air sampling for anhydrous ammonia and observation of work practices and working conditions were performed. One employee worked in the Diazo printer room on a regular basis. Sixteen short-term air samples (3 personal and 13 general area) were taken in the Diazo printer room during the NIOSH survey for airborne anhydrous ammonia exposure in the work area. Personal exposure to anhydrous ammonia ranged from 3.7 parts per million parts of air (ppm) to 4.0 ppm. General area results ranged from 1.8 ppm to 17.4 ppm. These concentrations are below the NIOSH recommended criteria for anhydrous ammonia of 50 ppm/5-minute ceiling concentration, and the American Conference of Governmental Industrial Hygienists (ACGIH) time-weighted average criteria of 25 ppm. Spot checks for anhydrous ammonia, carbon dioxide, and carbon monoxide were also performed using Drager tubes. The highest concentration found during sampling was 15 ppm for anhydrous ammonia, approximately 0.025 percent for carbon dioxide, and less than 10 ppm for carbon monoxide. All levels were below recommended permissible exposure limits.

An unstructured interview concerning the work and health history of the Diazo printer operator was performed. The interview revealed that the printer operator occasionally suffered breathing difficulty, sinus problems, and headaches when working more than 8 hours per day, and on heavy workload days when the building ventilation system was turned off after regular working hours.

On the basis of this evaluation, a health hazard due to anhydrous ammonia exposure for the Diazo printer operator did not exist on the day NIOSH sampled. However, a potential health hazard exists for this worker for anhydrous ammonia due to extended workday exposure (>8 hours), increased workload, and especially when the building ventilation system is turned off after regular work hours. Recommendations concerning employee exposure to anhydrous ammonia are presented in Section VI of this report.

KEYWORDS: SIC 2752, Diazo Printer, anhydrous ammonia, eye irritation, breathing difficulty, sinus irritation.

II. INTRODUCTION

On September 30, 1980, NIOSH received a technical assistance request from the Chief of the Photomechanical Branch of the National Oceanic and Atmospheric Administration to evaluate anhydrous ammonia exposure among its Ozalid operators, photographers, and plate makers. NIOSH performed its survey on November 3, 1980, and determined that only the Diazo Printer operator could have potential exposure to significant levels of anhydrous ammonia. Therefore, other workers who spent very little time in the Diazo Printer room were excluded from this evaluation.

III. BACKGROUND INFORMATION

The Photomechanics Department of the National Oceanic and Atmospheric Administration is located in the basement of the Department of Commerce building in Washington, D.C. The GAF (General Aniline Film) 1000.P is a 54 inch wide, high speed Diazo Printer, designed to produce optimum quality Diazo copies of oceanic maps and coastal charts at speeds of up to 100 feet per minute. The Diazo Printer operates much like a blueprint machine, with a high intensity mercury vapor lamp, light sensitive paper, and anhydrous ammonia fed at 55 cubic centimeters per minute into the machine as developer. Original copies of maps and charts can be fed into the machine almost continuously by the operator, while copies roll out of the back of the machine onto a collecting table. The copied maps and charts are rolled up, put into a tube, and sent to shipping. One worker does the map and chart copy preparation, as well as Diazo printing. The Diazo Printer is located in an enclosed 20' x 21' x 8' room, is isolated from the other machine print (lithographic) rooms, and is not subject to fugitive organic vapor emissions from these printing operations. Local exhaust is provided at the back and bottom of the Diazo Printer to carry away heat and excess anhydrous ammonia.

General ventilation is supplied by one centrally located ceiling vent and the general exhaust air is located in the ceiling, next to the wall, and in back of the operator.

IV. SAMPLING DESIGN

A. Evaluation Criteria and Health Effects Data

Exposure criteria have been developed to evaluate a worker's exposure to toxic substances in an occupational setting. Based on available human and animal studies, and industrial experience, these values represent levels to which nearly all workers may be exposed for an 8-hour day, 40-hour workweek, throughout a working lifetime without adverse effects. The recommended exposure criteria, their source, and known health effects are listed below.

Substance	Exposure Criteria	Source	Health Effects
Anhydrous Ammonia	50 ppm 50 ppm/ 5 min. ceiling 25 ppm	OSHA NIOSH ACGIH	Contact with liquid anhydrous ammonia or gas is irritating to the nose eyes, and to moist skin. Mild to moderate exposure to the gas can produce headache, salivation, burning of throat, and vomiting. Higher exposures can cause severe irritation of the respiratory tract w/ production of cough, pulmonary edema and respiratory arrest. (1,2,3)
Carbon Dioxide	5000 ppm 10,000 ppm	OSHA NIOSH	CO_2 is a simple asphyxiant. Concentrations greater than 10% (100,000 ppm) can produce unconsciousness and death from oxygen deficiency. Concentrations of 5% may produce shortness of breath. (1,2)
Carbon Monoxide	50 ppm 35 ppm	OSHA NIOSH	CO combines with hemoglobin to form carboxyhemoglobin which causes tissue hypoxia. Symptoms are headache, dizziness, drowsiness, nausea, vomiting, and death. (1,2)

B. Materials and Methods

The industrial hygiene survey consisted of sampling for anhydrous ammonia with sampling pumps calibrated at 1 liter per minute, and connected to sampling trains of tygon tubing and impingers. The impingers were filled with 10 to 20 milliliters of diluted sulfuric acid to collect anhydrous ammonia. All sampling was done in the Diazo Printer room. Three short-term personal breathing zone samples were taken on the Diazo Printer operator, and 13 general area samples were taken at various points in the room to characterize ambient levels, and possible pooling of anhydrous ammonia gas. Drager tubes for anhydrous ammonia, carbon dioxide, and carbon monoxide were used to spot check possible

contamination sources. Carbon dioxide and carbon monoxide measurements were made because of potential infusion of contaminated air from a parking garage located next to the Diazo Printing room. The impinger samples for anhydrous ammonia were analyzed according to NIOSH method P & CAM 125(4). Ventilation measurements were taken at all air supply and exhaust ports in the Diazo Printer room. Smoke tubes were used to characterize air flow and for determination of room pressure (positive or negative).

V. RESULTS AND DISCUSSION

The results of the air samples are presented in Table I. All environmental samples were below the OSHA criteria for anhydrous ammonia of 50 parts per million (ppm), and the ACGIH recommended criteria of 25 ppm for an 8-hour work day. The highest concentrations of anhydrous ammonia were found on the top right and back of the Diazo Printer ($\bar{x}$=8.9 ppm) as opposed to the left side and in front of the Printer ($\bar{x}$=3.1 ppm). The reason for this difference may be because of poor air circulation, the location of local exhaust unit on the Diazo Printer (bottom, left), and the vapor pressure of anhydrous ammonia gas (>1 atmosphere), which tends to migrate toward the floor.

Ventilation measurements were made at the ceiling air supply, ceiling exhaust, and at the face of the Diazo Printer for approximate local exhaust ventilation. Total air supply was 1956 cubic feet per minute (cfm) compared to total exhausted air (including local exhaust) at 2510 cfm. The room is under negative pressure in excess of 550 cfm and may be drawing in contaminants such as automobile emissions from the adjacent garage. Measurements for carbon monoxide and carbon dioxide, however, were within normal environmental levels of less than 10 ppm and 0.025 percent, respectively. When all ventilation units are on there is one room air change every 2 minutes, which is very adequate.

The informal interview with the Diazo Printer operator revealed this worker occasionally suffered respiratory irritation, eye and sinus irritation, and headaches on days when the work load was heavy, while working extra long work days (>8 hours), and the building's main ventilation systems were turned off. In addition, the local exhaust system does not work very well when the building ventilation is off. Since the local exhaust system (i.e., small fan and 6" diameter duct) is tied into the main exhaust air system, the increased static pressure caused by stagnant air in the larger main air duct hampers the removal of anhydrous ammonia gas.

VI. RECOMMENDATIONS

1. When working extra long days (>8 hours), the Diazo Printer operater should inform building management not to turn off main fan units that supply and exhaust air to this room.

2. Another suggestion would be to install an automatic on-off timer for the fan units to this room which could be pre-programmed to turn off after 12:00 P.M. and on before 6:00 A.M.

3. Balance air supply and exhaust systems so that the room is under slightly negative pressure. Present system is too negative which causes drafts and the potential infusion of outside air contamination.

4. Relocate exhaust system near the back and toward the bottom of the room for efficient removal of excess anhydrous ammonia gas. The present exhaust system, located behind the worker, draws some of the gas through the worker's breathing zone, and although it exhausts enough air, is very poorly located.

VII. REFERENCES

1. Occupational Diseases. A Guide to Their Recognition. Revised Edition. DHEW (NIOSH) Pub. No. 77-181, pp. 412, 414, 417. June, 1977.

2. Occupational Safety and Health Standards for General Industry. U.S. Dept. of Labor (OSHA) Section 1910.1000, pg. 292. Jan., 1978.

3. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment, with Intended Changes for 1979. American Conference of Governmental Industrial Hygienists (ACGIH). 1980.

4. NIOSH Manual of Analytical Methods, Second Edition, Volumes 1-5. DHEW (NIOSH) Pub. No. 77-157A. April, 1977.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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IX. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161.

Copies of this report have been sent to:

1. National Oceanic and Atmospheric Administration
2. Diazo Printer Operator
3. U.S. Dept. of Labor, Region III
4. NIOSH, Region III

Table I

Personal & General Area Air Samples
for Anhydrous Ammonia

National Oceanic and Atmospheric Administration
Department of Commerce
Washington, D.C.
November 3, 1980

HE 80-248

Sample Location	Sample Duration		Concentration (ppm) Anhydrous Ammonia
	Time On	Time Off	
Personal-Diazo print operator	09:45	10:22	4.0
General Area (GA) Rt. side top GAF printer	09:50	10:39	9.2
G.A. Lt. side top GAF printer	09:54	10:40	3.4
G.A. Rt. side middle GAF printer	10:00	10:28	7.5
G.A. Lt. side middle GAF printer	10:02	10:30	5.3
G.A. near ceiling exhaust	10:10	10:45	4.1
G.A. near floor back of GAF printer	10:14	10:47	7.7

Table I, Cont'd.

Sample Location	Sample Duration		Concentration (ppm) Anhydrous Ammonia
	Time On	Time Off	
Personal-Diazo print operator	10:22	10:55	3.7
G.A. Rt. side middle GAF printer	10:28	11:05	6.1
G.A. Lt. side middle GAF printer	10:30	11:06	4.7
G.A. Rt. side top GAF printer	10:39	11:44	4.2
G.A. Lt. side top GAF printer	10:40	11:45	1.8
G.A. near ceiling exhaust	10:45	11:23	3.4
G.A. near floor back of GAF printer	10:47	11:24	6.1
Personal-Diazo print operator	13:46	14:27	4.2
G.A. Rt. side top of machine	13:49	14:30	17.4

Recommended Exposure Criteria: 50 ppm - OSHA
50 ppm/5 min. - NIOSH ceiling

Limit of Detection for analytical method: 3.0 micrograms NH_3/sample

1 ppm = parts of contaminant per million parts of air