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FAIRCHILD FASHION &
MERCHANDISING GROUP
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I. SUMMARY

On December 4, 1992, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate employee exposures to chemicals used during film processing in the Photography Department, Fairchild Fashion & Merchandising Group, New York, New York. The request was prompted by employee complaints of rashes, headaches, sinus congestion, sneezing, coughing, and eye, nose, and throat irritation. The request indicated that employee symptoms were exacerbated by inadequate ventilation in the darkroom.

On February 11, 1993, a NIOSH investigator conducted a survey in the Photography Department. Personal breathing zone and area air sampling was conducted to characterize exposures to hydroquinone and aminoethanol compounds. No hydroquinone, ethanolamine, or diethanolamine was detected in the workroom air.

The environmental sampling results indicate that employees in the developing room and the darkroom were not exposed to excessive levels of hydroquinone or aminoethanol compounds. Recommendations to remove odors from the sampled areas, and to address workers' safety and health concerns, are included in Section VIII of this report.

KEYWORDS: SIC 7384 (photofinishing laboratories), aminoethanol compounds, diethanolamine, ethanolamine, hydroquinone.

II. INTRODUCTION

On December 4, 1992, the National Institute for Occupational Safety and Health (NIOSH) received a request from an employee representative to conduct a Health Hazard Evaluation (HHE) at Fairchild Fashion and Merchandising Group, New York, New York. The request indicated that employees in the Photography Department darkroom and developing room were experiencing eye and upper respiratory irritation, contact dermatitis, headaches, sinus congestion, sneezing, and coughing.

On February 11, 1993, a NIOSH investigator conducted an industrial hygiene evaluation of workers processing black and white photographs in the darkroom and developing room.

III. BACKGROUND

Fairchild Fashion and Merchandising Group publishes trade journals for the clothing industry. The Photography Department is located on the fourth floor of a midtown Manhattan building.

Film is processed in the developing area, where an employee makes negatives that are subsequently developed into black and white photographs in the darkroom. The developing area consists of two small rooms adjacent to a larger work area. Each of the smaller developing rooms, measuring approximately four feet by four feet, is entered through a revolving darkroom door. There is a sink in each of the small rooms which, when in use, contains one tray each of water, fixer, and developer. There is no local exhaust ventilation in either of the rooms.

Approximately five employees work in the darkroom where negatives are enlarged and developed into photographs using an Ektamatic processor or Dektol developing solutions. Developed photographs are placed in a solution of sodium thiosulfate pentahydrate and liquid hardener before passing through a series of water baths. The photographs are dried in an adjacent room. There is no local exhaust ventilation in the darkroom.

IV. EVALUATION DESIGN AND METHODS

The industrial hygiene investigation consisted of an evaluation of chemicals used in photo lab procedures, and worker exposure to airborne components of photographic chemicals during routine darkroom and developing room operations. Personal breathing zone (PBZ) and area air sampling for hydroquinone, ethanolamine, and diethanolamine was conducted in the developing room where Kodak HC-110 developer is used. Kodak HC-110 developer contains all of the sampled compounds. A different developer, identified as Kodak DEKTOL developer (single powder), is used in the darkroom. This developer contains hydroquinone, but no aminoethanol compounds. PBZ and area air sampling for hydroquinone was conducted in the darkroom; since no ethanolamine or diethanolamine were expected to be present in the darkroom, only one area air sample for aminoethanol compounds was obtained in this area.

PBZ sampling was conducted by attaching a battery-powered sampling pump to each worker's belt, and drawing air through appropriate sampling media located in the worker's breathing zone. Sampling pumps were set at flow rates specified for collecting the targeted contaminants, and were calibrated before and after sampling to ensure that the desired flow rates were maintained throughout the sampling period. Area samples were obtained using

pumps and media which were placed at selected locations in the darkroom and developing room during the sampling period.

Hydroquinone

Air sampling for hydroquinone was conducted according to NIOSH Method 5004.[1] Workplace air was drawn through a mixed cellulose ester filter (MCEF) and immediately after sampling, each filter was transferred with tweezers to a 60 milliliter (ml) ointment jar containing 10 ml of 1% acetic acid. Only one filter was placed in each jar. Field blanks were processed similarly. Samples were analyzed for hydroquinone by high performance liquid chromatography (HPLC) and ultraviolet detection. The minimum detectable concentration (MDC) was 16 micrograms of hydroquinone per cubic meter of air ($\mu g/m^3$), based upon an analytical limit of detection (LOD) of 10 µg of hydroquinone per sample and an average sample volume of 611 liters. The minimum quantifiable concentration (MQC) was 54 $\mu g/m^3$, based upon an analytical limit of quantitation (LOQ) of 33 µg per sample.

Ethanolamine and Diethanolamine

Air sampling for aminoethanol compounds was conducted according to NIOSH Method 3509.[1] Each sample was obtained by drawing air through a midget impinger containing 15 ml of 2 millimolar (mM) hexanesulfonic acid.

After sampling, the solution from each impinger was transferred to a vial for shipment. Field blanks were processed similarly. Samples were analyzed for ethanolamine and diethanolamine by ion chromatography. The minimum concentrations which could be detected and quantified, based upon an average sample volume of 192 liters, are given below in parts per million:

Analyte	LOD (µg/sample)	LOQ (µg/sample)	MDC (ppm)	MQC (ppm)
Ethanolamine	9	29	0.02	0.060
Diethanolamine	20	51	0.02	0.062

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

Some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and

thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),[2] and 3) the U.S. Department of Labor (OSHA) occupational health standards.[3] Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8-10 hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Hydroquinone[4]

Hydroquinone is a reducing agent which is used as a photographic developer, and as an antioxidant or stabilizer for certain materials which polymerize in the presence of oxidizing agents. Hydroquinone, as a solid, is colorless, and exists as hexagonal prisms. Many of its derivatives are used as bacteriostatic agents, and others, particularly 2,5-bis(ethyleneimino)-hydroquinone, have been reported to be good antimitotic and tumor-inhibiting agents. The NIOSH REL for hydroquinone is a 2 mg/m^3 ceiling concentration which should not be exceeded at any time. The OSHA PEL and the ACGIH TLV for hydroquinone is 2 mg/m^3 for an 8-hour TWA.

Skin sensitization to the dry solid is very rare, but does occur on occasion from contact with its alkaline solution. The skin may be depigmented by repeated applications of ointments of hydroquinone, but this virtually never occurs from contact with dust or dilute water solutions. Following prolonged exposure to elevated dust levels, brownish conjunctiva stains may appear. These may be followed by corneal opacities and structural changes in the cornea which may lead to loss of visual acuity. The early pigmentary stains are reversible, while the corneal changes tend to be progressive.

Oral ingestion of large quantities of hydroquinone may produce slurred speech, tinnitus, tremors, a sense of suffocation, vomiting, muscular twitching, headache, convulsions, dyspnea and cyanosis from methemoglobinemia, and coma and collapse from respiratory failure. The urine is usually green or brownish green. No systemic symptoms have been found following inhalation of hydroquinone dust. Oxidation of hydroquinone may produce quinone vapor which is highly irritating.

Diethanolamine[5]

Diethanolamine is a viscous liquid with a faint ammonia odor. It is used in the manufacture of rubber chemicals, surface active reagents, herbicides, demulsifiers. Diethanolamine is

used to scrub gases, and as an emulsifier and dispersing agent in agricultural chemicals, cosmetics and pharmaceuticals. Diethanolamine is a skin and mucous membrane irritant.

Ethanolamine[6]

Ethanolamine is a colorless liquid with a mild ammonia-like odor. Ethanolamine vapor is a skin, eye, and respiratory irritant and has some narcotic properties. In one study, liquid ethanolamine applied to the human skin for 1.5 hours caused marked redness. No systemic effects from industrial exposure have been reported.

The OSHA PEL, NIOSH REL, and ACGIH TLV for ethanolamine are 3 ppm for an 8-hour TWA; the ACGIH and NIOSH STEL for ethanolamine is 6 ppm.

VI. RESULTS

Hydroquinone

Results of air sampling for hydroquinone are presented in Table 1. Hydroquinone was not detected in any of the personal or area air monitoring samples.

Aminoethanol Compounds

Results of air sampling for ethanolamine and diethanolamine are presented in Tables 2. Neither compound was detected in any of the personal or area air samples.

VII. DISCUSSION

Analysis of workplace air samples obtained by the NIOSH investigator did not indicate exposure to airborne hydroquinone or aminoethanol compounds in the developing room and darkroom. However, there is a possibility of skin and eye contact with photographic chemicals, especially during the preparation of solutions used in the developing room and darkroom. A plumbed emergency eyewash should be available in the darkroom and each of the small developing rooms. The use of gloves and chemical goggles when chemicals are handled or mixed would diminish the potential for such exposure. The use of tongs to transfer photographs between trays of solutions (as currently practiced) should minimize skin contact with photographic solutions. Nevertheless, it was reported that an employee has experienced a rash on the hands after removing photographs from the final water bath, even though impervious gloves were worn. It is possible that the rash may have resulted from individual hypersensitivity to a component of darkroom solutions, some of which could be present in trace concentrations on or inside the gloves. Based upon the results of this investigation, no long-term or chronic health effects are anticipated among employees in the photo lab.

During the evaluation, concern was expressed about excessive odors from the solutions in the darkroom. An effective means of controlling odors, and exposure to airborne contaminants, is local exhaust ventilation. Local exhaust ventilation should be designed and installed under the supervision of a ventilation engineer in accordance with current practices for the design, installation, maintenance, and evaluation of industrial ventilation systems.

VIII. RECOMMENDATIONS

1. Local exhaust ventilation systems should be installed in the darkroom and the developing room to control chemical odors. Presently, the only source of ventilation is the building's heating, ventilating and air conditioning system. This system was not designed to remove contaminants generated in the photo lab.

2. Chemical goggles and impervious gloves should be worn when handling or preparing chemicals used for processing photographs. Care should be taken to ensure that personal protective equipment is stored in a clean location, and that it does not become contaminated with materials which could cause dermatitis or other adverse health effects.

3. A plumbed emergency eyewash should be installed in the darkroom and in each of the small developing rooms. Eyewash bottles do not provide adequate protection, as bottles cannot provide a minimum 15-minute flush.
4. Management should develop and implement a Chemical Hazard Communication Program in accordance with OSHA Standard 29 CFR 1910.1200. An effective Hazard Communication Program would ensure that employees are informed and trained in the hazards associated with chemicals used at the workplace.

IX. REFERENCES

1. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods, Volume 1, Third Edition. Cincinnati, Ohio. DHHS (NIOSH) Publication No. 84-100, Jan. 1984.

2. American Conference of Governmental Industrial Hygienists. Threshold limit values for chemical substances and physical agents in the workroom environment and biological exposure indices with intended changes for 1992 - 1993. Cincinnati, Ohio. American Conference of Governmental Industrial Hygienists, (ACGIH), 1992.

3. Occupational Safety and Health Administration. OSHA safety and health standards. 29 CFR 1910.1000. Occupational Safety and Health Administration, revised 1991.

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

5. Encyclopedia of Occupational Safety and Health. Geneva, Switzerland: International Labor Organization, 1983.

6. National Institute for Occupational Safety and Health. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. (DHHS (NIOSH) publication no. 81-123).

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Copies have been sent to:

1. Fairchild Fashion & Merchandising Group
2. OSHA, Region II
3. Confidential requestor

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.

Table 1.

Hydroquinone Air Sampling Results

Fairchild Fashion & Merchandising Group
New York, New York
February 11, 1993

Location	Type	Sampling Period	Sample Volume (liters)	Concentration[1] (mg/m^3)
Developing Room	Personal	0950-1502	597	< 0.016
	Area	1005-1503	581	< 0.016
Darkroom	Personal	1014-1243 1332-1600	581	< 0.016
	Personal	1019-1600	685	< 0.016

1. Minimum detectable concentration, 0.016 mg/m^3

Table 2.

Aminoethanol Compound Air Sampling Results

Fairchild Fashion & Merchandising Group
New York, New York
February 11, 1993

Location	Type	Sampling Period	Sample Volume (liters)	Concentration[1,2] (ppm)	
				EtA	DEA
Developing Room	Personal	0951-1502	182	< 0.02	< 0.02
	Area	1000-1503	201	< 0.02	< 0.02
Darkroom	Area	1036-1533	194	< 0.02	< 0.02

1. EtA - Ethanolamine
   DEA - diethanolamine

2. Minimum detectable concentration: EtA, 0.02 ppm, DEA, 0.02 ppm