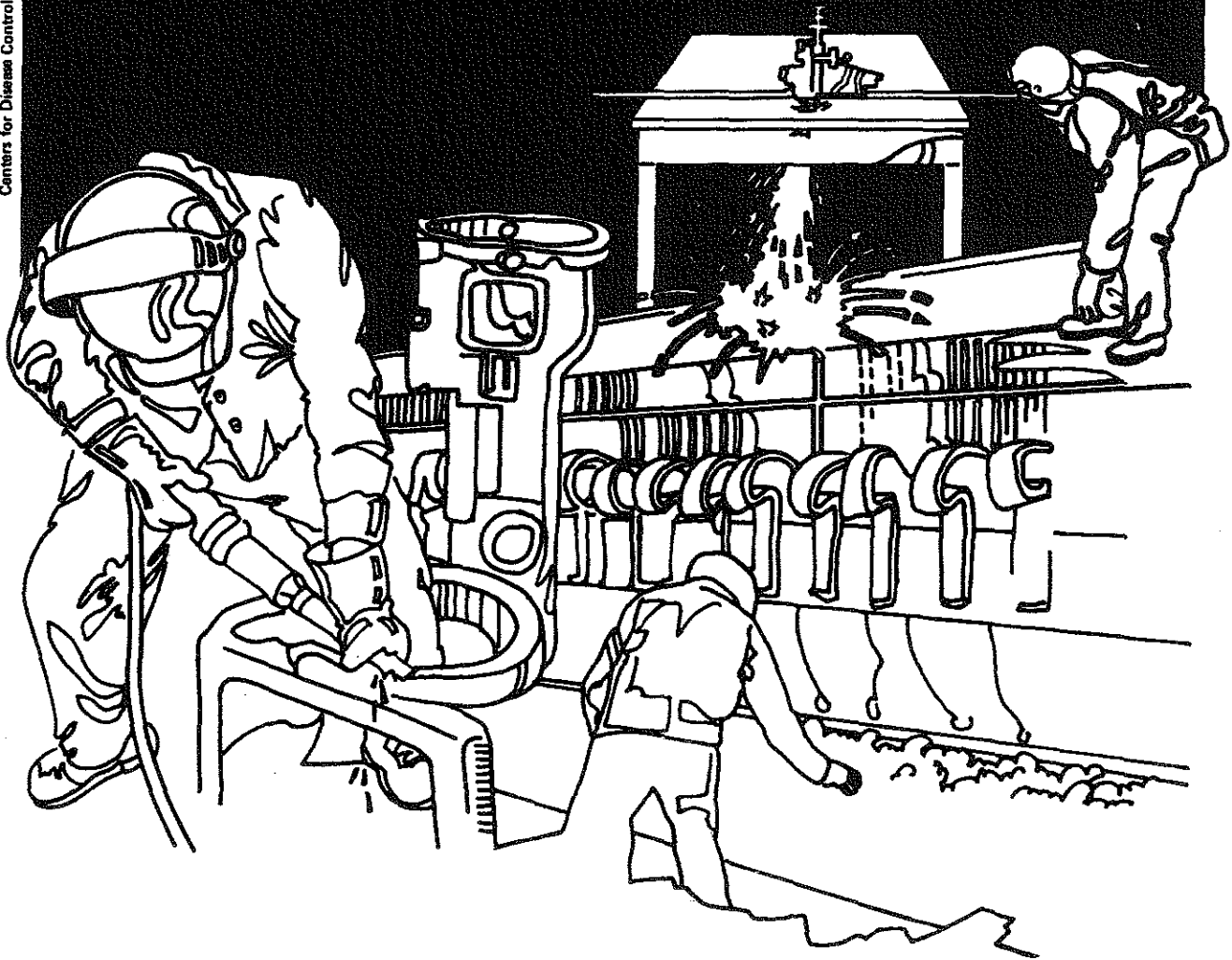


NIOSH



Health Hazard Evaluation Report

HETA 81-117-1087
TWEDDLE LITHO COMPANY
ST. CLAIR SHORES, 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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 81-117-1087
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TWEDDLE LITHO COMPANY
ST. CLAIR SHORES, MICHIGAN

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I. SUMMARY

On July 28-30, 1981, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation at Tweddle Litho Company (an offset lithographic printing company), St. Clair Shores, Michigan. The investigation evaluated exposures of printing press operators to dust generated from asbestos-containing brakes on web-fed presses, and exposures of press operators to organic solvents vaporized during washing of press rolls.

Two brake disc pads were found to contain 30% chrysotile asbestos fiber, as determined by polarized light microscopy (PLM) analysis. Eleven personal breathing zone air samples for measurement of exposure to airborne asbestos showed asbestos fiber concentrations of less than the minimum detectable limit (<4500 fibers per filter) by phase contrast microscopy analysis. Four samples of residual dusts recovered from the brake assembly housing box did not show any asbestos fibers by PLM analysis. The absence of asbestos fibers in the residual dusts was confirmed by transmission electron microscopy analysis of these samples. This result is explainable by the theory that (as a result of the high surface temperature and severe abrasion that occurs during the braking action) chrysotile undergoes dehydroxylation and recrystallization of chrysotile asbestos forms the amorphous non-toxic mineral forsterite (Mg_2SiO_4). Short-term exposures to isopropanol, xylene, and petroleum naphthas were evaluated during clean-up of the Miehle sheet-fed press rolls. Exposures were <5% (range 33 to 67 mg/m^3) of the NIOSH 15-minute criterion for isopropanol, <15% (range 46 to 118 mg/m^3) of the NIOSH 10-minute ceiling criterion for xylene, and <10% (range 25 to 125 mg/m^3) of the NIOSH ceiling criterion for petroleum naphthas. The petroleum naphtha component of the solvent wash mixture did not contain detectable amounts of n-hexane or n-heptane.

Health questionnaires were administered to 18 of 23 directly exposed workers. Four pressmen reported persistent problems with dermatitis and skin irritation localized on the hands. Five pressmen reported occasional dizziness and lightheadedness, and eight pressmen reported occasional mild eye irritation during cleaning of the press rolls. Six pressmen were concerned with exposure to excessive press noise.

Based on these results, NIOSH concluded that there was not a health hazard from airborne exposure to asbestos. Under the conditions evaluated, exposures to isopropanol, xylene, and petroleum naphthas above current evaluation criteria did not exist. The symptoms of dizziness, lightheadedness, and eye irritation reported, however, indicate that the pressmen could be periodically exposed to organic vapor levels with resultant mild acute toxicity. Recommendations to improve work practices and procedures, and criteria for conducting a noise survey are offered in Part VIII.

KEYWORDS: SIC 2752 (Lithographic Printing), asbestos, brakes, solvents, isopropanol, xylene, petroleum naphthas, and forsterite.

II. INTRODUCTION

On December 15, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation at Tweddle Litho Company, St. Clair Shores, Michigan. The Graphic Arts International Union asked NIOSH to evaluate asbestos and organic solvent exposures by pressman operating the web- and sheet-fed lithographic printing presses.

NIOSH distributed a letter report in August 1981 and an interim report in March 1982, which presented the results of the July 27-29, 1981, field survey.

III. BACKGROUND

Tweddle Litho Company is a commercial printer of catalogs, brochures, manuals, price lists, training guides. Standard offset lithographic techniques are used. Offset lithography involves one transfer of the ink from an offset plate to a resilient rubber-blanketed cylinder, followed by a second transfer from the rubber blanket to the paper stock as it passes between the blanket cylinder and impression cylinder.

The company began operations in 1954. There are presently approximately 31 administrative and 36 production employees.

The NIOSH health hazard evaluation was limited to the Press Department, which consists of both web- and sheet-fed presses. There are two web-fed presses with operating speeds of approximately 20,000 feet per hour. Both webs are equipped with automatic paper splicers for rapid paper roll change, heat-set ovens for proper ink curing, paper folding and glueing systems. The automatic paper splicer has a braking system that maintains proper tension on the paper to prevent wrinkling and bagging (or flapping paper). The system consists of a pneumatically operated disc brake that controls the rotational speed of the paper stock rollers. The workers were concerned with possible exposure to asbestos fibers released from the brakes on these presses. The concern included possible low-level chronic exposures because of continuous use of the braking system, and high-level acute exposures during blow-down of the braking assembly prior to checking and replacement of the disc brake pads. The web presses each involve a head pressman, second pressman, and feeder operator 15 work turns per week.

There is one two-color sheet-fed press used for short runs and cover productions. The press has nonstop loading and unloading capabilities. Each sheet (28- by 40-inch maximum dimensions) is fed automatically through the press individually. An isopropyl alcohol (hereafter referred to as isopropanol) damping system is used to increase the density of the water in the press. Worker concerns related to exposures to organic solvents during washing of the press

rollers after a production run. The sheet-fed press involves a head pressman and press helper five turns per week.

IV. EVALUATION DESIGN AND METHODS

NIOSH conducted an industrial hygiene and medical questionnaire survey on July 28-30, 1981.

A. Industrial Hygiene

The industrial hygiene survey involved an evaluation of exposures to asbestos by the web-fed press operators, and exposures to organic solvents (including isopropanol, xylene, and petroleum naphthas) by the sheet-fed press operators. Airborne samples of asbestos were collected on a mixed cellulose ester membrane filter mounted in an open-face cassette using calibrated constant flow sampling pumps operating at 1.5 liters per minute (LPM). The samples were analyzed using phase contrast microscopy according to NIOSH Method P&CAM 239.¹ The analytical limit of detection (LOD) is 4500 fibers greater than 5 micrometers in length per filter. Samples of the disc brake pad and bulk settled dust were analyzed for asbestos. A visual estimation of the percentage of asbestos was made using polarized light microscopy and dispersion staining techniques. Selected bulk settled dust samples were examined for asbestos and other elemental components using transmission electron microscopy (TEM).

Airborne isopropanol, xylene, and petroleum naphthas were collected on 150 milligram (mg) activated charcoal tubes using constant flow sampling pumps operating at 0.8 LPM. The isopropanol was desorbed from the charcoal with carbon disulfide and analyzed using a gas chromatograph equipped with a flame ionization detector according to NIOSH Method P&CAM S-65.² The analytical limit of detection is 0.01 milligrams (mg) per sample. The xylene and petroleum naphthas were desorbed from the charcoal with carbon disulfide and analyzed using a gas chromatograph equipped with a flame ionization detector according to NIOSH Method P&CAM 127.³ The analytical limit of detection was 0.01 mg for xylene and 0.1 mg per sample for petroleum naphthas.

A bulk liquid sample of the washing solvent was analyzed for n-hexane and n-heptane as possible constituents of the petroleum naphthas.

B. Medical

The medical survey involved completion of personal interviews and a health and occupational history questionnaire on the Press Department employees. Interviews were conducted to determine if workers experienced any symptoms, chronic conditions, or permanent

injuries related to solvents used in or dust generated by the printing process.

V. EVALUATION CRITERIA

Available studies provide conclusive evidence that inhalation of asbestos fibers causes chronic lung disease - asbestosis^{4,5} and cancer^{6,7} in man. NIOSH⁸ recommends that no employee be exposed to an 8-hour time-weighted average (TWA) airborne concentration of asbestos fibers in excess of 100,000 fibers greater than 5 micrometers in length per cubic meter (or 0.1 fibers >5 $\mu\text{m}/\text{cc}$) of air, as determined on the basis of a 40-hour workweek. NIOSH also recommends that no employee may be exposed to a concentration in excess of 500,000 fibers >5 $\mu\text{m}/\text{m}^3$ (or 0.5 fibers >5 $\mu\text{m}/\text{cc}$) of air, as determined over a period up to 15 minutes. The current OSHA Permissible Exposure Limit (PEL) is 2,000,000 fibers/ m^3 , 8-hour TWA, and 10,000,000 fibers/ m^3 , ceiling value.

Exposure to organic solvents can cause varying degrees of anesthesia, with minimal levels causing headaches, and greater exposure causing lightheadedness, "drunkenness", and even unconsciousness. Additionally, they may have a somewhat disagreeable odor and be irritating to eyes, nose, and throat. Skin contact with the solvents, particularly on the prolonged or repeated basis may remove the natural oil from the skin causing dryness and cracking. The NIOSH recommended airborne exposure standards for the isopropanol, xylene, and petroleum naphthas under the conditions evaluated (i.e. short-term exposures) are as follows: Isopropanol - 1968 milligrams per cubic meter (mg/m^3) expressed as a 15-minute ceiling exposure. Xylene - 868 mg/m^3 expressed as a 10-minute ceiling exposure. Petroleum naphthas - 1800 mg/m^3 expressed as a 10-minute ceiling exposure.

VI. RESULTS AND DISCUSSION

A. Industrial Hygiene

The brake disc pads used on the web-fed press automatic splicer were analyzed using polarized light microscopy and found to contain approximately 30% chrysotile asbestos.

Table 1 presents the results of 11 samples for airborne asbestos obtained in the breathing zones of the web-fed press operators including the head and second pressman, and feeder operator. Nine of the 11 samples were obtained to determine an 8-hour time-weighted average exposure concentration. The remaining two samples were obtained to determine peak period exposure during blow-down of the brake housing assembly for the automatic splicer. This procedure requiring less than 3 minutes is routinely performed by the head pressman prior to checking and/or replacement of the disc brake pads. All 11 samples showed asbestos fiber

concentrations less than the minimum detectable limit (<4500 fibers per filter) by phase contrast microscopy (PCM) analysis. Four samples of settled dust obtained from the brake assembly housing did not show any asbestos by PLM analysis.

These results indicated that although asbestos was shown to be present in the two brake samples analyzed, no asbestos was present in air and settled dust samples. In order to confirm the PLM analysis, two of the four settled dust samples were reexamined by transmission electron microscopy (TEM).

TEM analysis showed both settled dust samples to contain fibers estimated at less than 2% by weight. The fibers had a magnesium-silicate composition, but did not resemble chrysotile asbestos morphologically. The fibers did not display an identifiable diffraction pattern. The energy dispersive x-ray (EDAX) spectra of the nonfibrous particles in the samples showed a dominant magnesium, silicon, and iron composition. The TEM analysis indicates that the chrysotile asbestos has been completely altered from its original form and for the most part lost its fibrous habit. The few remaining fibers had also been structurally altered and no longer resembles chrysotile.

Investigators^{9,10,11} have questioned whether free asbestos fibers survive the high temperatures produced during braking action contending that asbestos thermally decomposes as a result of the high point contact temperature produced at the interface of the braking surface and disc pad. Differential thermal analysis indicates that chrysotile undergoes dehydroxylation at 650 to 680°C and recrystallization of chrysotile asbestos at about 810°C forming an amorphous non-toxic mineral known as forsterite (Mg_2SiO_4).¹²

Table 2 presents the airborne concentrations of isopropanol, xylene, and petroleum naphthas measured in the breathing zone of the press helper while washing the rolls of the Miehle sheet-fed printing press. Two 15-minute sequential samples were obtained for isopropanol and six 10-minute sequential samples were obtained for xylene and petroleum naphthas. The isopropanol concentrations (range 33 to 67 mg/m^3) were less than 5% of the NIOSH recommended standard of 1968 mg/m^3 , 15-minute ceiling value. The xylene concentrations (range 46 to 188 mg/m^3) were less than 15% of the NIOSH recommended standard of 868 mg/m^3 , 10-minute ceiling value. The petroleum naphtha concentrations (25 to 125 mg/m^3) were less than 10% of the NIOSH recommended standard of 1800 mg/m^3 , 10-minute ceiling value. Analysis of a bulk liquid sample of the washing solvent showed both n-hexane and n-heptane to be below the analytical limit of detection of 0.01 mg per sample.

B. Medical

Personal interviews were conducted and health and occupational history questionnaires were administered to 18 employees who operate the printing presses. Four individuals reported persistent problems with dermatitis and skin irritation localized on the hands - especially the fingers and nail cuticles. The skin irritation was most commonly associated with using the acid etch that removes ink from the press rollers. Five persons reported occasional dizziness and lightheadedness, and eight persons reported occasional mild eye irritation during cleaning or "solvent wash-up" of the printing press rollers. All of these individuals reported the disappearance of these symptoms shortly after the cleaning task was completed. Six individuals reported having varying degrees of hearing loss. However, none of these employees have had recent audiometric tests to determine the extent of hearing losses. Of 18 employees surveyed, only three reported having had an audiometric test within the last 3 years. Twelve employees reported using hearing protectors, however, at the time of this investigation, use of hearing protectors was observed to be inconsistent and sporadic.

In general, the employees do not seem to have any severe problems related to exposures to solvents and chemicals used in the printing process or dust associated with the presses braking systems. The symptoms of occasional eye irritation, lightheadedness, and dizziness are consistent with the acute toxicity that may occur from exposure to the referenced solvents under the conditions of exposure evaluated.^{13,14,15} The symptoms reported were viewed by most of the employees to be of a minor nature. Serious concerns from working with the printing process were not expressed.

VII. CONCLUSIONS

Although the disc brake pads used on the web-fed press automatic splicer contained approximately 30% chrysotile asbestos fibers, analysis of brake lining wear dust and associated airborne dust did not show detectable concentrations of asbestos fibers. This result is explainable by the theory that most of the fiber is converted to an amorphous mineral known as forsterite by the high surface temperature and severe abrasion occurring during brake application.

Airborne exposures to isopropanol, xylene, and petroleum naphthas during wash-up of the press rollers were below the NIOSH recommended standards. The reported symptoms of occasional eye irritation, dizziness, and lightheadedness are consistent with acute exposures to these organic solvents. Four individuals appear to have dermatitis characteristic of the printing industry.

VIII. RECOMMENDATIONS

1. A vacuum procedure, rather than the current method of using compressed air, should be used to remove the brake lining wear dust from the brake assembly housing. Until an alternate method to perform this operation is established (i.e. vacuum), the worker should be provided with a particulate removing single-use disposable respirator. The respirator should be selected for protection against pneumoconiosis and fibrosis producing dusts.
2. Although the individual exposure concentrations of the organic solvents measured during washing of press rollers does not indicate a general need for requiring the use of respiratory protection during this procedure, some workers may be experiencing symptoms from short-term exposure. These symptoms may be attributable to the additive toxicologic effects of these organic compounds. Therefore, the workers should be offered the opportunity to use a chemical cartridge organic-vapor removing respirator during the washing procedures.
3. It appears that certain workers are experiencing dermatitis on the hands. Protective gloves should be made available to the employees and their use encouraged, to minimize skin contact with the inks, acid etch, and solvents. Gloves made of neoprene latex may provide the best overall protection for the acid-organic solvent exposure situation in question. The maintenance of a high standard of personal hygiene and cleanliness (i.e. washing of hands as soon as practical after skin contact occurs) is very important. The use of barrier hand creams (such as Kerodex® used by some of the workers) should be encouraged.
4. Communication with the workers at a distance greater than 3 feet was difficult. Therefore, workers on the web presses may be potentially at risk of exposure to excessive noise. A detailed noise survey should be conducted to determine the exposures of the pressmen operating the web-fed and sheet-fed presses. The noise survey should characterize the a) overall noise level, b) frequency distribution or spectrum of the noise, and c) duration and distribution of exposure during a typical workday. If excessive noise exposure is determined, effective hearing conservation and noise abatement programs should be instituted.
5. Because of the bulk and weight (estimated to be 1100 to 1500 pounds) of the rolls of paper and the steel shafts used to mount the rolls on the presses, safety footwear with steel-reinforced toes should be worn.
6. The First-Aid box in the Press Department is inadequately stocked. This station should be updated with supplies appropriate to the

injuries that may be sustained in this Department (e.g., bandages, gauze pads, adhesive tape, antiseptics, etc.).

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH

Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Tweddle Litho Company, St. Clair Shores, Michigan.
2. Graphic Arts International Union, Local 289, Royal Oak, Michigan.
3. NIOSH, Region V
4. OSHA, Region V

For the purpose of informing the approximately 23 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

Personal Breathing Zone Concentrations of Asbestos Fibers

Tweddle Litho Company
St. Clair Shores, Michigan
HETA 81-117

July 28-29, 1981

Sample Date	Sample Description	Sample Period	Sample Volume (Liters)	Air Concentration* (Fibers per m ³)	Comments
7-28	Head Pressman	0820-1157	325.5	LLD**	
7-28	Head Pressman	1235-1528	274.5	LLD	
7-28	Head Pressman	1159-1201	3.0	LLD	Blow-down of brakes of bottom splicer
7-28	Head Pressman	1600-1601	1.5	LLD	Blow-down of brakes of forward splicer
7-28	Second Pressman	0815-1158	334.5	LLD	
7-28	Second Pressman	1236-1530	261.0	LLD	
7-28	Feeder Operator	0817-1155	327.0	LLD	
7-28	Feeder Operator	1237-1526	253.5	LLD	
7-29	Head Pressman	0811-1155 1238-1555	631.5	LLD	
7-29	Second Pressman	0810-1155 1235-1545	622.5	LLD	
7-29	Feeder Operator	0812-1155 1235-1540	612.0	LLD	
NIOSH Recommended Standard				100,000	

* Fibers of asbestos greater than 5 micrometers in length per cubic meter of air.

** Lower limit of detection reported as 4500 fibers per filter.

TABLE 2

Personal Breathing Concentrations of Organic Vapors Measured During Wash-Up of the Miehle Press

Tweddle Litho Company
St. Clair Shores, Michigan
HETA 81-117

July 28, 1981

Sample Description	Sample Period	Sample Volume (Liters)	Air Concentration - mg/m ³ *		
			Isopropanol	Xylene	Petroleum Napthas
Feeder Operator	1430-1445	12	67	**	**
Feeder Operator	1445-1500	12	33	**	**
Feeder Operator	1429-1439	8	**	46	25
Feeder Operator	1441-1451	8	**	49	38
Feeder Operator	1451-1501	8	**	69	63
Feeder Operator	1652-1702	8	**	80	63
Feeder Operator	1702-1712	8	**	118	125
NIOSH Recommended Standard			1968	868	1800

* Milligrams of contaminants per cubic meter of air sampled.

** Sample not analyzed for this contaminant.