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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HAZARD EVALUATION AND TECHNICAL ASSISTANCE
REPORT NO. TA 77-2

ARTANIS OFFSET, INC.
28 E. 22nd Street
NEW YORK, NEW YORK 10010

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I. SUMMARY

On December 1-2, 1976, an industrial hygiene survey was conducted at Artanis Offset, Inc., in New York City. The survey was conducted by the Industrial Hygiene Section of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations, and Field Studies, of the National Institute for Occupational Safety and Health, (NIOSH). The owner of the printing shop had read that printing inks could contain polychlorinated biphenyls (PCBs) and requested that NIOSH evaluate the workplace for possible exposure to PCBs and solvents used in the process. A total of 14 samples were taken for air contaminants, 11 of which were personal breathing zone air samples.

A total of nine personal samples were collected for organic vapors - cyclohexanone, benzene, and petroleum naphtha. All samples were below recommended evaluation criteria and OSHA standards (Table 1).

One area and one personal sample were collected for total nuisance particulates. Both samples were below recommended evaluation criteria and OSHA standards.

One personal sample for PCBs indicated a concentration of 0.01 milligrams of PCBs per cubic meter of air (mg/M^3), a value below all evaluation criteria (Table 1). A bulk sample of a commonly used printing ink was analyzed but PCBs could not be detected in the sample (Table 2).

A bulk sample of a spray powder used in the printing process was analyzed for the presence of free crystalline silica and asbestos. The analysis revealed the powder was 1% fibrous asbestos, which included anthophyllite and tremolite fiber forms. Ten percent of the powder was fibrous talc and non-fibrous tremolite (Table 2). - A fraction of the powder contained free crystalline silica. Local exhaust ventilation did not exist to control the release of dust into the atmosphere from this operation, and general ventilation in the work area was only 5-10 feet per minute (fpm). It is therefore recommended that the release of dust be controlled by local exhaust ventilation - velocities ranging from 500-2000 feet per minute may be needed to capture the dust. As an alternative, a material not presenting the potential health hazard to asbestos fibers should be substituted for the material in question.

II. INTRODUCTION AND PURPOSE

On December 1-2, 1976, at the request of the owner, an industrial hygiene survey was conducted at Artanis Offset, Inc., in New York City. The owner recently read about the possible existence of polychlorinated biphenyls (PCBs) in printing inks, and requested that NIOSH investigate potential exposures to PCBs and other solvents used in the workplace.

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III. EVALUATION

A. Description of Facilities

The offset printing activities are carried out in a third floor room measuring approximately 40 feet long by 20 feet wide. Printing is done on about one-half of the floor, where two "1250" Multiliths are operated routinely with one on standby. Plates used in the offset printer are first produced with the desired image by using a "burner" unit, then hand scrubbed with a one step plate-developing solvent (containing cyclohexanone) or a gun desensitizer for a 2-3 minute period. As many as 20-25 plates may be developed in a day. The plate is then affixed to the printer, inks are mixed in the fountain of the press, and then printing starts. Occasionally, a powder is automatically sprayed onto the printed material to keep the ink from spotting on the sheet above in the stack. Multilith rollers are cleaned periodically with a petroleum naphtha-based solvent.

B. Environmental Study Procedures and Instrumentation

Atmospheric samples (personal and area) for benzene, cyclohexanone, and petroleum naphtha were collected by drawing air through tubes containing activated charcoal. Personal samples were taken at the worker's breathing zone using Sipin* pumps operating at a flow rate of approximately 50-200 milliliters per minute (ml/min.). Benzene was also determined in case of its presence as an impurity in the solvents.

Atmospheric samples (personal and area) for nuisance dust were collected by drawing air through 5 micron (u) pore size, 37 millimeter polyvinyl chloride filters encased in 3-piece cassettes. Mine Safety Appliance* (MSA) gravimetric pumps, Type G, were used to draw air through the filters at a flow rate of 1.5 liters per minute (lpm). The pumps were worn by the employees.

A personal atmospheric sample for polychlorinated biphenyls (PCBs) was collected by drawing air through a Florisil* tube using a Sipin* pump. The pump, operating at a flow rate of approximately 50 ml/minute, was worn by the employees.

A bulk sample of the spray powder was analyzed for the presence of asbestos and free crystalline silica. Also, a bulk sample of a printing ink was examined for the presence of PCBs.

Samples were analyzed at the Utah Biomedical Test Laboratory (UBTL) and at NIOSH, Cincinnati, Ohio.

Ventilation measurements were taken with a Sierra Thermoanemometer*.

*Mention of commercial names does not constitute endorsement by the National Institute for Occupational Safety and Health.

C. Toxicology and Evaluation Criteria

Cyclohexanone

Cyclohexanone is a colorless, slightly volatile liquid with an acetone-like odor.¹ Due to its low volatility, high concentrations would only be expected at high temperatures. It has good warning properties at low concentrations which would help protect against systemic injury.² Eye, throat, and respiratory irritation may occur at 50 parts per million (ppm) - the OSHA standard - when unaccustomed individuals are exposed to the vapor.³ Prolonged or frequent skin contact may result in irritation or dermatitis.

Petroleum Naphthas (including Mineral Spirits)

Acute exposure to high concentrations of petroleum naphthas, a generic name for a group of related compounds including mineral spirits, have been known to produce central nervous system depression. Effects ranging from headache, nausea, inebriation, and stupor to anesthesia and coma have been reported following single acute exposures. Nose, throat, or eye irritation may be the first sign of potentially hazardous inhalation exposure. Prolonged or repeated contact will cause dehydration and defatting of the skin (16,17).

Benzene

The most significant effect is from chronic intoxication. Benzene's action is primarily on the bone marrow, which results in numerous blood changes and, in serious cases, causes a progressive malignant disease of the blood forming organs. Benzene has a narcotic effect upon acute exposure (18).

Total Nuisance Dust

"Nuisance" dusts have a long history of producing little harm on the respiratory system. The relationship between these dusts and effect on the lungs has been given the following characteristics (3):

1. The architecture of the air spaces remains intact.
2. Scar tissue is not formed to any significant degree.
3. Any tissue reaction is potentially reversible.

Excessive concentrations of nuisance dusts may reduce visibility and cause unpleasant deposits in the eyes, ears, and nasal passages.

Polychlorinated Biphenyls (PCBs)

PCBs are poorly metabolized and tend to accumulate in animal tissues, including humans (4,5,6,7,8). The accumulation, particularly in tissues and organs rich in lipids, appears to be higher in the case of penta and more highly chlorinated biphenyls.(9)

Studies have revealed PCBs in human fat tissue and blood plasma. PCBs, in amounts greater than 2 parts per million, were reported in 198 of 637 (31 percent) samples of human fat tissue taken from the general population of 18 states and the District of Columbia.(5) PCB residues ranging up to 29 parts per billion have also been found in 43 percent of 616 plasma samples collected from volunteers in a southeastern U.S. County.(6)

Human - The known toxic effects of PCBs in humans include an acne-like skin eruption (chloracne), pigmentation of the skin and nails, excessive eye discharge, swelling of eyelids, and distinctive hair follicles.(10)

In August, 1976, NIOSH reported the possible association between exposure to PCBs and certain types of cancer. Results of a study done by A. Bahn of the University of Pennsylvania at a Mobil Oil Corporation facility showed significantly more skin cancer (melanoma) and pancreatic cancer than would be expected in a population of the size studied.

For a number of years, chloracne of the face and neck has been reported among workers exposed to chlorinated hydrocarbons. Workers exposed to PCBs in the process of insulating cables,(11) in the production of condensers(12) and in the manufacture of chlorobiphenyls(13) have reported these skin lesions along with systemic effects such as digestive disturbances, edema of the face and hands burning of the eyes, impotence and hematuris.(7,13)

The potential effects of PCBs in humans are further illustrated by a 1968 outbreak of poisoning in Japan that involved over 1,000 people who ingested PCB contaminated rice bran oil for a period of several months. The contamination of the oil (estimated 1,500 to 2,000 ppm) occurred when heat transfer pipes immersed in the oil during processing developed pinsized holes. The clinical aspects of the poisoning included chloracne, brown pigmentation of the skin and nails, distinctive hair follicles, increased eye discharge, swelling of the eyelids, transient visual disturbance, and systemic gastrointestinal symptoms with jaundice.(10)

In some patients, symptoms persisted three years after PCB exposure was discontinued. Infants born to poisoned mothers had decreased birth weights, and showed skin discoloration due to PCB placental passage. Two stillbirths to PCB exposed-women were also reported.(14)

Asbestos

Asbestos is a generic term which applies to a number of naturally occurring silicates of variable composition, but basically is of a form of hydrous magnesium silicate. Their chief characteristic is a structure composed of long, parallel, flexible fibers, capable of repeated longitudinal subdivision. The most widely used form in the United States is chrysotile, a fibrous form of serpentine. Other types include amosite, crocidolite, tremolite, anthophyllite and actinolite.

One of the potential health hazards associated with exposure to asbestos is that of inhalation of airborne fibers, resulting in a type of pneumoconiosis referred to as asbestosis. Asbestos fibers are capable of passing through the upper respiratory tract and being deposited in the terminal bronchioles of the lungs. The fibers, upon deposition in the terminal bronchioles, initiate a tissue response which results in the coating of the fiber with the ultimate production of what is known as the asbestos "body". If large quantities of the fibers are inhaled over a prolonged period, the tissue reaction progresses until a generalized, diffuse fibrosis becomes evident. This fibrosis is first seen in the lower lobes of the lungs, but eventually if exposure continues, appears in the other lobes as well. The fibrosis can impair the transfer of oxygen across the alveolar membrane and result in respiratory insufficiency, or cardiac failure.

Along with asbestosis, studies have provided conclusive evidence that exposure to asbestos fibers causes cancer in man. The frequency of bronchial cancer is greater in occupationally exposed persons, as well as an increased occurrence in development of mesotheliomas of the pleura and peritoneum.(15)

Talc

Talc is a mineral defined as having the chemical formula - $MgSi_4O_{10}(OH)_2$ - a hydrated magnesium silicate. "Talc" in the industrial sense may represent a varied mixture of minerals with similar physical properties as talc: it can be formed from geological alteration of other magnesium silicates, such as asbestos, which can be present as impurities in any given talc. Inhalation of talc can therefore pose a potential health hazard if proper precautions in identifying hazardous impurities are not addressed.(19)

The following table lists the Occupational Safety and Health Adm. (OSHA) standards (the current enforceable limits) and also the environmental criteria recommended by NIOSH and the ACGIH. All values are based on an 8-hour time-weighted average exposure (TWA).

	Sources		
	USDOL-OSHA(1) (legal)	NIOSH recommended	ACGIH-TLV(2)
Cyclohexanone	50 ppm(3)	---	50 ppm
Benzene	10 ppm	1 ppm	25 ppm
Petroleum Naphtha	500 ppm	---	400 ppm
Total Dust (Nuisance Dust)	15 mg/M ³ (4)	---	10 mg/M ³
Polychlorinated Biphenyls	1 mg/M ³ (5)	---	1 mg/M ³
	0.5 mg/M ³ (6)	---	0.5 mg/M ³

- (1) Occupational Safety and Health Administration
- (2) American Conference of Governmental Industrial Hygienists
- (3) Parts of substance per million parts of air
- (4) Milligrams of substance per cubic meter of air
- (5) 42% chlorine containing
- (6) 54% chlorine containing

IV. DISCUSSION OF RESULTS

Organic Vapors

Table 1 illustrates the results of air sampling for various air contaminants in the printing shop. All personal and area air samples for cyclohexanone (in the plate developer), petroleum naphtha (in the roller and blanket cleaner) and benzene (as a possible impurity) had atmospheric concentrations below the evaluation criteria used here or were not detected.

Total Nuisance Dust

Two samples were collected for total nuisance dust, one personal and one area sample, each on a different day. The personal sample was below all evaluation criteria and represents a 4-hour exposure of a printer who had the powder dispenser operating periodically during the sampling period. The area sample was taken very close to the printer's position, and can be thought to represent a personal exposure. This area sample (9.1 mg/M³) was approximately 90% of the (ACGIH) recommended standard of 10 mg/M³ (Table 1). The powder dispenser operated during most of this 4-hour sampling period.

PCBs

A bulk sample of a commonly used black ink was analyzed for the presence of polychlorinated biphenyls (PCBs). No PCBs could be detected. The printer was exposed to an atmospheric concentration of 0.01 milligrams of PCBs per cubic meter of air (0.01 mg/M³), below all the evaluation criteria.

Asbestos and Free Crystalline Silica

A bulk sample of the spray powder was analyzed for the presence of asbestos fibers. Approximately 1% of the sample was fibrous asbestos. Approximately 10% of the sample was asbestos-like minerals, including non-fibrous particles of tremolite and fibrous talc in about equal amounts (Table 2).

This spray powder was further analyzed by the Industrial Hygiene Section, Industry-Wide Studies Branch, NIOSH, after NIOSH's contract analytical laboratory reported back that the sample appeared to contain talc mined in New York State. Upon examination by electron microscopy, the sample was again demonstrated to contain asbestos fibers.

During the survey, dust from the spray powder was released into the workroom air around the employees. Settled dust was found on surfaces around the work area, as no type of local ventilation was used to control the release of dust. General ventilation measurements showed a range of only 5-10 feet per minute (fpm) near the offset printers. Since the request for technical assistance centered on other chemicals, atmospheric samples to determine employee exposure to asbestos fibers were not collected. However, a potential health hazard from asbestos fibers is judged to exist and therefore it is recommended that local exhaust ventilation be used on the offset printer to minimize the release of dust. Velocities ranging from 500-2000 fpm may be needed to capture the dust. Alternatively, a material not posing the potential health hazard could be substituted in place of the presently used powder.

The amount of free crystalline silica found in the powder was small and is not judged to be a health hazard (Table 2).

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TABLE I
Results of Air Sampling for Air Contaminants

Artanis Offset, Inc.
New York, New York

December 1-2, 1976

Job Description or Location	Type Sample ¹	Sampling Period (hrs./min.)	Cyclohexanone (PPM) ²	Benzene (PPM) ²	Petroleum Naphtha (PPM)	Total Dust (mg/M ³) ³	Polychlorinated (PCB's) (mg/M ³)
Printer (12/1/76)	P	4/15	N.D. ⁴	N.D.	N.D.	-	-
Near #1250 (12/1/76) Multilith	A	4/17	-	-	-	9.1	-
First Printer (12/2/76)	P	5/35	N.D.	N.D.	1	-	-
First Printer (12/2/76)	P	5/58	-	-	-	-	0.01
Second Printer (12/2/76)	P	4/0	N.D.	N.D.	0.8	-	-
Second Printer (12/2/76)	P	4/0	-	-	-	1.4	-
Above developing table (12/2/76)	A	5/40	N.D.	N.D.	0.14	-	-

1. P = Personal A = Area
2. PPM = Parts of contaminant per million parts of air
3. mg/M³ = milligrams of substance per cubic meter of air
4. N.D. = non-detectable

HYGIENIC STANDARDS - (8-hour time weighted average exposures)

	SOURCE		ACGIH (TLV)
	OSHA	NIOSH	
Cyclohexanone	50 PPM	-	50 PPM
Benzene	10 PPM	1 PPM	25 PPM
Petroleum naphtha	500 PPM	-	400 PPM
Total dust (nuisance dust)	15 mg/M ³	-	10 mg/M ³
Polychlorinated Biphenyls	1 mg/M ³ (42% chlorine)	-	same as OSHA
	0.5 mg/M ³ (54% chlorine)	-	same as OSHA

TABLE 2

Results of Bulk Sample Analyses
 Artanis Offset, Inc.

<u>Bulk Sample</u>	<u>Fibrous Asbestos</u>	<u>Non-Fibrous Tremolite & Fibrous Talc</u>	<u>Free Crystalline Silica</u>
White Powder	1%	10%	0.18%

Polychlorinated Biphenyls

Black Ink Non-detectible