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U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HAZARD EVALUATION AND TECHNICAL ASSISTANCE
REPORT NO. HE 78-71-633

KENTILE FLOORS, INC.
BROOKLYN, NEW YORK

NOVEMBER, 1979

I. TOXICITY DETERMINATION

A survey team for the National Institute for Occupational Safety and Health (NIOSH) performed a health hazard evaluation at Kentile Floors Inc., Brooklyn, New York on July 10, September 25 and 26, and October 23 - 25, 1978 regarding alleged worker exposure to asbestos, asphalt, vinly chloride monomer, dyes and pigments.

The methodology used to evaluate the workers' environment included:

1) environmental air sampling
2) a review of material inventory and material safety data sheets
3) a review of the Occupational Safety and Health Administration (OSHA) data collected during previous visits
4) medical interviews and evaluations of workers
5) a review of employees' health records
6) a review of pertinent scientific literature
7) a review of the company's respirator program
8) observations of employees' work practices and engineering controls

Environmental air samples and bulk samples were collected and analyzed for the following contaminants (see Table I-VI): asbestos, total nuisance dust, mineral spirits, benzene, polynuclear aromatic (PNA) hydrocarbons, (benzo(a)pyrene, chrysene, pyrene, benzo(a)anthracene, fluoranthene,)carbon black, and benzene-soluble fraction. Asbestos was the only contaminant found to exceed the NIOSH recommended criteria. Three of the thirty samples exceeded the NIOSH recommended criteria of 0.10 fibers per cubic centimeter of air(fibers/cc). All other air contaminants sampled were below recommended exposure limits where such criteria exists.

Apart from a case of contact dermatitis, no medical evidence of work-related illness was detected at this plant.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical

Information Services (NTIS), Springfield, Virginia. 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 the following:

A. Kentile Floors, Inc., Brooklyn New York
B. Authorized representatives of the United Rubber Workers (URW) Local No. 457, Brooklyn, New York
C. International Union of URW, Akron, Ohio
D. NIOSH - Region II
E. U. S. Department of Labor - Region II

For the purpose of informing the approximately 75 "affected employees", the employer shall promptly "post" for a period of 30 calendar days, the Determination Report in a prominent place(s) near where the exposed employees work.

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 normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health received such a request from an authorized representative of employees. This request was included in the request submitted by the International Union representative in behalf of employees at Kentile Floors, Inc. at Chicato, Illinois and South Plainfield, New Jersey. The request alleged that employees may be exposed to asbestos, asphalt, vinyl chloride monomer, dyes and pigments.

Concern was expressed over reports from URW Local 505 (Chicago, Illinois), and OSHA officials, of excessive numbers of malignancies of diverse sites, as well as liver, heart and lung disease. Similar problems had not been reported at the other two Kentile facilities. If the above reports of occupational diseases had been substantiated at the Chicago plant, thus necessitating epidemiological mortality and morbidity studies, employees at the New York facility would have provided an ideal control group as the manufacturing processes, and materials, are identical. A case of laryngeal cancer was documented at the Chicago facility which should possibly be regarded as being of occupational origin, but since the usual latent period of this carcinoma exceeds the period of employment at this plant, and the worker had been previously employed in an industry associated with the development of respiratory-tract cancers, no conclusion could be reached as to the causative agent(s). No occupational disease was found at the New Jersey plant. [HHE Reports 78-73, 78-72]

Although the initial phases of the environmental-medical investigation were not performed simultaneously, a walk-through survey of the facility was performed by each NIOSH representative with union and management representatives. This allowed the investigators the opportunity to better understand the general operation in order to perform a comprehensive environmental evaluation and medical evaluation if needed during the follow-up survey. Additionally, this survey allowed the union representative to identify areas the employees considered hazardous.

IV. HEALTH HAZARD EVALUATION

A. Process Description and Evaluation

Kentile Floors, Inc. is a manufacturer of vinyl asbestos and asphalt asbestos floor covering. The company employs 370 workers of whom about 250 are production workers. The plant operates a one-shift operation (Shipping Dept. - 7:00 am - 4:30 pm and Production Dept. - 8:00 am - 5:30 pm) 9 hours per day, 5 days per week. The Maintenance Department performs routine equipment maintenance and repairs on Saturday. The company performs environmental sampling for several chemicals (e.g. asbestos, total dust, vinyl chloride monomer); however, all the potentially toxic chemicals are not monitored on a routine basis.

The areas evaluated were the production lines (#8, #3, #2, and the mottle line #1), the mottle crushing operation, mottle storage area and the ink mixing room. Employess who work in any one of these areas are issued separate lockers for clean and dirty clothes and the following safety equipment: hard hat, safety shoes, gloves, respirator, plastic aprons, etc. Shower facilities are available for the employees; however, there is no requirement that they be used.

Workers who are required to use respirators have two assigned to them. At the end of the work shift, the employees' respirators are collected, disassembled, cleaned and air-dried by the crib supervisor or his alternate. The respirators are returned to their respective owners at the beginning of their shift.

All workers potentially exposed to asbestos have worn respirators since 1972.

1. Production Process:

There are three production lines (#8,#3,#2) and one auxiliary line (#1), only three of which are in use. The company is using two production lines and the auxiliary line (mottle line or decorative tile line) which are similar in operation. These three lines are operated by approximately 50 workers. The areas of major concern along the production lines were the process area and the tile coloring area.

The raw materials weighed in the process areas of line #8, #3, and #1 are stored in the warehouse (building 9,10,11). The chemicals are transported to each process line as they are needed. Inadvertent chemical spills are vacuum cleaned.

The process area consists of four stations: two scale operators (one for weighing of raw materials and one for weighing scrap material), a pigment scale operator, and the Banbury® mixer operator. The process areas for all the lines utilize a hopper car and a conveyer system for the transporting chemicals from the scales to the Banbury mixer. An empty hopper car is positioned onto the scale under a hood. The scale operator pulls a handle which gravity feeds a tared quantity of polyvinyl chloride resin to the empty hopper. Next a bag of asbestos or talc is added to the hopper with a quart of water.

The hopper car is sent to the next station (scrap scaler) where it is positioned under a hood. Any recycled product returned from the end of the line due to unsatisfactory appearance is added to the hopper. At the next position (pigment scale operator) a plastic bag containing previously weighed pigments from bulk samples are added to the hopper. The hopper then travels to the Banbury station where the bucket is emptied into the Banbury mixer along with automatically dispensed portions of limestone and plasticizer/oil mixture. The chemicals are friction mixed and discharged onto a conveyer belt. The mixture is then gauged, colored, waxed, polished and cut.

The empty hopper is returned to the first station to be refilled. There are several hopper cars at various stages of the cycle at all times to allow for a continuous flow of product.

The mottling line differs from line #8 and #3 because the gauged sheets of tile are crushed into chips and either conveyed to line #8 and #3 to decorate the tile or the mottle may be conveyed to the storage bins on the second floor to be used at a later date.

2. Ink Mixing Process

One operator spends a maximum of 30 minutes per day in the ink mixing room. However, some ink mixing is also performed along the tile line. The room is air-conditioned and exhausted. The operator wears a respirator with an organic vapor cartridge whenever he enters the room.

The ink room houses containers of inks and mineral spirits. The ink formulation consists of mixing inks and mineral spirits to obtain the desired color and consistency which is optically

*Mention of commercial names or products does not constitute endorsement by NIOSH

compared to the standard. Once the mixing is complete, the worker returns to the production line to monitor the tile inking operation.

3. Mottle Crushing and Storage

Two persons work in this area: one man monitors the crushing operation and one man transports bins of mottle chips via fork lift truck. After the mottle has been crushed, the chips are either transported to another crusher, or are temporarily stored, or are delivered to the mottle supply man on the second floor. The mottle supply man shovels chips from the storage bin to the supply bin for lines #8 and #3.

The exhaust ventilation system was reported to be 10% greater than the make-up air in order to meet Environmental Protection Agency regulations. The mottle crusher and the process area for line #8 are located in building #6. The building is about 9,785 square feet (ft^2) with an average ceiling height of 26 feet (ft). The building exhaust ventilation system was reported to be 16,200 cubic feet per minute (cfm). The make-up air is provided via open windows and adjacent rooms.

Line #3 process area is located in building #5. This room occupies 7,744 ft^2 with an average ceiling height of 21 ft. The exhaust system is 14,100 cfm, and the make-up air is provided by the adjacent rooms.

Line #1 and #2 process area are located in building #4. The room occupies 12,979 ft^2 with an average ceiling height of 27 ft. It should be noted that Lines #2 and #1 are rarely used simultaneously. There are two exhaust ventilation systems which operate at 6,100 cfm and 21,000 cfm respectively. This exhaust system is vented through a bag house which was reported to operate at 24,000 cfm.

Each of the hopper scales has canopy exhaust hoods which are enclosed on two sides and have curtains on two sides to increase exhaust efficiency. The system was designed to exhaust air away from the worker at a rate of 150 feet per minute (fpm) when the hopper car is in place.

The pigment scale operators booth for each line has a slot exhaust ventilation system. The average capture velocity measured at the point on the table where the pigments are weighed are as follows: Line #8 pigment table (3" x 42" duct) - 90 fpm; Line #3 pigment table (1" x 58" duct) - 40 fpm: Line #1 pigment table (1-1/4" x 18" duct) - 150 fpm.

Both Banbury mixers for each of the three lines have two adjacent slot exhaust ducts at the chute entrance and one exhaust duct within the mixer. The exhaust duct at the chute entrance is designed to operate at 200 - 300 cfm per square foot of open face area.

B. Evaluation Design/Methods

1. Environmental Survey

On July 10, 1978, an initial environmental survey was conducted by the industrial hygienist. No environmental air samples were collected during the visit. The purpose of the initial visit was to perform a walk-through survey, obtain a copy of the material inventory list, and collect any data that would be useful in planning the follow-up survey.

During the walk-through inspection, the project officer observed a mist along #8 production line which partially obscured the light. As the investigator approached the mist, he experienced eye irritation. An employee was observed mixing inks with mineral spirits. Additionally, the exhaust fan near the ink application station was not activated. Once the fan was turned on, the mists began to dissipate.

2. Environmental Air Sampling

Personal and area samples collected during the follow-up survey October 23 - 25, 1978 were used to evaluate employee exposure. The personal samples were attached to the workers' shirt collar in order to characterize breathing zone samples. The area samples were 1.0 foot to 5.0 feet from the workers' breathing zone. The sampling pump flow rates were calibrated daily. Each of the sampling data tables includes information denoting the types of samples collected.

Carbon Black - Carbon black dust samples were collected with Mine Safety Appliance (MSA)® Model G battery operated personal sampling pumps. A known volume of air is drawn through a cassette containing a tared 37-millimeter (mm) diameter 2.0 micrometer (um) pore-size polyvinyl chloride (PVC) filter (type FWSB). The sampling pumps operated at 1.5 liters per minute for four hours. The analytical method consists of weighing the filter in a clean tared crucible. The crucible and filter are placed in a muffle and the filter was ashed by gradually raising the temperature to 800°C. After ashing, the crucible was re-weighed. The loss on ignition represents the weight of the filter plus the carbon black contained in the sample.

Benzene-Soluble Fraction and Polynuclear Aromatic Hydrocarbon- Collection of these contaminants is accomplished by using a MSA pump in conjunction with a sampling cassette containing a 37-mm diameter/0.8 um pore-size glass fiber silver membrane filter. The sampling train (pump and filter) is operated at 1.5 liters per minute (lpm).

1. Benzene-Soluble Fraction - The samples were analyzed by NIOSH Physical and Chemical Analytical Method (P&CAM) #217. The particulate matter on the filters was extracted with benzene ultrasonically. After extraction, the benzene solution was filtered and evaporated to dryness in a tared Teflon boat; the weight gain is due to the benzene-soluble residue in one-half the sample.

2. PNA - The samples were analyzed by reversed-phase high pressure liquid chromatography. Analytical procedures involve the application of a methanol/water solvent gradient. The ultraviolet detection scans the sample at 365 nanometers (nm) and 280 nm simultaneously which aids in compound identification (P&CAM) #206 modified technique)

Solvents - (Mineral Spirits and Benzene) - A sampling train consisting of a Sipin® vacuum pump and a 150 milligram charcoal tube was used to collect a known volume of air. Air contaminants are adsorbed to the charcoal grains and later analyzed. The two sections of the charcoal tube are separately desorbed in a 1.0 ml of carbon disulfide containing dodecane as an internal standard. An aliquot is analyzed by gas chromatography with a flame ionization detector according to the NIOSH method #127 modified.

Asbestos - The samples were collected using a sampling train with a three piece cassette, 37 mm diameter/0.8 um pore size mixed cellulose membrane filter (type AA). The filter is sampled open face in order to assure even dispersal of fibers on the filter. The pump was calibrated daily and operated at 1.5 lpm for a pre-determined time. The sample was later analyzed by NIOSH method P&CAM #239 utilizing phase contrast microscopy.

Total Nuisance Particulate - A personal sampling train with a tared 37-mm diameter/5.0 um pore size, tared polyvinyl chloride filter or its equivalent was used to collect nuisance dust. The pump was operated at 1.5 lpm for the prescribed time or until the filter appeared to be overloading with dust particulate. The filter was analyzed gravimetrically according to NIOSH method #29. The weight of the sample was determined by subtracting the tare weight from the total weight.

Bulk Samples - Several bulk samples were submitted to the laboratory for analyses:

1. Talc - A bulk sample was submitted to the laboratory for analyses of free crystalline silica and asbestos.

2. Carbon Black - Two bulk samples were analyzed for benzene soluble fraction and polynuclear aromatic hydrocarbons.

3. A bulk sample of vinyl resin and alpha methyl styrene was analyzed for benzene soluble fraction and polynuclear aromatic hydrocarbons.

3. Medical Survey

On September 25, and 26, 1978, a medical survey was conducted at Kentile Floors, Inc., Brooklyn, New York. A walk-through inspection was made on September 25th, with both management and labor representatives.

The NIOSH physician asked the President, URW Local #457, to let the workers know that a government doctor would be in the plant the next day, and would be available for private consultation on any work-related health problems.

A supply of forms authorizing release of medical information from workers' private physicians to NIOSH was given to the labor representative, and it was requested of him that he distribute them to all workers who believe that their health has been adversely affected by the working environment. On completion, these forms were to be forwarded to the NIOSH doctor, and, to facilitate this matter, a supply of stamped, addressed envelopes were sent to URW Local 457 on the medical officer's return to Cincinnati.

The following morning the NIOSH physician visited the plant's medical facilities and met the doctor and full-time nurse.

One worker reported for consultation.

The NIOSH medical investigator then inspected the chemical storage area, which had been locked the previous day. A stack of bags labeled Dianisidine was noted. This pigment is infrequently used in small quantities.

C. Evaluation Criteria and Toxicity Data

1. Environmental

There are several criteria used to evaluate the toxic air contaminants for an employee's work environment: (1) NIOSH

Criteria Documents for a Recommended Occupational Health Standard, (2) Proposed and Recommended Threshold Limit Values (TLV's) as suggested by the American Conference of Governmental Industrial hygienists (ACGIH), 1976, (3) the OSHA Standards.

The concentration for each contaminant is based upon the current state of knowledge concerning toxicity of these substances. The concentration is designed to allow an occupational exposure up to a 10-hour work day, 40-hour work week as a time-weighted average (TWA) over a normal lifetime without the worker experiencing adverse health effects. In some instances, a few employees may experience discomfort at or below the TWA.

There are some airborne contaminants for which this TWA is inadequate; consequently, the substance may be proceeded by the letter "C". This letter indicates a ceiling value for an interval of 30 minutes or less. The ceiling value is used to identify hazardous substances which are fast-acting and should never be exceeded.

The criteria mentioned above has been tabulated, footnoted and compared to the OSHA Standard listed in the Code of Federal Regulations (CFR), (1978) Title 29, part 1910, Subpart 2, Section .1000. The OSHA standard has been cited so that the reader may see which of the standards have been exceeded. However, no discussion of the OSHA standards, with respect to airborne levels, will be presented.

TIME-WEIGHTED AVERAGE

Substance	8-Hour	10-Hour	Ceiling Value	Minutes
Asbestos[1] (fibers must be longer than 5.0 microns)		0.10 fibers/cc[a]	0.50 fibers/cc	15
Inert Nuisance Dust[2]	10 mg/m^3			
Refined Petroleum Solvents[3] (Mineral Spirits or Naphtha)		350 mg/m[b]	1800 mg/m^3	15
Benzene[4]			3.2 mg/m^3	60
Carbon Black[5]		3.5 mg/m^3 and 0.10 mg/m^3 as cyclohexane extractable substances (PNA's)		

Substance	8-Hour	10-Hour	Ceiling Value	Minutes
Polynuclear Aromatic[6] Hydrocarbons (PNA)		0.10 mg/m^3 as benzene or cyclohexane extractable substances in the presence of specific PNA's.		

a) fibers/cc - Fibers of particulate per cubic centimeter of air
b) mg/m^3 - approximate milligrams of particulate per cubic meter of air

1. NIOSH Criteria Document, Revised edition (1977). The OSHA standard is 2 fibers/cc as an 8-hour TWA and 10 fibers/cc as a ceiling concentration.
2. ACGIH TLV Document (1978). The OSHA standard is 15.0 mg/m^3 (1978)
3. NIOSH Criteria Document (1977). The OSHA standard (1978) is 400 mg/m^3.
4. NIOSH Recommendation Revised as a part of NIOSH testimony at OSHA hearing (1977). The OSHA standard is 3.2 mg/m^3 (1978) TWA with a maximum ceiling concentration of 160 mg/m^3 for ten minutes.
5. NIOSH Criteria Document (1978). The OSHA standard (1978) is 3.5 mg/m^3.
6. NIOSH has no specific criteria for each PNA. Thus, PNA's are evaluated as cyclohexane extractable substances in the presence of PNA's for a specific substance, e.g. coal tar pitch, carbon black, etc. The OSHA standard and ACGIH TLV evaluates PNA's as a benzene soluble fraction (0.20 mg/m^3) for a specific substance, e.g. coal tar pitch.

2. Toxicity Data

Asbestos

Available studies provide conclusive evidence that exposure to asbestos fibers can cause cancer and asbestosis in man.

Asbestosis is a chronic lung disease due to inhalation of asbestos fibers and is characterized by diffuse interstitial fibrosis, frequently associated with thickening of the pleura and/or pleural calcification. The characteristic X-ray changes are small, irregular opacities in the lower and middle lung fields. Asbestosis is a progressive disease which may develop in from seven to ten years depending upon degree of exposure, and type of asbestos fiber. Usually the disease becomes evident 20 - 40 years after the first exposure, and may progress even after exposure has ceased.

Bronchogenic carcinoma and mesothelioma occur among workers exposed to asbestos fibers. There is a marked enhancement of bronchogenic carcinoma (lung cancer) in those exposed to asbestos who also smoke cigarettes. Mesothelioma is a cancer

of the lining of the lungs (pleura) or the abdominal cavity (peritoneum). Other types of cancer associated with asbestos exposure are those of the larynx and gastro-intestinal tract. All these cancers have a lengthy induction period (i.e. the time which elapses between the onset of exposure, and the development of the carcinoma), usually in excess of twenty years.

There are data that show that the lower the exposure, the lower the risk of developing asbestosis and cancer. NIOSH has found no evidence for a threshold, or for a "safe" level of asbestos exposure for the development of cancer. In view of the above, NIOSH's recommended standard was set at the lowest level detectable by available analytical techniques. Such a standard should also prevent the development of asbestosis.

Dianisidine

This substance, 3,3' - di' methoxybenzidine controlled as a human carcinogen in Great Britain, is labeled in Germany as "can cause cancer in man", and it is listed in NIOSH's "Suspected Carcinogens" as an animal cancer-causing agent.

D. Evaluation and Discussion

Environmental

Thirty asbestos samples (personal and area) were collected from Lines #8, #3, and #1 as either 8-hour TWA samples or as 15 minute ceiling concentration samples (see Table I). Three of the asbestos samples exceeded the NIOSH recommended criteria of 0.10 fibers/cc. The fiber concentrations ranged from .11 - .12 fibers/cc. None of the samples exceeded the 15 minute ceiling concentration of 0.50 fibers/cc.

Thirty-nine personal and area samples were collected for total nuisance dust exposure (table II - III). None of the samples exceeded the OSHA standard (15 mg/m^3) or the ACGIH TLV (10 mg/m^3). The dust concentrations ranged from 0.29-5.08 mg/m^3.

Nine personal and area samples (table IV) were collected for mineral spirits and benzene. The air samples were collected from the ink mixing room and the production line operation. No benzene solvent was detected on the charcoal tube. The mineral spirits concentration was well below the NIOSH recommended criteria of 350 mg/m^3. The environmental air levels of mineral spirits ranged from 3.9 - 85.4 mg/m^3.

Six personal air samples were collected for polynuclear aromatic hydrocarbons along the three lines (table V). No PNA's were detected on the filter samples.

Six carbon black air samples were collected at the pigment scale operators position. However, these filters were inadvertently analyzed for total dust and not carbon black; ergo, no determination can be made regarding the actual carbon black concentration. Even if the filters are assumed to contain pure carbon black samples, none of these samples would have exceeded the NIOSH recommended criteria of 3.5 mg/m^3. The levels of dust measured on the filters ranged from 0.3 - 2.35 mg/m^3.

Two talc bulk samples were analyzed for free silica and asbestos content. Neither of the bulk samples contained significant concentrations of either contaminants. The concentrations of quartz and cristobalite were 0.3 and less than 0.1 percent respectively. The concentration of asbestos was less than 1 percent block tremolite.

Two carbon black bulk samples were obtained from the same material which was being used along different lines. One bulk sample analysis indicated PNA's (pyrene and fluoranthene) and the other carbon black sample did not contain any PNA's.

The purpose of the HHE survey was to evaluate/sample chemicals used in the manufacturing process of floor tile. It was attempted to evaluate all the potentially toxic chemicals cited on the request. However, this was not possible because all the chemicals are not used on a routine basis. Therefore, specific chemicals were evaluated based on relative toxicity, quantity and frequency of use. It was also determined that dyes are not used in the manufacturing process.

Observations

An ink mist was observed to obscure the light along production line #8. The exhaust fans along the line were not activated. Once the fans were activated, the mist began to dissipate.

The employees who add scrap material to the hopper were observed using an ax to separate the scrap. The scrap scale operator did not wear safety glasses.

The bags of asbestos that are loaded into the hopper car are piled onto a slide table. These bags blocked off the exhaust ventilation rendering it useless.

There was an accumulation of asbestos product on the slide table top and the area between the slide table and the exhaust duct. This area was neglected during the periodic vacuuming.

The face area of the pigment scale operators booth appeared to be larger than necessary, thereby decreasing the exhaust system capture velocity.

The employees' gloves and respirators were placed in the same storage bag during lunch; consequently, the respirators possibly became contaminated.

The exhaust duct along line #8, mixer #15, was not properly connected, thereby reducing the collection efficiency.

Medical

During the walk-through inspection, the President of URW Local 457, when questioned by the NIOSH doctor as to whether he was aware of any work-related health problems among the current work force, stated that two men were away from work, on disability pay, and one worker had been transferred from dusty areas. It was requested of him that he have these men sign the forms authorizing the release of their medical records from their personal physician(s) to NIOSH, and forward these completed documents to the NIOSH physician.

No such forms have been received from current, or past, workers of this plant.

On the following morning, the NIOSH doctor ascertained from the plant physician that he was not aware of any work-related disease(s) among the current work force. He confirmed the statement made by the union representative with respect to the three workers and supplied the NIOSH medical investigator with their relevant medical records, which were reviewed. The worker who had been transferred from dusty areas had evidence of non-asbestos related pulmonary pathology. He has been referred to his private physician, and will also have annual medical examinations at the plant. The other two men were not asbestos workers, and, therefore there were no X-ray or pulmonary-function records. None of these workers was diagnosed as suffering from work-related disease.

The plant physician is present at the facility for 3-1/2 hours, twice a week. He performs all pre-placement examinations, receives all physicians' return-to-work slips, and interviews any worker who has been absent from work, for health reasons, for a period in excess of 3 days.

All medical records are kept indefinitely. The plant doctor stated that about 35 men are potentially exposed to asbestos, and these workers have an annual physical examination which includes a chest X-ray and pulmonary function testing. If any abnormality is detected in the results of the lung function examination, the worker is transferred from dusty areas, and he is referred to his private physician, to whom the abnormal results are forwarded. The plant physician stated that he has had no response from workers' private doctors when he requests the results of any medical investigations undertaken. The workers are reluctant to sign forms releasing medical information to the plant physician.

One worker sought a medical consultation with the NIOSH physician. He reported an irritant dermatitis on the front of his ankles when working with titanium dioxide, which clears when exposure ceases. Appropriate advice and recommendations were made to him.

E. Recommendations

1. It should be assured by a line supervisor or his alternate that the exhaust ventilation is turned on prior to the start of the production line operation, thereby preventing the buildup of oil mists or dust.

2. The ventilation ducting should be inspected periodically to assure the proper operation of the ventilation system.

3. The scrap scale operators should wear safety glasses with side shields to protect themselves from flying objects when separating the tile.

4. The asbestos bags unloaded from the pallet should not be stacked on the slide table because it interferes with the exhaust ventilation.

5. The areas around the slide table should be vacuumed throughout the day to prevent asbestos dust accumulation and inadvertent contamination of other areas.

6. The pigment scale operators booth has a larger face area than appears to be necessary. The installation of a sheet of plexiglass at the upper portion of the face would improve the exhaust system face velocity, thereby increasing capture velocity.

7. The employees should not store their gloves and respirators in the same bag while going to lunch so as to prevent inadvertent respirator contamination.

8. Chemicals which are carcinogenic or suspect carcinogens should be stored away from other less toxic chemicals, and these chemicals should be easily identified.

9. It is suggested that the company re-evaluate their material inventory list in order to determine which chemicals are potentially toxic and need to be monitored.

10. For the men potentially exposed to asbestos, all work clothes should be collected in the plant shower/locker room at the end of each shift, so that they can be placed in plastic bags for proper cleaning. These work clothes must not be taken home to be washed, as any asbestos contamination could pose a health risk to others.

11. Dianisidine should be regarded as a human carcinogen. Thus it should no longer be used in this operation. Any substitute pigment should be throoughly evaluated for toxicity and carcinogenicity.

V. AUTHORSHIP AND ACKNOWLEDGMENTS

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TABLE I
Summary of Air Sampling
For Asbestos
Kentile Floors
Brooklyn, New York

October 24-25, 1978

Date	Sample Number	Type Sample[2]	Job Classification or Location	Sampling Period	Volume(Liters)	Concentration(Fibers/cc)[1]
10/24	6	P	Line #3 Asbestos Scale Operator	0815-1650	525	0.03
10/24	21*	P	Line #3 Asbestos Scale Operator	1045-1100	22.5	N.D.[3] *
10/24	10	P	Line #3 Scrap Scale Operator	0807-1655	747	0.03
10/24	7	P	Line #3 Pigment Scale Operator	0805-1645	735	N.D.
10/24	9	P	Line #3 Relief Operator	0830-1635	727	0.04
10/24	18*	P	Line #3 Mixer Operator	1310-1325	22.5	N.D. *
10/25	25	P	Line #3 Asbestos Scale Operator	0805-1636	690	0.08
10/25	28*	P	Line #3 Asbestos Scale Operator	0930-0945	22.5	N.D. *
10/25	24	P	Line #3 Scrap Scale Operator	0810-1625	697	0.05
10/25	22	A[4]	Line #3 Pigment scale table	0820-1620	720	N.D.
10/25	23	P	Line #3 Mixer Operator	0800-1625	682	0.02
10/25	27*	P	Line #3 Mixer Operator	1230-1250	30.0	N.D. *
10/24	1	P	Line #1 Asbestos Scale Operator	0815-1655	730	0.02
10/24	3	P	Line #1 Scrap Scale Operator	0825-1657	699	0.02
10/24	4	P	Line #1 Pigment Scale Operator	0810-1659	793	N.D.
10/24	2	P	Line #1 Mixer Operator	0850-1701	636	0.05
10/24	14*	P	Line #1 Mixer Operator	1400-1415	22.5	N.D. *
10/24	13	P	Line #1 Asbestos Scale Operator	1439-1454	22.5	N.D.
10/25	35	P	Line #1 Utility Man	0814-1631	661	0.02
10/24	20*	P	Line #8 Mixer Operator	1120-1135	22.5	0.24 *
10/24	19*	P	Line #8 Asbestos Scale Operator	1100-1115	22.5	0.37 *

1. Fibers/cc - Approximate Fibers of asbestos per cubic centimeter of air.
2. P - Personnel sample.
3. N.D. - None detected.
4. A - Area sample.
5. TWA - Time weighted average.
* - 15 minute ceiling concentration.

NIOSH CRITERIA:
1. 8-Hr. TWA[5] - 0.10 fibers/cc
2. 15-minute ceiling contration - 0.50fibers/cc

Limit of Detection: 4500 Fibers per filter.

TABLE 1 (Continued)

SUMMARY OF AIR SAMPLING
FOR ASBESTOS

KENTILE FLOORS
BROOKLYN, NEW YORK

October 24-25, 1978

DATE	SAMPLE NUMBER	TYPE SAMPLE	JOB CLASSIFICATION OR LOCATION	SAMPLING PERIOD	SAMPLING VOLUME (Liters)	CONCENTRATION (Fibers/cc)[1]
10/24	11	P[2]	Line #8 Pigment Scale Operator	0805-1702	760	N.D.[3]
10/24	15	P	Line #8 Asbestos Scale Operator	0809-1657	699	0.007
10/24	12	P	Line #8 Utility Man	0850-1655	662	0.04
10/25	30	P	Line #8 Pigment Scale Operator	0800-1515	652	0.01
10/25	26	P	Line #8 Utility Man	0805-1515	570	0.11
10/25	34	P	Line #8 Scrap Scale Operator	0815-1515	547	0.04
10/25	29	P	Line #8 Asbestos Scale Operator	0820-1520	577	0.11
10/25	33	P	Line #8 Mixer Operator	0825-1535	570	0.12
10/25	32	A[4]	Mottle line	0900-1600	630	0.03

1. Fibers/cc - Approximate Fibers of Asbestos per cubic centimeter of air.
2. P - Personnel sample.
3. N.D. - None detected.
4. A - Area sample.
5. TWA - Time weighted average.

NIOSH Criteria:
1. 8-Hr. TWA[5] - 0.10 fibers /cc
2. 15-minute Ceiling Conc. - 0.50 fibers/cc

Limit of detection: 4500 fibers/filter

TABLE II
Summary of Air Sampling
For Total Nuisance Dust
Kentile Floors
Brooklyn, New York

October 24-25, 1978

Date	Sample Number	Type Sample	Job Classification or Location	Sampling Period	Volume(Liters)	Concentration(mg/m^3)[1]
10/24	3281	P[2]	Line #3 Asbestos Scale Operator	0815-1650	637	1.40
10/24	3279	P	Line #3 Scrap Scale Operator	0807-1655	747	1.73
10/24	3290	P	Line #3 Pigment Scale Operator	0805-1645	735	2.97
10/24	3289	A[3]	Line #3 Pigment Scale Table	0835-1645	735	1.61
10/24	3280	P	Line #3 Relief Man	0830-1635	727	1.68
10/24	3292	P	Line #3 Mixer Operator	0830-1340	390	3.23
10/24	3301	P	Line #3 Mixer Operator	1340-1700	300	3.27
10/25	3294	P	Line #3 Asbestos Scale Operator	0805-1630	712	0.62
10/25	3284	P	Line #3 Scrap Scale Operator	0810-1625	697	0.85
10/25	3300	A	Line #3 Pigment Scale table	0820-1620	720	1.17
10/25	3287	A	Line #3 Mixer Operator	0800-1345	517	2.51
10/24	3291	P	Line #8 Mottle crusher Operator	0820-1705	727	0.76
10/24	3393	A	Line #8 Top of mixer control panel	0830-1125	262	5.08
10/24	3395	A	Line #8 Top of mixer control panel	1125-1705	585	1.52
10/24	3302	P	Line #8 Pigment scale operator	0805-1702	760	2.22
10/24	3389	P	Line #8 Pigment Scale Operator	0809-1657	699	0.66
10/24	3394	P	Line #8 Scrap scale Operator	0815-1703	730	8.49
10/24	3388	P	Line #8 Utility-man	0850-1655	662	0.42
10/25	3293	P	Line #8 Pigment scale Operator	0800-1515	652	1.06
10/25	3286	P	Line #8 Utility-man	0805-1515	570	0.44
10/25	3382	P	Line #8 Scrap scale Operator	0815-1515	562	0.39
10/25	1562	P	Line #8 Asbestos scale Operator	0820-1520	577	0.50
10/25	1869	P	Line #8 Mixer Operator	0825-1535	570	2.60
10/25	1660	A	Line #8 Mottle Area	0900-1600	630	0.29

1. mg/m^3 - Approximate milligrams of contaminant per cubic meter of air
2. P - Personnel sample.
3. A - Area sample.

NIOSH Criteria - None
ACGIH TLV - 10 mg/m^3

TABLE III
Summary of Air Sampling for Total
Nuisance Dust Collected Along
Mottle Line (Line #1)
Kentile Floors
Brooklyn, New York

October 24-25, 1978

Date	Sample Number	Type Sample	Job Classification or Location	Sampling Period	Volume(Liters)	Concentration(mg/m^3)[1]
10/24	3375	P[2]	Utility Man	0835-1658	754	0.62
10/24	3288	P	Scale Operator	0815-1655	730	2.36
10/24	3381	P	Scrap Scale Operator	0825-1655	721	2.26
10/24	3387	A[3]	Pigment Scale Table	0810-1659	793	1.20
10/24	3380	A	Mixer Operator	0850-1701	736	3.52
10/24	3379	P	Shoveling Mottle into Supply Bin	0900-1705	625	1.01
10/24	3377	P	Scrap Scale Operator	0900-1705	625	3.22
10/25	3298	P	Shoveling Mottle into Supply Bin	0828-1629	661	2.28
10/25	3296	P	Scrap Scale Operator	0830-1630	664	3.73
10/25	3295	A	Pigment Scale Table	0823-1619	714	0.53
10/25	3299	P	Utility Man	0814-1631	664	1.29
10/25	3282	P	Scrap Scale Operator	0808-1620	684	2.47
10/25	3283	P	Scale Operator	0805-1628	604	3.15
10/25	3297	P	Pigment Scale Operator	0804-1615	688	3.76
10/25	3285	P	Mixer Operator	0800-1616	664	1.90

1. mg/m^3 - Approximate milligrams of contaminant per cubic meter of air.
2. P - Personnel sample.
3. A - Area sample.

NIOSH Criteria - None
ACGIH TLV - 10. mg/m^3

TABLE IV
Summary of Air Sampling
for Mineral Spirits and Benzene
Kentile Floors
Brooklyn, New York

October 24-25, 1978

Date	Sample Number	Type Sample	Job Classification or Location	Sampling Period	Volume (Liters)	Concentration (mg/m^3)[1] Mineral Spirits	Benzene
10/24	1	P[2]	Line #8 Calendar Operator	0835-1705	22.3	9 4	N.D.[3]
10/24	2	A[4]	Line #8 Calendar line Control panel	0837-1705	26.3	6.1	N.D.
10/24	3	P	Line #8 Calender Operator	0840-1705	22.7	33.5	N.D.
10/24	4	A	Ink Mixing room	1415-1440	4.8	85.4	N.D.
10/25	5	P	Line #8 Calendar Operator	0830-1510	21.4	19.6	N.D.
10/25	6	A	Line #8 Mixer Operator control panel	0825-1520	25.3	3.9	N.D.
10/25	7	P	Line #8 Relief man	0835-1510	19.4	32.5	N.D.
10/25	8	P	Line #8 Calendar Operator	0840-1520	19.1	8.9	N.D.
10/25	9	A	Line #8 Calendar control panel	0840-1550	20.0	5.0	N.D.

1. mg/m^3 - Approximate milligrams of contaminant per cubic meter of air.
2. P - Personnel sample
3. N.D. - None detected
4. A - Area sample
5. TWA - Time weighted average

NIOSH CRITERIA: 8-Hour - TWA[5]
1. Mineral Spirits - 350 mg/m^3
2. Benzene - 3.2 mg/m^3

TABLE V
Summary of Personal Air Sampling for
Polynuclear Aromatic (PNA) Hydrocarbons
Kentile Floors
Brooklyn, New York

October 24-25, 1978

Date	Number	Job Classification or Location	Sampling Period	Sampling Volume(Liters)	Concentration(µg/sample)[1] Benzo(a) pyrene	Chrysene	Pyrene	Benzo(a) Anthracene	Fluoranthene	Benzene Solubles(mg/m³)[2]
10/25	7	Line #3 Pigment Scale Operator	0815-1630	682	N.D.[4]	N.D.	N.D.	N.D.	N.D.	1.35
10/25	1	Line #3 Mixer Operator	0800-1625	712	N.D.	N.D.	N.D.	N.D.	N.D.	0.42
10/24	4	Line #1 Pigment Scale Operator	0805-1700	720	N.D.	N.D.	N.D.	N.D.	N.D.	0.81
10/24	2	Line #1 Mixer Operator	0850-1701	636	N.D.	N.D.	N.D.	N.D.	N.D.	0.84
10/24	3	Line #8 Mixer Operator	0825-1705	682	N.D.	N.D.	N.D.	N.D.	N.D.	2.55
10/24	8	Line #8 Pigment scale Operator	0800-1700	757	N.D.	N.D.	N.D.	N.D.	N.D.	0.34

1. µg/sample - Approximate microgram of contaminant per milliliters of sample.
2. mg/m³ - Approximate milligrams of contaminant per cubic meter of air.
3. N.D. - None detected.

Limit of Detection:
1. Benzo(a) Pyrene - 1.0µg/sample
2. Chrysene - 2.5µg/sample
3. Pyrene - 5.0µg/sample
4. Benzo(a)Anthracene - 2.0µg/sample
5. Fluoranthene - 1.0µg/sample

TABLE VI

Summary of Personal Air Sampling for Carbon Black
Kentile Floors
Brooklyn, New York
October 24-25, 1978

DATE	SAMPLE NUMBER	JOB CLASSIFICATION OR LOCATION	SAMPLING PERIOD	SAMPLING VOLUME(Liters)	TOTAL DUST* CONCENTRATION mg/m3 [1]
10/24	1572	Line #1, Pigment Scale Operator	0805-1315	429	1.91
10/24	1692	Line #1, Pigment Scale Operator	1315-1700	338	1.42
10/24	1617	Line #8, Pigment Scale Operator	0805-1305	458	0.74
10/24	1582	Line #8, Pigment Scale Operator	1340-1700	300	0.30
10/25	1592	Line #3, Pigment Scale Operator	0815-1300	428	1.75
10/25	1736	Line #3, Pigment Scale Operator	1340-1630	255	2.35

1. mg/m^3 - Approximate milligrams of contaminant per cubic meter of air.

* The carbon black samples were inadvertently analyzed for total nusance dust. Therefore these concentrations can not be considered pure carbon black concentrations.

NIOSH Recommended Criteria (1978)
1. Carbon Black - 3.5 mg/m^3
   - 0.1 mg/m^3 in presance of polycyclic aromatic hydrocarbons.