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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 78-73-612

KENTILE FLOORS, INC.  
CHICAGO, ILLINOIS  
SEPTEMBER 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., Chicago, Illinois on June 26-27 and August 19-22, 1978, to evaluate alleged worker exposure to asbestos, polynuclear aromatic hydrocarbons (PNA), vinyl chloride monomer, talc, alpha methyl styrene, and numerous organic and inorganic dyes and pigments.

The methodology used to evaluate the workers' environment included: (1) environmental air sampling, (2) a review of materials inventory and the 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, and (8) observations of employees' work practices and engineering controls.

Environmental air samples and bulk samples were collected and analyzed for the following contaminants (see Tables I-VI): carbon black, PNA's (benzo(a)pyrene, anthracene, phenanthrene, pyrene, chrysene, benzene-soluble fraction), mineral spirits, benzene, asbestos, total dust, lead, and total chromium. Asbestos was the only contaminant found to exceed a NIOSH recommended criteria. Eight of thirty asbestos samples exceeded the NIOSH recommended criteria of 0.10 fibers per cubic centimeter of air.

No cases of asbestosis were documented among the past and present workers at this plant. Of the three authenticated cases of cancer revealed in this investigation, only one should possibly be regarded as being of occupational origin. Since this cancer has a lengthy latent period, i.e., the amount of time elapsing between exposure to occupational carcinogen(s) and the development of a tumor, one cannot be sure in this case what the causative agent(s) could be, as prior to his first employment at this plant, the man worked in an industry associated with the development of respiratory-tract cancers.

## 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., Chicago, Illinois
- B. Authorized representatives of the United Rubber Workers (URW)  
Local No. 505, Chicago, Illinois
- C. International Union of URW, Akron, Ohio
- D. NIOSH - Region V
- E. U.S. Department of Labor - Region V

For the purpose of informing the approximately 50 "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. The request alleged that personnel were exposed to materials used in the production of vinyl asbestos and asphalt asbestos floor covering. Furthermore, "the OSHA industrial hygiene survey verified exposures to asbestos, benzo(a)pyrene, coal tar pitch volatiles and chrysene." Malignant tumors of various types were reported by the local union to the International Union and/or OSHA investigator. However, information associated with these reports seemed sketchy and warranted further investigation.

## 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 300 workers

of whom approximately 250 are factory workers. The employees work one of two shifts (7:00 am - 4:30 pm or 4:30 pm - 2:00 am) nine hours per day, five days per week. The maintenance department works on Saturdays in order to perform routine equipment maintenance and repairs. The company performs environmental air sampling for asbestos, total dust, etc. However, the frequency of monitoring was not determined.

The areas evaluated were the process room, the recycling process and the ink mixing operation. All personnel assigned to the process room or recycling operation are assigned separate lockers for clean and dirty clothes. Additionally, workers are required to wear the following protective equipment: coveralls, respirator and safety shoes. Employees are relieved from duty ten minutes before the end of their shift in order to shower; however, showers are not mandatory.

Workers in the process room or the recycling area are each assigned two respirators. At the end of each shift, the dirty respirators are collected by the supervisor for daily cleaning. Two employees disassemble each respirator and hand-clean them according to requirements described in the respiratory guide supplied with the respirators. The units are air-dried, assembled with new filters, and returned to their respective owners at the beginning of their shift.

#### 1. Process Room

In the process room, located in Building 2, chemical weighing and mixing is accomplished. There are two tile lines (#5 and #7) and a mottling or decorative tile line (#6) which are very similar operations. All three lines are operated by 20 workers during the day shift, whereas the second shift (10 workers) operates only one production line.

The materials are normally stored in the warehouse and transported to the process room, via fork lifts, as needed. Inadvertent chemical spills are normally vacuum cleaned.

Lines #5, #6 and #7 utilize a hopper car and a conveyor system for transporting chemicals from the scales to the \*Banbury<sup>®</sup> mixer. The pigment operator measures the required quantities of pigments (from bulk materials) at a booth which has slot ventilation. The pigment is placed in a plastic bag and dropped into the hopper car. The hopper proceeds to the first of two scales, both of which have canopy exhaust ventilation, where the resin scale operator places a bag of asbestos onto a horizontal chute, splits it in both directions and pushes the bag into the hopper. Two additional chemicals are automatically

metered and conveyed to the hopper. The hopper car is transferred to the second scale operator who loads the hopper with scrap tile. It should be noted that the scale operators switch positions every four hours. The hopper car is then conveyed to the Banbury mixer where the operator dumps the hopper load into one of two mixers inlet chute which are alternately charged and dumped onto a conveyor belt below.

In addition, the mixer operator triggers a switch which dumps the other chemicals (plasticizer, limestone, polyvinyl chloride pellets, scrap tiles, and water) into the inlet chute. The materials are mixed for the prescribed time; after which, the load is released through the discharge chute. The mixture, when released, is hot (160-300°F) due to frictional mixing. The mixture is subsequently conveyed to the mills to be gauged, colored, waxed, polished, cut and packed. The mottle, once gauged, is crushed and added to the vinyl asbestos tile.

Building 2 occupies about 4,500 square feet (ft<sup>2</sup>) with an average ceiling height of about 25 feet. The entire ventilation system is purged through a bag house where the dust is collected, bagged and identified with a tag indicating asbestos dust. The exhaust system operates at 48,000 cubic feet per minute (cfm). The make-up air unit operates at 90,000 cfm. This make-up air is primarily used to cool the hot running machines.

The pigment scale operators' booth has slot ventilation (42 x 1 inch) which operates at about 50 feet per minute (fpm).

Each of the hopper scales have canopy exhausts 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 fpm when the hopper car is in place. Both Banbury machines 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.

## 2. Recycling Process

The recycling process, located on the second floor above the process room, is operated by two workers. One employee is the utility man/Banbury relief man and the other employee monitors the conveyor belts which transport scrap tile chips to the Banbury machine. The conveyor system occasionally becomes overloaded with scrap, thus requiring the operator to divert some of the scrap material into 55 gallon drums for temporary storage.

As the conveyor supply of scrap tile diminishes, the operator empties the drums of scrap tile back onto the conveyor belts. Also, the operator transports drums of scrap to and from the warehouse. The exhaust ventilation for the recycling line consists of an open duct which returns room air to the roof.

### 3. Ink Mixing Room

One employee spends 15-20 minutes per day in the ink mixing room (300 ft<sup>2</sup>) preparing formulations. The room contains drums of ink and mineral spirits. Although the room has no exhaust ventilation, there is a wall-mounted air conditioner which the worker uses at his discretion. Also, the worker leaves the large entrance door open whenever he works in the room because of the strong odors.

The ink formulation consists of mixing inks and mineral spirits to obtain the desired color and consistency which is optically compared to the standard. Once the mixing is complete, the worker leaves this room for the rest of the day.

## B. Evaluation Design/Methods

### 1. Environmental/Medical Survey

On June 27, 1978, an initial environmental/medical survey was conducted. After the opening conference, a walk-through inspection was made with both management and labor representatives. The entire plant was visited so that the NIOSH representatives would better understand the general operation. The specific departments identified as being potentially hazardous were the ink room, process room, mill room, and the recycling room.

### 2. Environmental Air Sampling

Personnel and area samples were used to evaluate employee exposure. The personnel samples were attached to the workers' shirt collar in order to characterize a breathing zone sample. The area samples were 1.0 feet to 3.0 feet from the workers' breathing zone. Each of the sampling data tables include information denoting the types of samples collected.

#### Carbon Black

Carbon black dust samples were collected with mine safety appliance (MSA) Model G battery operated personnel 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 pump flow rates were calibrated daily and operated at 1.5 liters per minute to collect 2 four-hour samples. The analytical method consists of weighing the filter in a clean tared crucible. The crucible and filter were placed in a muffle furnace and the filter was ashed by gradually raising the temperature to 800°C. After ashing, the crucibles were 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 Hydrocarbons

Collection of these two 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 calibrated daily and operated at 1.5 lpm for about eight hours.

#### Benzene-Soluble Fraction

The samples were analyzed by NIOSH Physical and Chemical Method #217 (P&CAM). The particulate matter on the filters was extracted with benzene ultrasonically. After extraction, the benzene solution was filtered and evaporated to 1.0 milliliter (ml). An aliquot was evaporated in a tared Teflon boat; the weight gain is due to the benzene soluble residue in one-half the sample.

#### PNA

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

Identification of specific peaks in the chromatograms derived from the samples were compared with those of known standard compounds. The limits of detection listed in Table II apply to a 1.0 microliter (ul) injection from a 1.0 ml sample. The detection limits are different because all samples were analyzed using a large injection volume to increase sensitivity. The reported limit of detection may vary between samples due to injecting different sample volumes.

#### Solvents (Mineral Spirits and Benzene)

A sampling train consisting of a Sipin<sup>®</sup> vacuum pump and a 150 milligram activated charcoal tube is used to collect a known volume of air. Air contaminants are adsorbed to the charcoal grains and later analyzed. The charcoal tubes, which have two sections, are separately desorbed in 1.0 ml of carbon disulfide containing dodecane as an internal standard and analyzed by gas chromatography with a flame ionization detector according to 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.

#### Nuisance Dust

A personal sampling train with a tared 37-mm diameter/5.0 um pore size, tared polyvinyl chloride filter (type FWSB) 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 subsequently analyzed gravimetrically according to NIOSH method #29. The weight of the sample was determined by subtracting the tare weight from the total weight.

#### Lead and Total Chromium

These metals were collected by drawing air through a 37-mm diameter/0.8 um pore size mixed cellulose ester membrane filter (type DM-800) with an MSA model G pump. The filter analyses consisted of ashing the filters with nitric acid and perchloric acid and subsequently analyzing the solution by atomic absorption spectrophotometry (NIOSH method #173).

### 3. Medical

On June 26, 1978 the physician examined all the medical information which OSHA officers had obtained from the President, URW Local 505, and from Kentile (Chicago) employees, ex-employees, or their next of kin.



Some death certificates were included in the Kentile file, and their contents were noted.

On June 27, 1978, the medical records of all workers included in the list supplied to NIOSH, by Local 505 President, were examined at the plant. There was free discussion of the records with the plant physician and full-time nurse. Further information was obtained from the Union's Local president.

The plant employs a full-time nurse on the day-shift, stationed in a well-equipped First Aid room.

All asbestos-exposed workers have had annual chest X-rays since 1971, and pulmonary function tests for the past five years, performed at a local clinic.

No cases of asbestosis were on record at the plant.

A physician from the local clinic performs all pre-placement physicals, annual examinations and sees all workers who have been absent from work for health reasons for periods in excess of three days.

On arrival at Kentile Floors, Inc., the medical officer asked the Illinois representative to let the workers know that a government doctor was present in the plant and was available for consultation on any work related health problems.

Of the three workers who sought this medical advice, only one had an occupational disease. He had an irritant dermatitis on his face, and more markedly, inside his elbows.

The medical officer gave the union representative a supply of "Release of Medical Information to NIOSH" forms which he was requested to distribute to all workers who believe that they are suffering from work-related disease. On completion, these forms were to be forwarded to the NIOSH physician. To facilitate this matter, a supply of self-addressed envelopes were sent to Local 505 by the medical investigator.

On receipt of fourteen completed forms, authorizing release of medical information to NIOSH, the personal physician(s) and/or medical facilities listed in these documents were contacted by letter, and all relevant medical information was requested of them. A photocopy of the signed medical-release forms accompanied each request. The plant physician sent relevant medical information on workers, as requested.

No medical reports were received on four of the workers participating in this investigation. A reply that there were no records of such a patient was received on three of them. The personal physician of the fourth man was deceased, and the disposition of his medical files was unknown.

C. Evaluation Criteria and Toxicity Data

I. Environmental

There are several criteria used to evaluate the toxic air contaminants of 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 criteria for each contaminant are based upon the current state of knowledge concerning toxicity of these substances. The criteria are designed to allow an occupational exposure for 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 at or below the TWA.

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

The criteria mentioned above have 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 Standard, with respect to airborne levels, will be presented.

TIME-WEIGHTED AVERAGE

| <u>SUBSTANCE</u>                                                        | <u>8-HOUR</u>       | <u>10-HOUR</u>                                                                                                                                        | <u>CEILING<br/>VALUE</u> | <u>MINUTES</u> |
|-------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------|
| Carbon Black <sup>1</sup>                                               |                     | 3.5mg/m <sup>3a</sup> and<br>0.10mg/m <sup>3</sup> as<br>cyclohexane<br>extractable<br>substances (PNA's)                                             |                          |                |
| Polynuclear Aromatic <sup>2</sup><br>Hydrocarbons (PNA)                 |                     | 0.2mg/m <sup>3</sup> as benzene<br>extractable or<br>0.1mg/m <sup>3</sup> cyclohexane<br>extractable fraction<br>in the presence of<br>specific PNA's |                          |                |
| Refined Petroleum Solvents <sup>3</sup><br>(Mineral Spirits or Naphtha) |                     | 350mg/m <sup>3</sup>                                                                                                                                  | 1800mg/m <sup>3</sup>    | 15             |
| Benzene <sup>4</sup>                                                    |                     |                                                                                                                                                       | 3.2mg/m <sup>3</sup>     | 60             |
| Asbestos <sup>5</sup> (fibers must be<br>longer than 5.0 micron)        |                     | 0.10 fibers/cc <sup>b</sup>                                                                                                                           | 0.50 fibers/cc           | 15             |
| Inert Nuisance Dust <sup>6</sup>                                        | 10mg/m <sup>3</sup> |                                                                                                                                                       |                          |                |
| Inorganic Lead <sup>7</sup>                                             |                     | 0.05mg/m <sup>3</sup>                                                                                                                                 |                          |                |
| Total Chromium <sup>8</sup>                                             |                     | 1.0ug/m <sup>3c</sup>                                                                                                                                 |                          |                |

a) mg/m<sup>3</sup> - Approximate milligrams of particulate per cubic meter of air

b) Fibers/cc - Fibers of particulate per cubic centimeter of air

c) ug/m<sup>3</sup> Approximate micrograms of particulate per cubic meter of air

1. NIOSH Criteria Document (1978). The OSHA Standard (1978) is 3.5mg/m<sup>3</sup>.

2. NIOSH has no specific criteria for each PNA. Thus, PNA's are evaluated as cyclohexane extractable substances (.10mg/m<sup>3</sup>) in the presence of a specific substance, e.g. coal tar pitch, carbon black, etc. The OSHA standard and TLV evaluate PNA's as a benzene soluble fraction (0.20mg/m<sup>3</sup>) for a specific substance, e.g. coal tar pitch.

3. NIOSH Criteria Document (1977). The OSHA Standard (1978) is  $400\text{mg}/\text{m}^3$ .
4. NIOSH Recommendation Revised as a part of NIOSH testimony at OSHA hearing (1977). The OSHA Standard is  $32\text{mg}/\text{m}^3$  (1978) TWA with a maximum ceiling concentration of  $160\text{mg}/\text{m}^3$  for 10 minutes.
5. 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.
6. ACGIH TLV Document (1978). The OSHA Standard is  $15.0\text{mg}/\text{m}^3$ . (1978).
7. The OSHA Standard is  $0.05\text{mg}/\text{m}^3$ . (1979)
8. NIOSH Criteria Document (1975). The OSHA Standard is  $1.0\text{ug}/\text{m}^3$ . (1978)

## 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 (fibrosis) 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 seven to ten years depending upon degree of exposure and type of asbestos fiber. Usually the disease becomes evident 20-40 years after 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 the risk 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 which 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 with respect to the development of cancer.

D. Evaluation Results and Discussion

1. Environmental

Four carbon black samples (personal and area) were collected at the pigment scale operations booth. Also, a bulk sample of the pigment was analyzed. It was learned that the company dilutes the carbon black with limestone in order to obtain the desired pigment concentration. An analysis of the carbon black revealed it to be 58 percent pure. None of the air samples indicated any carbon black accumulation on the filters.

Ten PNA samples (personal and area) were collected from several positions along the three lines. Another agency performed a survey in which several PNA's were identified; however, the source of contamination could not be determined. It was first suspected that carbon black might have been the source of contamination; however, this thought was discounted after viewing the operation in detail. It was attempted to sample at different positions along the line to ascertain if one specific area reflected PNA exposure. A laboratory analysis indicated that the sample chromatograms did not contain any peaks which would be interpreted as polynuclear aromatic hydrocarbon compounds.

Eight personal and area samples were collected for mineral spirits and benzene. None of these samples exceeded the NIOSH recommended standard. A bulk sample of the mineral spirits was used to identify the naphtha peaks.

Thirty asbestos samples (personal) were collected from three lines as 8-hour TWA samples and as 15 minute samples. Seven of the TWA samples exceeded the NIOSH recommended criteria of 0.10 fibers/cc. None of the samples exceeded the 15 minute sample of 0.50 fibers/cc.

Thirty-nine personal and area samples were collected for total nuisance dust exposure. None of the samples exceeded the OSHA standard or the ACGIH threshold limit value of  $15.0\text{mg}/\text{m}^3$  and  $10.0\text{mg}/\text{m}^3$  respectively.

Four samples (personal and area) were collected for the chrome yellow pigment. None of the samples exceeded the OSHA lead standard ( $0.05\text{mg}/\text{m}^3$ ) or NIOSH recommended standard for chromium ( $1.0\text{ug}/\text{m}^3$ ).

The health hazard survey attempted to evaluate all the potentially toxic chemicals on the inventory list, but attention was primarily focused on the specific chemicals cited on the health hazard evaluation request. However, since all of these chemicals are not used on a daily basis some could not be evaluated. It was also determined that dyes are not used by the company, and alpha methyl styrene is no longer used consequently, specific chemicals were evaluated based on the relative toxicity, quantity and frequency of use.

All of the employees working along the process line were observed to wear their respirators during this evaluation. Most of the employees only fastened one of the two straps, and in several cases, the employees placed a paper towel around their chin between the skin and the respirator to absorb moisture.

The employees working in the recycling area do not wear a respirator except when filling drums with excess scrap material. Neither of the workers wears safety glasses. As chips are transferred from one conveyor line to another, the chips become airborne momentarily. Several scrap chips hit the NIOSH investigators face and glasses during the day's survey. It was also observed that the guards for the conveyor system are not the same size. The conveyor line with the smaller guard rails allowed considerably more spillage of scrap material.

It was observed that as the automatic conveyor system filled the hopper car, the chemicals created a slight amount of dust some of which escaped the canopy exhaust system.

All of the chemicals are stored in the warehouse. Some of the chemicals are either animal carcinogens or suspected human carcinogens. These chemicals are not specifically identified as such or stored away from other less toxic chemicals.

There was a 2-3 inch gap between the ceiling and an I-beam structure on the locker room, thereby allowing dust to contaminate the area. This problem was corrected by the company prior to the follow-up survey.

The exhaust ducting along line 6 in the process room (Bldg 2) at the A calendar was disconnected.

#### Medical

Excess cancers of the respiratory and gastro-intestinal tract have been documented in workers with significant asbestos

exposure but of the three authenticated cases of cancer revealed in this investigation (two of the larynx and one of the colon) only one should be regarded as possibly being of occupational origin. This is a case of laryngeal cancer in a worker who is reported to be a light drinker, non-smoker. Smoking and drinking have been implicated in the genesis of laryngeal cancer. This cancer has a lengthy latent period i.e., the amount of time elapsing between exposure to an occupational carcinogen(s) and the development of a tumor. One cannot be sure, in this case, what the causative agent(s) could be. Prior to his first employment at this plant, the man worked in an industry associated with the development of respiratory-tract cancers. The other two workers were not process operators; therefore, they would have comparatively light exposure to asbestos, and there is no record of previous occupational exposure to other known, or suspected, carcinogens.

The diagnosis of asbestosis made on one worker by a physician at a local hospital was not confirmed by lung-disease experts at NIOSH's Appalachian Laboratory of Occupational Safety and Health, and the University of Cincinnati, after evaluation of the findings of all medical investigations undertaken on this man.

The diagnoses recorded on the remaining seven workers included dermatitis, chronic bronchitis, diabetes and heart disease. With the possible exception of the case of dermatitis, these diseases are not considered to be caused by occupational exposures at this plant.

#### D. Recommendations

1. The company should review their material inventory list to determine which chemicals are potentially toxic. The toxic chemicals should be monitored periodically.
2. Employees should be instructed to fasten all straps on their respirators. Also, paper towels should not be placed between the skin and respirator because this will reduce the respirator's effectiveness.
3. Employees working in the recycling area should wear respirators when filling the drums. All employees working on or near the recycling conveyor belts should wear safety glasses with side shields to prevent eye injury.
4. The canopy exhaust system for each of the three process lines should be examined to ascertain whether the side

curtains are effectively capturing the dust generated while filling the hopper.

5. Chemicals which are carcinogens (e.g. Dianisidine Orange) or suspect carcinogens for humans and animals should be identified and stored away from non-carcinogens.
6. The ventilation exhaust system should be inspected periodically to assure proper operation.
7. For the men potentially exposed to asbestos, all work clothes should be collected in the plant shower/locker room at the end of each day, so that they can be placed in plastic bags for proper cleaning. These work clothes must not be taken home to be washed because this could expose others at home to asbestos.

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TABLE I  
Summary of Air Sampling for Carbon Black  
Kentile Floors  
Chicago, Illinois  
September 21, 1978

| Sample Number | Type of Sample | Job Classification or Location                     | Sampling  |                 | Carbon Black Concentration (mg/m <sup>3</sup> ) <sup>1</sup> |
|---------------|----------------|----------------------------------------------------|-----------|-----------------|--------------------------------------------------------------|
|               |                |                                                    | Period    | Volume (Liters) |                                                              |
| 1216          | Personnel      | Line #7 Pigment Scale Operator                     | 0810-1216 | 342             | N.D. <sup>2</sup>                                            |
| 1206          | Personnel      | Line #7 Pigment Scale Operator                     | 1248-1557 | 279             | N.D.                                                         |
| 449           | Work Area      | Line #7 Pigment Scale Operator (B.Z.) <sup>3</sup> | 0810-1212 | 360             | N.D.                                                         |
| 704           | Work Area      | Line #7 Pigment Scale Operator (B.Z.)              | 1212-1557 | 333             | N.D.                                                         |

1. mg/m<sup>3</sup> - Approximate milligrams of carbon black per cubic meter of air.

NIOSH Recommended Criteria (1978)-3.5mg/m<sup>3</sup>

2. N.D. - None Detected (Limit of Detection is 0.5 mg).

3. B.Z. - Breathing zone sample.

TABLE II  
Summary of Air Sampling for Polynuclear  
Aromatic (PNA) Hydrocarbons  
Kentile Floors  
Chicago, Illinois

September 20 - 21, 1978

| Date | Sample Number | Type Sample    | Job Classification Or Location            | Sampling Period | Sampling Volume(Liters) | CONCENTRATION $\mu\text{g}/\text{sample}^1$ |            |              |        |          | Benzene Soluble(mg/m <sup>3</sup> ) <sup>2</sup> |
|------|---------------|----------------|-------------------------------------------|-----------------|-------------------------|---------------------------------------------|------------|--------------|--------|----------|--------------------------------------------------|
|      |               |                |                                           |                 |                         | Benzo(a) pyrene                             | Anthracene | Phenanthrene | Pyrene | Chrysene |                                                  |
| 9/20 | PNA-1         | A <sup>3</sup> | Line #7 Pigment table (B.Z.) <sup>4</sup> | 0746-1549       | 729                     | < 0.04                                      | < 0.20     | < 0.08       | < 0.20 | < 0.10   | 0.27 <sup>5</sup>                                |
| 9/20 | PNA-2         | P <sup>5</sup> | Line #7 Mixer Operator                    | 0805-1550       | 684                     | < 0.04                                      | < 0.20     | < 0.08       | < 0.20 | < 0.10   | 0.08                                             |
| 9/21 | PNA-3         | A              | Line #7 Mixer Operator(B.Z.)              | 0800-1548       | 702                     | < 0.20                                      | < 1.00     | < 0.40       | < 1.00 | < 0.50   | 1.28                                             |
| 9/21 | PNA-4         | P              | Line #7 Mixer Operator                    | 0800-1548       | 639                     | < 0.05                                      | < 0.25     | < 0.10       | < 0.25 | < 0.13   | 0.37                                             |
| 9/20 | PNA-6         | A              | Line #5 Pigment table (B.Z.)              | 0818-1558       | 693                     | < 0.04                                      | < 0.20     | < 0.08       | < 0.20 | < 0.10   | 0.28                                             |
| 9/20 | PNA-7         | P              | Line #5 Mixer Operator                    | 1242-1601       | 297                     | < 0.04                                      | < 0.20     | < 0.08       | < 0.20 | < 0.10   | 0.33                                             |
| 9/21 | PNA-8         | A              | Line #5 Mixer Operator                    | 0816-1550       | 684                     | < 0.10                                      | < 0.50     | < 0.20       | < 0.50 | < 0.25   | 0.84                                             |
| 9/21 | PNA-9         | P              | Line #5 Mixer Operator                    | 0816-1548       | 693                     | < 0.10                                      | < 0.50     | < 0.20       | < 0.50 | < 0.25   | 0.66                                             |
| 9/20 | PNA-11        | P              | Line #6 Mixer Operator                    | 0735-1550       | 675                     | < 0.10                                      | < 0.50     | < 0.20       | < 0.50 | < 0.25   | 0.56                                             |
| 9/21 | PNA-12        | P              | Line #6 Mixer Operator                    | 0741-1555       | 684                     | < 0.04                                      | < 0.20     | < 0.08       | < 0.20 | < 0.10   | 0.20                                             |

1.  $\mu\text{g}/\text{sample}$  - microgram of particulate per sample analyzed.
2.  $\text{mg}/\text{m}^3$  - approximate milligrams of particulate per cubic meter of air.
3. A - Area sample.
4. B.Z. - Breathing zone sample.
5. P - Personnel sample.
6. Limits of Detection - The reported limit of detection varied between samples due to different injection volumes.

| Limits of Detection <sup>6</sup> |                                    |
|----------------------------------|------------------------------------|
| Benzo (a) pyrene                 | - 1 $\mu\text{g}/\text{sample}$    |
| Anthracene                       | - 5 $\mu\text{g}/\text{sample}$    |
| Phenanthrene                     | - 2 $\mu\text{g}/\text{sample}$    |
| Pyrene                           | - 5 $\mu\text{g}/\text{sample}$    |
| Chrysene                         | - 2.5 $\mu\text{g}/\text{sample}$  |
| Benzene Solubles                 | - 0.02 $\mu\text{g}/\text{sample}$ |

TABLE III  
Summary of Air Samples Collected  
During Ink Mixing Operation  
Kentile Floors  
Chicago, Illinois

September 20 - 21, 1978

| Date | Number | Type of Sample | Job Classification or Location | Period      | Sampling Volume(Liters) | Concentration(mg/m <sup>3</sup> ) <sup>1</sup> |                   |
|------|--------|----------------|--------------------------------|-------------|-------------------------|------------------------------------------------|-------------------|
|      |        |                |                                |             |                         | Mineral Spirits                                | Benzene           |
| 9/20 | 1      | P <sup>2</sup> | Ink Mixer                      | 13:57-14:09 | 0.52                    | 67.3                                           | N.D. <sup>3</sup> |
| 9/20 | 2      | P              | Ink Mixer                      | 13:58-14:09 | 0.90                    | 50.0                                           | N.D.              |
| 9/20 | 3      | A <sup>4</sup> | Desk Top                       | 14:00-14:10 | 0.37                    | 94.6                                           | N.D.              |
| 9/20 | 4      | A              | On Top of Barrel               | 13:59-14:08 | 0.38                    | 65.8                                           | N.D.              |
| 9/21 | 6      | P              | Ink Mixer                      | 12:58-1:09  | 0.45                    | 166.6                                          | N.D.              |
| 9/21 | 7      | P              | Ink Mixer                      | 12:58-1:09  | 0.83                    | 54.2                                           | N.D.              |
| 9/21 | 8      | A              | On Top of Barrel               | 12:58-1:10  | 0.38                    | 39.5                                           | N.D.              |
| 9/21 | 10     | A              | Desk Top                       | 12:58-1:11  | 13.0                    | 82.7                                           | 0.15              |

1. mg/m<sup>3</sup> - Approximate milligrams of particulate per cubic meter of air.  
 2. P - Personnel sample.  
 3. N.D. - None detected.  
 4. A - Area sample.

Limits of Detection:  
 Mineral Spirits - 0.01mg  
 Benzene - 0.001mg

NIOSH EVALUATION CRITERIA

1. Minerals Spirits (15min. Ceiling Conc.) - 1800mg/m<sup>3</sup>  
 2. Benzene - 3.2mg/m<sup>3</sup>

TABLE IV  
Summary of Personnel Air Samples  
Collected for Asbestos  
Kentile Floors  
Chicago, Illinois

September 20-21, 1978

| Date | Sample Number | Job Classification or Location | Period    | Sampling        | Concentration (Fibers/cc) <sup>1</sup> |
|------|---------------|--------------------------------|-----------|-----------------|----------------------------------------|
|      |               |                                |           | Volume (liters) |                                        |
| 9/20 | 41*           | Line #6 Asbestos Weigher       | 0745-0800 | 22.5            | N.D. <sup>2</sup> *                    |
| 9/20 | 42            | Line #6 Resin Scale Operator   | 0725-1545 | 690.            | 0.02                                   |
| 9/20 | 43*           | Line #6 Mixer Operator         | 1320-1335 | 22.5            | N.D.*                                  |
| 9/20 | 1             | Line #7 Resin Scale Operator   | 0725-1609 | 735.            | 0.41                                   |
| 9/20 | 2             | Line #7 Scrap tile loader      | 0732-1605 | 712.            | 0.11                                   |
| 9/20 | 4             | Line #7 Resin Scale Operator   | 1047-1057 | 15.0            | 0.61                                   |
| 9/20 | 5             | Line #7 Scrap tile loader      | 1038-1056 | 27.0            | N.D.                                   |
| 9/20 | 6             | Line #7 Scrap tile loader      | 1510-1529 | 19.5            | 0.27                                   |
| 9/20 | 7             | Line #7 Resin Scale Operator   | 1523-1542 | 28.5            | 0.19                                   |
| 9/21 | 8             | Line #7 Resin Scale Operator   | 0748-1600 | 682.            | 0.29                                   |
| 9/21 | 9             | Line #7 Scrap Tile loader      | 0751-1553 | 675.            | 0.13                                   |
| 9/21 | 10            | Line #7 Pigment Scale Operator | 0810-1557 | 637.            | 0.02                                   |
| 9/21 | 11            | Line #7 Mixer Operator         | 0800-1548 | 660.            | 0.05                                   |
| 9/21 | 14*           | Line #7 Resin Scale Operator   | 1011-1026 | 22.5            | N.D.*                                  |
| 9/21 | 15*           | Line #7 Scrap tile loader      | 1014-1029 | 22.5            | N.D.*                                  |
| 9/21 | 16*           | Line #7 Mixer Operator         | 1031-1046 | 22.5            | N.D.*                                  |
| 9/21 | 21*           | Line #5 Scrap tile loader      | 0958-1018 | 30.0            | N.D.*                                  |
| 9/21 | 22*           | Line #5 Resin Scale Operator   | 0957-1014 | 25.5            | N.D.*                                  |
| 9/21 | 23*           | Line #5 Scrap tile loader      | 1505-1520 | 22.5            | N.D.*                                  |

1. Fibers/cc - Fibers of asbestos per cubic centimeter of air.  
2. N.D. - None detected (Limit of detection is 4500 fibers per filter)  
\* - Approximately 15 minute sample

NIOSH Criteria:

1. 8-Hr time weighted average 0.1 Fibers/cc
2. 15-minute ceiling concentration-0.5 fibers/cc

TABLE IV (continued)  
 Summary of Personnel Air Samples  
 Collected for Asbestos  
 Kentile Floors  
 Chicago, Illinois  
 September 20-21, 1978

| Date | Sample Number | Job Classification or Location | Period    | Sampling       | Concentration(Fibers/cc) <sup>1</sup> |
|------|---------------|--------------------------------|-----------|----------------|---------------------------------------|
|      |               |                                |           | Volume(liters) |                                       |
| 9/20 | 24*           | Line #5 Resin Scale Operator   | 1508-1522 | 21.0           | N.D. <sup>2</sup> *                   |
| 9/20 | 25            | Line #5 Scrap tile loader      | 0800-1606 | 630            | 0.08                                  |
| 9/20 | 26            | Line #5 Utility Man            | 1304-1608 | 277            | 0.07                                  |
| 9/21 | 27*           | Line #5 Scrap tile loader      | 1013-1028 | 22.5           | N.D. *                                |
| 9/21 | 28*           | Line #5 Resin Scale Operator   | 1032-1048 | 24.0           | 0.19 *                                |
| 9/21 | 29            | Line #5 Mixer Operator         | 0816-1548 | 637.           | 0.04                                  |
| 9/21 | 30*           | Line #5 Mixer Operator         | 1037-1054 | 25.5           | N.D. *                                |
| 9/21 | 31            | Line #5 Utility Man            | 0830-1604 | 615            | 0.05                                  |
| 9/21 | 33            | Line #5 Scrap tile loader      | 0751-1604 | 675            | 0.05                                  |
| 9/21 | 34            | Line #5 Resin scale Operator   | 0745-1602 | 682.           | 0.08                                  |
| 9/21 | 35*           | Line #5 Scrap tile Loader      | 1058-1114 | 24.0           | N.D. *                                |

1. Fibers/cc - Fibers of asbestos per cubic centimeter of air.  
 2. N.D. - None detected (Limit of detection is 4500 fibers per filter).  
 \* - Approximately 15 minute sample.

NIOSH CRITERIA:

- 8-hr time weighted average - 0.1 fibers/cc
- 15-minute ceiling concentration - 0.5 fibers/cc

TABLE V  
Summary of Air Sampling for TOTAL DUST  
Keritile Floors  
Chicago, Illinois

September 20-21, 1978

| Date | Sample Number | Type Sample    | Job Classification or Location            | Sampling  |                 | Concentration (mg/m <sup>3</sup> ) <sup>1</sup> |
|------|---------------|----------------|-------------------------------------------|-----------|-----------------|-------------------------------------------------|
|      |               |                |                                           | Period    | Volume (Liters) |                                                 |
| 9/20 | F2915         | P <sup>2</sup> | Line #7 Resin Scale                       | 0725-1609 | 711             | 0.77                                            |
| 9/20 | F2908         | P              | Line #7 Scrap tile loader                 | 0732-1605 | 657             | 0.68                                            |
| 9/20 | D713          | P              | Line #7 Pigment Scale Operator            | 0751-1602 | 675             | 4.53                                            |
| 9/20 | D719          | P              | Line #7 Pigment Scale Operator            | 0751-1226 | 414             | 2.73                                            |
| 9/20 | D699          | P              | Line #7 Pigment Scale Operator            | 1304-1602 | 261             | 9.27                                            |
| 9/20 | F2752         | A <sup>3</sup> | Line #7 Pigment table (B.Z.) <sup>4</sup> | 1230-1549 | 297             | 3.03                                            |
| 9/20 | D1226         | A              | Line #7 Pigment table (B.Z.)              | 0746-1549 | 729             | 0.74                                            |
| 9/20 | D710          | A              | Line #7 Pigment table (B.Z.)              | 0746-1252 | 369             | 1.27                                            |
| 9/20 | D709          | A              | Line #7 Pigment table (B.Z.)              | 1259-1549 | 252             | 1.51                                            |
| 9/20 | F2759         | P              | Line #7 Utility Man                       | 0801-1559 | 657             | 3.09                                            |
| 9/20 | D1224         | P              | Line #7 Mixer Operator                    | 0936-1550 | 684             | 0.26                                            |
| 9/20 | F2914         | P              | Line #5 Resin Scale Operator              | 0747-1612 | 630             | 0.76                                            |
| 9/20 | F2770         | P              | Line #5 Scrap tile loader                 | 0800-1606 | 576             | 0.90                                            |
| 9/20 | D1227         | P              | Line #5 Pigment Scale Operator            | 0806-1555 | 369             | 0.95                                            |
| 9/20 | D1210         | P              | Line #5 Pigment Scale Operator            | 0806-1253 | 369             | 0.57                                            |
| 9/20 | D710          | P              | Line #5 Pigment Scale Operator            | 1253-1555 | 270             | 1.07                                            |
| 9/20 | D718          | A              | Line #5 Pigment table (B.Z.)              | 1256-1558 | 288             | 1.01                                            |
| 9/20 | D705          | A              | Line #5 Pigment table (B.Z.)              | 0818-1250 | 405             | 0.72                                            |
| 9/20 | D717          | A              | Line #5 Pigment table (B.Z.)              | 0818-1558 | 333             | 1.50                                            |
| 9/20 | F2904         | A              | Line #5 Pigment table (B.Z.)              | 0818-1558 | 333             | 1.41                                            |
| 9/20 | F2757         | P              | Line #5 Utility Man                       | 0835-1608 | 621             | 1.21                                            |
| 9/20 | D1218         | P              | Line #5 Mixer Operator                    | 1242-1601 | 297             | 1.01                                            |

1. mg/m<sup>3</sup> - Approximate milligrams of contaminant per cubic meter of air.
2. P - Personnel sample.
3. A - Area sample
4. B.Z. - Breathing zone sample.

ACGIH TLV:

1. Total nuisance dust - 10.0 mg/m<sup>3</sup>

TABLE V (continued)  
Summary of Air Sampling for TOTAL DUST  
Kentile Floors  
Chicago, Illinois

September 20-21, 1978

| Date | Sample Number | Type Sample    | Job Classification or Location | Period    | Sampling Volume(Liters) | Concentration(mg/m <sup>3</sup> ) <sup>1</sup> |
|------|---------------|----------------|--------------------------------|-----------|-------------------------|------------------------------------------------|
| 9/20 | D453          | P <sup>2</sup> | Line #6 Resin Scale Operator   | 0725-1545 | 705.                    | 1.69                                           |
| 9/20 | D433          | P              | Line #6 Pigment Scale Operator | 0730-1515 | 697.                    | 2.61                                           |
| 9/20 | D706          | P              | Line #6 Mixer Operator         | 0950-1550 | 427.                    | 1.01                                           |
| 9/21 | F2901         | P              | Line #7 Resin Scale Operator   | 0748-1600 | 660.                    | 0.80                                           |
| 9/21 | F2907         | P              | Line #7 Scrap tile loader      | 0751-1553 | 652.                    | 0.69                                           |
| 9/21 | F2906         | P              | Line #7 Pigment Scale Operator | 0810-1557 | 697.                    | 1.29                                           |
| 9/21 | F2751         | P              | Line #7 Mixer Operator         | 0800-1548 | 705.                    | 2.61                                           |
| 9/21 | F2769         | P              | Line #7 Utility Man            | 0813-1550 | 630.                    | 3.68                                           |
| 9/21 | F2900         | P              | Line #6 Resin Scale Operator   | 0737-1550 | 705.                    | 7.25                                           |
| 9/21 | F2893         | P              | Line #6 Scrap tile Operator    | 0736-1550 | 697.                    | 4.06                                           |
| 9/21 | F2763         | P              | Line #6 Pigment Scale Operator | 0734-1550 | 609                     | 5.06                                           |
| 9/21 | F2897         | P              | Line #5 Resin Scale Operator   | 0745-1602 | 657.                    | 0.68                                           |
| 9/21 | F2754         | P              | Line #5 Scrap tile loader      | 0845-1604 | 547.                    | 0.79                                           |
| 9/21 | F2771         | P              | Line #5 Utility Man            | 0830-1604 | 615.                    | 1.41                                           |
| 9/21 | F2899         | P              | Line #5 Pigment Scale Operator | 0818-1600 | 682                     | 0.72                                           |
| 9/21 | F2765         | P              | Line #5 Mixer Operator         | 0816-1550 | 690                     | 5.36                                           |
| 9/20 | F2892         | A <sup>3</sup> | Recycling Operator             | 0845-1545 | 630                     | 3.73                                           |

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

ACGIH TLV:

1. Total nuisance dust - 10.0 mg/m<sup>3</sup>



TABLE VI  
Summary of Air Sampling for Lead and Total Chromium  
Kentile Floors  
Chicago, Illinois  
September 21, 1978

| Sample Number | Type of Sample | Job Classification or Location            | Sampling  |                | Concentration (mg/m <sup>3</sup> ) <sup>1</sup> |                |
|---------------|----------------|-------------------------------------------|-----------|----------------|-------------------------------------------------|----------------|
|               |                |                                           | Period    | Volume(Liters) | Lead                                            | Total Chromium |
| 1202          | Personnel      | Line #5 Pigment Scale Operator            | 0805-1236 | 369            | N.D. <sup>2</sup>                               | N.D.           |
| 440           | Personnel      | Line #5 Pigment Scale Operat              | 1236-1558 | 306            | 0.01                                            | N.D.           |
| 435           | Area           | Line #5 Pigment Table (B.Z.) <sup>3</sup> | 0818-1236 | 387            | N.D.                                            | N.D.           |
| 446           | Area           | Line #5 Pigment Table (B.Z.)              | 1236-1600 | 306            | 0.02                                            | N.D.           |

- 
1. mg/m<sup>3</sup> - Approximate milligrams of contaminant per cubic meter of air.  
 2. N.D. - None detected (Limit of Detection for lead and total chromium are 3.0 and 5.0 microgram per sample respectively)  
 3. B.Z. - Breathing zone sample.

**NIOSH RECOMMENDED CRITERIA:**

1. Lead (1978)-0.1mg/m<sup>3</sup>
2. Total Chromium (1975)-1.0 µg/m<sup>3</sup>

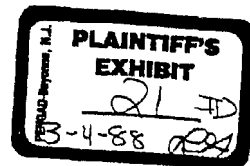
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE  
CENTER FOR DISEASE CONTROL  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH  
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION AND TECHNICAL ASSISTANCE  
REPORT NO. HE 78-72-618

10

KENTILE FLOORS INC.  
SOUTH PLAINFIELD, NEW JERSEY

SEPTEMBER 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., South Plainfield, New Jersey on June 28-29, and October 11-12, 1978, regarding alleged exposures to vinyl chloride monomer, dyes and pigments.

The methodology used to evaluate the workers' environment included: (1) environmental air sampling, (2) a review of materials inventory and materials safety data sheets, (3) medical interviews and evaluations of workers, (4) a review of pertinent scientific literature, (5) a review of the company's respirator program, (6) observations of employees' work practices and engineering controls.

Environmental air samples and bulk samples were collected and analyzed for the following contaminants (Tables I-V): carbon black, polynuclear aromatic hydrocarbons (PNA)-(benzo(a)pyrene, pyrene, chrysene, phenanthrene, anthracene, benzene-soluble fraction), mineral spirits, methyl chloroform, benzene, barium, cadmium, talc, lead and total dust. A potential health hazard was found to exist based on the samples collected for lead. Two personal samples exceeded the recommended OSHA inorganic lead standard, and four samples exceeded the Occupational Safety and Health Administration (OSHA) standard for exposure to total nuisance particulate. Sample results for all other contaminants were below recommended exposure criteria.

No medical evidence of work-related illness was detected at the 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 Publication Office at the Cincinnati address. Copies of this report have been sent to the following:

- A. Kentile Floors Inc., South Plainfield, New Jersey
- B. Authorized representatives of United Rubber Workers (URW),  
Local No. 472, South Plainfield, New Jersey.
- 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 50 "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 USC 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 stemmed from a similar request submitted by the International Union representatives on behalf of employees at Kentile Floors, Inc. at Chicago, Illinois. This request alleged that employees may be exposed to vinyl chloride monomer, dyes and pigments. A walk-through survey of the entire facility was performed by NIOSH representatives with union and management representation. This allowed the investigators to better understand the general operation in order to perform a comprehensive evaluation 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 coving and vinyl floor covering. The company employs 275 workers of which 225 are production workers. The employees work one of three 8-hour shifts, five days per week.

Safety equipment such as respirators, goggles, safety shoes, face shields, safety glasses, etc. are furnished to the people, depending upon where the employee works. The employees either clean their own respirators or the respirators may be given to the plant nurse to be cleaned and sanitized. The plant policy requires monthly sterilization of respirators.

Employees who work in extremely dirty areas (e.g. Bldg. 13, the process room, or Bldg. 1, the compounding department) are issued two lockers in order to store clean and dirty clothes separately. Shower facilities are also available; however, showers are not mandatory.

The company performs environmental air sampling for total dust once per year. Sampling for vinyl chloride monomer is no longer performed because the environmental levels were measured to be a factor of five below the OSHA standard.

The areas evaluated were the process room, the scrap blending area, the press area and the compounding department.

1. Process Room - The process room, located in Building 13, is where the chemical weighing and mixing is performed. This department is a one-shift operation comprised of several jobs which include:

- a. Compounding Area - Two compounders load a compound charging hopper with specific quantities of dry chemicals. The quantities and chemicals vary depending upon the product being formulated. These chemicals are conveyed to one of four pre-blenders located on the mezzanine level. Additionally, the compounders add resin and cadmium-barium stabilizers to the pre-blenders. The chemicals are mixed until the Banbury operator presses a switch which allows the pre-blend mix to be conveyed to the \*Banbury mixer on the first level.
- b. Pigment Scale Operator - The operator weighs prescribed quantities of pigments (colors change from day to day) at a table adjacent to the Banbury mixer platform. The pigment is placed in a plastic bag and the bags are conveyed up to the Banbury operators platform. There was no local exhaust ventilation at the pigment table. The ambient air currents measured at the workers' station ranged from 50-125 feet per minute (fpm).
- c. Scrapping Operation - This operator uses a modified fork lift truck to lift 55 gallon drums (two at a time) which are filled with scrap and emptied into one of two hoppers. The scrap material is conveyed to one of seven blenders located on the mezzanine level. The material is mixed for a specific amount of time; after which, the scrap is conveyed to the Banbury mixer with the pre-blend mix.
- d. Banbury Mixer operator - The operator alternately charges one of two Banbury mixers with a batch of chemicals from the

pre-blender and the blender. The operator also adds the tared plastic bag of pigments. The chemicals are mixed and subsequently dropped onto a conveyor belt below. The mixture when released is hot (160° - 300°F) due to frictional mixing. The mixture is then pelletized, rolled into sheets, gauged by calendars, cooled, cut and stacked; afterwhich, the vinyl sheets are sent to the curing department.

The first floor and the mezzanine level of Building 13 occupy 38,000 and 20,000 square feet (ft<sup>2</sup>) respectively. The average ceiling height is estimated to be 25 feet (ft.). The exhaust ventilation rate for Building 13 is reported to be 69,400 cubic feet per minute (cfm). The make up air is reported to be 59,450 cfm. The make up air rate does not include ventilation through the five large doors (10 X 10'). The conveyor exhaust transport velocity was reported to be 7,500 feet per minute (fpm). The building fans are heavy-duty vane axial which can operate at eight inches of water pressure. Each of the blenders and pre-blenders with the exception of one pre-blender have local exhaust ventilation which leads to the roof.

2. Scrap Blending Area - This operation, housed in a portion of Building 6, is operated by two blender operators and one fork lift operator. The process is operated eight hours per day, three days per week. Fifty-five gallon drums of various scrap tile colors are emptied into one of two blenders and mixed to insure a uniform color of the same product. Afterwards, the empty drums are refilled and stored until they are needed.

The scrap blending area is about 94,428 cubic feet (ft<sup>3</sup>). The roof exhaust ventilation was reported to operate at 650 cfm, and the make up air was reported to be 5,800 cfm. Additionally, a curtain door (12' X 12') is continually open to the outside. There is a local exhaust duct (10.5 inches by 2.5 inches) adjacent to the scrap delivery nozzle which is used to collect dust at the source. The exhaust rate at the face of the exhaust duct was 2,000 feet per minute.

3. Press Area - The press operation located in part of Building #1 is a three shift, 8-hour day, 5 day per week operation. There are 9 small presses and eleven large presses. However, all of the presses are not necessarily operated at the same time. The presses are used to cure plain vinyl sheets and/or vinyl sheets with specially designed vinyl inserts. A mold release agent is sprayed on all the presses, and a solvent/wax solution is applied to the vinyl sheets cured on the small presses only. The wax solution may be applied any time after the sheets have been cured, but the workers choose to wax the vinyl sheets as soon as they are removed from the oven.

The press area was estimated to occupy about 314,000 ft<sup>3</sup> and have 2.9 air changes per hour. The exhaust ventilation consists of eight roof mounted exhaust fans which are independently controlled and seven window fans.

4. Compound Department - This department is also located in Building 1. There are several operations performed in this department which include:
  - a. Charging Area - Three compounders load various dry chemicals (e.g. calcium carbonate, lead silico sulfate, polyvinyl chloride, etc.) into a charging hopper. The chemicals are vacuumed transported to one of three reserve tanks on the third floor where the compounder adds pigment, resin and stabilizers. Once the chemicals have been thoroughly mixed, the chemicals are conveyed on demand to the Banbury machine. After the reserve tank is emptied, the Banbury operator depresses a switch which sounds an auditory signal to the compounders so that they can recharge the reserve tank.
  - b. Waste Scale Area - One worker spends several hours per day weighing out prescribed quantities of pigments and stabilizers into plastic bags. The scale is enclosed on three sides and equipped with two exhaust ducts to control dust generation. Once a 55 gallon drum has been filled with the plastic bags of pigment and stabilizers, the drum is transported to the Banbury operator on the mezzanine level. The compounder then assists the two other workers who charge the compound hopper.
  - c. Banbury Operation - The Banbury operator charges the mixer with scrap material, resin, a bag of pre-weighed pigment and a batch load from the reserve tank. The Banbury operator charges the mixer and subsequently empties the hot load onto a conveyor belt below. The material is pelletized, filled into 55 gallon drums, and stored until it is needed.

The compound department was estimated to be 124,000 ft<sup>3</sup> and the ventilation rate was reported to be 2.9 air changes per hour. The charging hopper which can be loaded from two sides is 9 feet by 6 feet with a one-inch slot exhaust system along the entire center length. The face capture velocity was measured and averaged to be about 1,100 fpm.

The reserve tanks located on the third floor were all equipped with an exhaust system which was vented to the roof.

The Banbury mixer has two adjacent exhaust ducts at the chute entrance which are designed to operate at 200-300 cfm per square foot of open face area, and one exhaust duct within the mixer.

## B. Evaluation Design

### 1. Environmental/Medical Survey

On June 28, 1978, an initial environmental/medical survey was conducted simultaneously at Kentile Floors, Inc., South Plainfield, New Jersey in order to minimize plant disruption.

After the opening conference a walk-through inspection was made with both management and labor representatives. The entire facility was visited so that the NIOSH representatives would better understand the general operation. Several processes were not operational during our visit (scrap recycling, pulverization process and the scrap mixers); consequently, management volunteered to shift personnel in order to demonstrate those processes not being used. Rather than cause unnecessary disruption to the plant operation, it was decided by the project officer, and agreed to by the plant manager, that those processes not used during the initial visit would be operational for the follow-up survey.

### 2. Environmental

No environmental air samples were collected during the initial visit. The purpose of the initial visit was to perform a cursory evaluation, obtain a copy of the material inventory list, and collect any other information that would be beneficial in planning a comprehensive follow-up survey.

Two bulk samples of talc material were collected and sent to the laboratory for analyses, for the presence of free silica and asbestos.

One employee (#11 mixer operator) was in possession of, but not using, a respirator in poor condition. The respirator was missing an exhaust valve cover, and the exhaust valve was defective. Furthermore, the employee was not cognizant that his respirator was in poor condition.

Several employees in the curing room complained of inadequate air movement and improperly operating exhaust fan louvers. The ventilation system, for the curing room, was inspected with the maintenance supervisor. He stated that the ventilation system

is inspected and lubricated twice a year. However, the exhaust fan louvers are not periodically maintained. The two banks of exhaust fans revealed the following difficulties. One bank, consisting of four exhaust fans only had one fan switch turned on and three switches turned off. The remaining three switches were activated and found to be operational. The second bank, consisting of two exhaust fans, had two defective switches, one of which was cracked. These exhaust fan louvers appeared to be coated with an oil residue. An attempt was made to inspect the louvers more closely to determine whether the louvers were movable or stationary; however, the louvers were not visually accessible from the roof.

Additionally, it could not be determined who was responsible for activating the exhaust fan switches at the beginning of the shift.

### 3. Medical

Medical evaluation consisted of (1) a walk-through inspection of the facilities with the President of URW, Local 472, and with management representatives; (2) private consultation with any employees who believed their health was adversely affected by working conditions in the plant; (3) consultation with the Kentile Industrial physician; (4) interviews with workers randomly selected during the second walk-through inspection on the second day.

During the walk-through inspection of June 28, 1978, the NIOSH physician ascertained from the President, URW, Local 472 that apart from one worker who claimed that his chest was affected by fumes from a mixer, he was not aware of any significant work-related health problems among the employees.

It was requested of him that he inform all workers that the government doctor would be present in the plant on the following day, and would be available for private consultation with any employee who believed that their health was adversely affected by working conditions in the plant.

On the following morning the NIOSH doctor met the industrial physician retained by Kentile Floors, Inc., for the past 25 years. He attends for one hour each day, for four days in the week.

He stated that there were no significant health problems in the plant, and that there is a broad health and welfare program in effect.



Management responds to all his recommendations with respect to potential health hazards.

This industrial physician performs all pre-placement examinations, receives all physicians' return-to-work slips, and he sees all forms received from insurance health claims.

He also interviews any worker who has been absent from work, for health reasons, for a period in excess of 3 days.

The NIOSH medical officer then repeated the previous day's walk-through, speaking to workers, at random, and questioning them as to whether they or their co-workers, believed that they were suffering from any work-related disease.

The physician was again informed that a worker on a mixer believed that his chest was affected. This man was not then present for consultation.

Men working on the waxing hot sheet complained of headaches and upper respiratory tract irritation, whilst this process was in operation.

The NIOSH doctor experienced throat irritation whilst speaking to these workers.

Four workers presented at the First Aid room for consultation one of whom was the man referred to by the President, URW, Local 472.

None was currently suffering from any work-induced - or aggravated - health problems associated with materials handled and/or generated at this plant.

The men complaining of chest problems were briefly examined.

One of these workers who requires medical follow-up has been informed by letter of this recommendation.

## C. Evaluation Methods

### Environmental

Personal and area samples were used to evaluate employee exposure. The personal samples were attached to the workers' shirt collar in order to characterize a breathing zone sample. The area samples were 1.0 foot to 5.0 feet from the workers' breathing zone. Depending upon the type and condition of the filter, samples were either

collected for as much of an eight-hour shift as possible, or 2 four-hour samples were collected. Additionally, the sampling pump flow rates were calibrated daily.

Carbon Black - Carbon black dust samples were collected with Mine Safety Appliance (MSA) Model G battery operated personnel sampling pumps. A known volume of air is drawn through a cassette containing a tared 37-millimeter (mm) diameter 2.0 micrometer (um) pore-sized 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 were 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 benzene-soluble fraction 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 filters. The sampling train (pump and filter) is operated at 1.5 liters per minute (1pm).

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 was 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, Methyl Chloroform and Benzene) - A sampling train consisting of a Sipin vacuum pump and a 150 milligram charcoal tube was used to sample 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.

Metals (Barium, Cadmium and lead) - A sampling train (MSA pump and a 37-mm 0.8 um pore size mixed cellulose ester membrane filter) was operated at a flow rate of 1.5 lpm. The filters were dissolved in nitric acid and perchloric acid. An aliquot was subsequently analyzed by atomic absorption spectrophotometry (NIOSH method No. 173).

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 - Two bulk samples were submitted to the laboratory for analyses of free crystalline silica and asbestos identification.
2. Carbon Black - One bulk sample was submitted for analyses of benzene soluble fraction and PNA identification.

#### D. Evaluation Criteria and Toxicity Data

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 criteria for each contaminant are based upon the current state of knowledge concerning toxicity of these substances. The criteria are designed to allow an occupational exposure for 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 discomfort. In some instances, a few employees may experience adverse health effects at or below the TWA.

There are some airborne contaminants for which this TWA is inadequate; consequently, the substance may be preceded by the letter "C". This

letter indicates a ceiling value for a sampling interval of 30 minutes or less. the ceiling value is used to identify hazardous substances which are fast acting and should not 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.

#### TIME-WEIGHTED AVERAGE

| <u>SUBSTANCE</u>                                                        | <u>8-HOUR</u>         | <u>10-HOUR</u>                                                                                                                 | <u>CEILING<br/>VALUE</u> | <u>MINUTES</u> |
|-------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------|
| Carbon Black <sup>1</sup>                                               |                       | 3.5 mg/m <sup>3a</sup> and<br>0.10 mg/m <sup>3</sup> as<br>cyclohexane extrac-<br>table substance                              |                          |                |
| Polynuclear Aromatic<br>Hydrocarbons (PNA) <sup>2</sup>                 |                       | 0.2 mg/m <sup>3</sup> as benzene<br>or 0.1 mg/m <sup>3</sup> cyclohexane extrac-<br>table in the presence of<br>specific PNA's |                          |                |
| Refined Petroleum Solvents <sup>3</sup><br>(Mineral Spirits or Naphtha) |                       | 55 ppm <sup>b</sup>                                                                                                            | 283 ppm                  | 15             |
| Methyl Chloroform <sup>4</sup>                                          |                       | 350 ppm                                                                                                                        |                          |                |
| Benzene <sup>5</sup>                                                    |                       |                                                                                                                                | 1 ppm                    | 60             |
| Barium <sup>6</sup><br>(soluble compounds)                              | 0.5 mg/m <sup>3</sup> |                                                                                                                                |                          |                |
| Cadmium <sup>7</sup>                                                    |                       | 40 ug/m <sup>3c</sup>                                                                                                          | 200 ug/m <sup>3</sup>    | 15             |
| Inorganic Lead <sup>8</sup>                                             |                       | 0.05 mg/m <sup>3</sup>                                                                                                         |                          |                |
| Inert Nuisance Dust <sup>9</sup>                                        |                       | 10 mg/m <sup>3</sup>                                                                                                           |                          |                |

- 
- a) mg/m<sup>3</sup> - Approximate milligrams of particulate per cubic meter of air  
 b) ppm - parts of a vapor or gas per million parts of contaminated air by volume  
 c) ug/m<sup>3</sup> - Approximate micrograms of particulate per cubic meter of air

1. NIOSH Criteria Document (1978). The OSHA Standard (1978) is 3.5 mg/m<sup>3</sup>.
2. 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 TLV evaluates PNA's as a benzene soluble fraction ( $0.20 \text{ mg/m}^3$ ) for a specific substance, e.g. coal tar pitch.

3. NIOSH Criteria Document (1977). The OSHA standard (1978) is 63 ppm.
4. NIOSH Criteria Document (1976). The OSHA standard (1978) is 350 ppm.
5. NIOSH Recommendation Revised as part of NIOSH testimony at OSHA Hearing (1977). The a OSHA standard is 10 ppm.
6. The OSHA Standard (1977) and TLV Document (1977).
7. NIOSH Criteria Document (1976). The OSHA Standard (1978) is  $.2 \text{ mg/m}^3$  as an 8-hour TWA.
8. The OSHA Standard (1979) is  $0.05 \text{ mg/m}^3$ .
9. ACGIH TLV Document (1978). The OSHA Standard (1978) is  $15.0 \text{ mg/m}^3$ .

#### Toxicity Data

##### Lead

Although capable of causing acute toxicity when absorbed in large amounts, lead is usually associated with chronic toxicity due to absorption of lesser amounts over prolonged periods of time. The major route of entry of lead, and its inorganic compounds, is the lung, although slight amounts may be ingested.

The early effects of lead poisoning are non-specific, and except for laboratory testing, are difficult to distinguish from the symptoms of minor seasonal illness. The symptoms are decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, digestive symptoms (particularly constipation), abdominal pains, and decreased appetite. These symptoms are reversible and complete recovery is possible when removed from exposure.

The three systems most commonly affected are the bone marrow (producer of red blood cells), the nervous system, and the kidneys.

Because of more efficient material handling methods and biological monitoring, serious cases of lead poisoning are rare in industry today.

##### Inert Dust

Although exposure to levels of inert, or nuisance, dust in excess of OSHA's standard has not been shown to cause irreversible and/or

persistent lung damage, a dusty environment can cause mucous membrane irritation and worker discomfort.

## E. EVALUATION AND DISCUSSION

### Environmental

Only three carbon black samples (personal and area) were collected during the two days because very little black pigment was used in the formulation (Table I). The laboratory analyses of the filters showed that no black pigment could be detected.

It was observed that one of two local exhaust ducts for the compound scale was used to hold a piece of cardboard that contained weight requirements for each of the pigments. Unfortunately, this cardboard interfered with the proper use of the exhaust duct.

The analyses of the carbon black bulk was performed to determine the PNA and benzene-soluble fraction composition. The analyses detected two PNA's (benzo(a)pyrene B(a)P and pyrene) at concentrations of 12.6 micrograms per gram of sample (ug/g) and 148 ug/g respectively. The benzene soluble fraction concentration was reported to be 8.69 milligrams per gram of sample. Although no carbon black was detected on the limited number of samples collected a potential health hazard exists due to the presence of specific PNA's identified in the bulk sample. Ergo, further sampling would be warranted for the carbon black scaling operation.

Ten PNA samples (personal and area) were collected from several areas (Table II): Compound-Banbury area and the Compound Waste area at the scale. Since PNA's such as B(a)P and chrysene can be measured in the ambient air, it was decided to do simultaneous sampling outside the process room. A laboratory analysis indicated that the sample chromatograms did not contain any peaks which could be interpreted as polynuclear aromatic hydrocarbon compounds.

Eight personal samples were collected for mineral spirits, methyl chloroform and benzene. The laboratory analyses of the charcoal tubes did not detect any benzene solvent. The concentration of mineral spirits and methyl chloroform were well below the NIOSH recommended standards (Table III).

The application of the solvent/wax solution to the hot vinyl sheets, which are cured in the small presses, produced vapors which irritated the eyes and/or throat of the workers. The NIOSH medical officer experienced throat irritation while talking to the employees at their work stations.

Although it was suspected that mineral spirit vapors could cause mucous membrane irritation, the levels measured during the follow-up

survey were all below NIOSH recommended criteria. The fact that all exhaust ventilation systems were not operational during the initial survey may have contributed to a vapor accumulation around the press areas. All exhaust fans were fully operational during sampling on the follow-up survey.

It should be noted that the employees were given squeegees with long handles so that the workers would not have to stand over the vinyl sheets while waxing. However, the employees still complained of physical irritation.

Nine samples (personal and area) were collected from two general areas where barium, cadmium, and lead dusts could be exposing the workers. The sources of contamination are the barium/cadmium stabilizers and the dibasic lead sulfate. Of those three metallic dusts, two dust samples (inorganic lead) exceeded the OSHA standard of  $0.05 \text{ mg/m}^3$ . Even though two samples did exceed the current OSHA lead standard, this does not constitute a major work area exposure. The significantly higher lead concentration measured on one filter would indicate that a re-evaluation of the compound-charging area is necessary to determine whether the sample filters were inadvertently contaminated or whether the employee's work practice is significantly different than the other workers, or whether the ambient lead levels are high due to the work operation. The laboratory analyses of the bulk sample of dibasic lead sulfate indicated that 49% of the compound was lead.

Thirty-eight total nuisance dust samples (personal and area) were collected (Table IV and V). Four personal samples collected from the compounders in the process room exceeded the OSHA standard of  $15.0 \text{ mg/m}^3$ . It was anticipated to sample some of the other chemicals used in the formulations (e.g. talc, amorphous silica, calcium carbonate, etc.); however, the products being manufactured did not include all of these chemicals. The major constituent sampled was calcium carbonate.

Two bulk talc samples were submitted to the laboratory for analyses of free crystalline silica and asbestos content. One bulk sample was destroyed during shipment. An analysis of the other bulk sample did not detect any free crystalline silica, but the talc did contain 30-40% block tremolite asbestos. About 10% of the block tremolite was observed to be a true tremolite fiber which by definition has an aspect ratio (length to width ratio) of 3 to 1. The talc material used on the follow-up was not reported to contain asbestos or free silica.

It was attempted to sample all the chemicals cited in the Health Hazard Evaluation Request. Unfortunately, the ingredients for the various products changed frequently due to marketing demands.

Consequently, specific chemicals were evaluated based on the relative toxicity, quantity, and frequency of use.

No monitoring was performed for dyes because it was determined that dyes are not used by the company. Also, monitoring was not performed for vinyl chloride monomer because the polyvinyl chloride resin was not considered to be a potential problem based on the method of usage. Furthermore the company reported that the levels of vinyl chloride concentrations were a factor of 5 below the criteria.

It was observed that some respirators were not being worn properly. One employee fastened only one of the two straps on the respirator. Another employee pulled his respirator off his face immediately after loading the compound hopper even though dust was visibly present in the air. The loading technique of the compounders in the process room varied considerably. One worker handled the bags of chemicals harshly, and the other worker emptied the bags gently so as to not create unnecessary dust.

The fork lift operator for the scrapping operation was observed emptying the 55-gallon drums of scrap quickly into the hopper, thereby, generating much dust. In addition, the large doors adjacent to the scrapper hopper were usually open. Thus, the air currents entering the process room dispersed the dust throughout the room.

The noise in the process room was so loud that the people working side by side had to yell to one another. Hearing protectors were not required in the area.

One employee indicated that he cleans his respirator every day or two. He indicated that the frequency of cleaning the respirator is apparently left to the discretion of the worker.

The doors on the pre-blenders in the mezzanine level of the process room were not always closed during the mixing operation. Also there appeared to be a considerable amount of dust accumulation on the floors where the pre-blenders and the blenders are located. This is also where the barium/cadmium stabilizers are stored.

#### Medical

Analysis of personal samplers indicated that two of the workers were exposed to levels of lead in air in excess of the OSHA standard - one minimally, and the other considerably. Although these workers wear respirators, and occasional, and brief, exposures to levels of lead dust above the standard are unlikely to adversely affect the health of the workers, nevertheless, lead is toxic, and every effort



should be made to adhere to NIOSH's recommendations. These men have been notified, by letter, of their exposure, and they have been advised to consult the plant - and/or their private physicians, to have blood-lead estimations performed to establish whether, or not, excessive lead absorption is occurring. Furthermore, four of the samples indicated that dust levels exceeded the OSHA standard.

F. Recommendations

1. The company should review their material inventory list to determine which chemicals are potentially toxic. Those chemicals should be monitored periodically.
2. Employees should be given periodic training regarding how to properly wear and clean their respirators.
3. Employees should be required to clean their respirator daily.
4. Compounders should be instructed to empty bags of chemicals more gently in order to prevent dust generation.
5. The fork lift operator in the process room should be instructed to slowly empty the 55-gallon drums in order to control dust generation.
6. A noise survey should be performed in the process room to determine the sound pressure levels.
7. The mezzanine level should be cleaned daily. Also the doors on the blenders and pre-blenders should have spring latches installed to insure the doors are properly closed during mixing.
8. One pre-blender should have a canopy exhaust duct installed so that dust does not accumulate in the mezzanine area.
9. Environmental sampling should be performed in the compound waste area to determine the airborne lead concentration.
10. The employees should apply the solvent/wax solution to the vinyl sheets after the sheets are cooled in order to reduce irritation.
11. The bi-annual inspection and lubrication of the exhaust ventilation system should be modified to include maintenance of the exhaust fan louvers.
12. One person should be responsible for turning on exhaust fan switches at the beginning of each shift.

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TABLE I  
Summary of Air Sampling for Carbon Black  
Kentile Floors  
South Plainfield, New Jersey

October 11-12, 1978

| <u>Date</u> | <u>Sample<br/>Number</u> | <u>Type<br/>Sample</u> | <u>Job Classification<br/>or Location</u> | <u>Period</u> | <u>Sample<br/>Volume(Liters)</u> | <u>Concentration (mg/m)<sup>1</sup></u> |
|-------------|--------------------------|------------------------|-------------------------------------------|---------------|----------------------------------|-----------------------------------------|
| 10/11       | 1690                     | Area                   | Compounding-Waste Area Above Hood         | 0743-0900     | 116                              | N.D. <sup>2</sup>                       |
| 10/11       | 1682                     | Personnel              | Compounding-Waste Area                    | 0740-0855     | 113                              | N.D.                                    |
| 10/12       | 1683                     | Personnel              | Compounding-Waste Area                    | 0710-1135     | 668                              | N.D.                                    |

1. mg/m<sup>3</sup> - Approximate milligrams of contaminant per cubic meter of air.
2. N.D. - None detected (Limit of detection is 0.5 mg).
3. TWA - Time weighted average.

NIOSH Criteria:

1. Carbon Black - 3.5 mg/m<sup>3</sup>;  
- 0.1 mg/m<sup>3</sup> TWA<sup>3</sup> as cyclohexane soluble fraction in presence of polycyclic aromatic hydrocarbons.

TABLE II  
Summary of Air Sampling for Polynuclear  
Aromatic (PHA) Hydrocarbons  
Kentile Floors  
South Plainfield, New Jersey  
October 11-12, 1978

| Date  | Sample Number | Type Sample    | Job Classification or Location                   | Sample    |                | Concentration (µg/sample) <sup>1</sup> |        |          |              |            | Benzene soluble (mg/m <sup>3</sup> ) <sup>2</sup> |
|-------|---------------|----------------|--------------------------------------------------|-----------|----------------|----------------------------------------|--------|----------|--------------|------------|---------------------------------------------------|
|       |               |                |                                                  | Period    | Volume(liters) | Benzo(a) pyrene                        | Pyrene | Chrysene | Phenanthrene | Anthracene |                                                   |
| 10/11 | P-13          | A <sup>3</sup> | Process Room-Outside of Bldg. Door near scrapper | 0855-1459 | 546            | N.D. <sup>4</sup>                      | N.D.   | N.D.     | N.D.         | N.D.       | N.D.                                              |
| 10/11 | P-19          | A              | Process Room-Outside of Bldg. Door Near Scrapper | 0855-1459 | 546            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | N.D.                                              |
| 10/12 | P-2           | A              | Process Room-Outside of Bldg. Door Near Scrapper | 0905-1451 | 519            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | N.D.                                              |
| 10/12 | P-1           | A              | Process Room-Outside of Bldg. Door Near Scrapper | 0739-1451 | 648            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | 0.06                                              |
| 10/11 | P-17          | A              | Compounding-Above Banbury Controls               | 0755-1447 | 618            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | 0.03                                              |
| 10/11 | P-16          | A              | Compound Waste Area-Above Hood                   | 0743-0900 | 116            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | 0.17                                              |
| 10/11 | P-14          | P <sup>5</sup> | Compounding-Banbury Area                         | 0750-1450 | 585            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | 0.07                                              |
| 10/11 | P-15          | P              | Compound Waste Area                              | 0740-0855 | 113            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | 0.17                                              |
| 10/12 | P-3           | A              | Compounding-Above Banbury Controls               | 0735-1504 | 674            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | 0.03                                              |
| 10/12 | P-10          | P              | Compounding-Banbury Area                         | 0750-1504 | 599            | N.D.                                   | N.D.   | N.D.     | N.D.         | N.D.       | 0.17                                              |

1. µg/sample - Microgram of particulate per sample
2. mg/m<sup>3</sup> - Approximate milligrams of particulate per cubic meter of air.
3. A - Area sample.
4. N.D. - None detected
5. P - Personnel sample

Limits of Detection:

1. Benzo (a) pyrene - 1.0 µg/sample
2. Pyrene - 5.0 µg/sample
3. Chrysene - 2.5 µg/sample
4. Phenanthrene - 2.0 µg/sample
5. Anthracene - 5.0 µg/sample
6. Benzene soluble - 0.02 mg/sample

TABLE III  
Summary of Personnel Air Sampling for Solvents  
in the Curing Area  
Kentile Floors  
South Plainfield, New Jersey

October 11-12, 1978

| <u>Date</u> | <u>Sample Number</u> | <u>Job Classification or Location</u> | <u>Period</u> | <u>Sample Volume (liters)</u> | <u>Concentration (PPM)<sup>1</sup></u> |                          |                   |
|-------------|----------------------|---------------------------------------|---------------|-------------------------------|----------------------------------------|--------------------------|-------------------|
|             |                      |                                       |               |                               | <u>Mineral Spirits</u>                 | <u>Methyl Chloroform</u> | <u>Benzene</u>    |
| 10/11       | 1                    | Operator-Press 5&6                    | 0750-1500     | 22.1                          | 3.2                                    | 0.10                     | N.D. <sup>2</sup> |
| 10/11       | 2                    | Operator-Press 3&4                    | 0800-1500     | 20.0                          | 6.0                                    | 2.7                      | N.D.              |
| 10/11       | 3                    | Operator-Press 1&2                    | 0804-1500     | 21.8                          | 8.0                                    | 3.6                      | N.D.              |
| 10/11       | 4                    | Operator-Press 1&2                    | 0821-1500     | 18.6                          | 7.8                                    | 2.2                      | N.D.              |
| 10/12       | 5                    | Operator-Press 1&2                    | 0724-1435     | 25.8                          | 2.5                                    | 0.6                      | N.D.              |
| 10/12       | 6                    | Operator-Press 1&2                    | 0724-1433     | 23.3                          | 2.7                                    | 0.9                      | N.D.              |
| 10/12       | 7                    | Operator-Press 6&7                    | 0720-1431     | 23.9                          | 0.3                                    | 0.8                      | N.D.              |
| 10/12       | 8                    | Operator Press 6&7                    | 0720-1437     | 21.5                          | 2.0                                    | 0.2                      | N.D.              |

1. PPM - Parts of a gas or vapor per million parts of contaminated air by volume at 25°C. and 760 millimeters of mercury pressure.

2. N.D. - None detected.

3. mg - Milligrams

Limits of Detection:

1. Mineral Spirits - 0.01 mg<sup>3</sup>.
2. Methyl Chloroform - 0.01 mg.
3. Benzene - 0.001 mg.

NIOSH Criteria:

1. Mineral Spirits - 55 PPM
2. Methyl Chloroform - 350 PPM
3. Benzene - 1.0 PPM

TABLE IV  
Summary of Environmental Sampling  
For Metals and Total Dust  
Kentile Floors  
South Plainfield, New Jersey

October 11-12, 1978

| Date  | Sample Number | Type Sample    | Job Classification or Location      | Sample    | Volume(Liters) | Barium | Concentration(mg/m <sup>3</sup> ) <sup>1</sup> |                   |       | Total Dust |
|-------|---------------|----------------|-------------------------------------|-----------|----------------|--------|------------------------------------------------|-------------------|-------|------------|
|       |               |                |                                     | Period    |                |        | Cadmium                                        | Lead              |       |            |
| 10/11 | 1673          | P <sup>2</sup> | Process Room, Compounder            | 0853-1455 | 472            | 0.04   | 0.02                                           | N.D. <sup>3</sup> | 6.92  |            |
| 10/11 | 1728          | P              | Process Room, Compounder            | 0853-1455 | 461            | 0.03   | 0.03                                           | N.D.              | 17.09 |            |
| 10/12 | 1666          | P              | Process Room, Compounder            | 0720-1454 | 626            | N.D.   | N.D.                                           | N.D.              | 4.87  |            |
| 10/12 | 1664          | P              | Process Room, Compounder            | 0723-1454 | 621            | N.D.   | N.D.                                           | 0.01              | 15.08 |            |
| 10/12 | 1707          | A <sup>4</sup> | North End of Compd. Charging Hopper | 1033-1440 | 371            | N.D.   | N.D.                                           | 0.04              | 0.75  |            |
| 10/12 | 1687          | A              | Center of Compd. Charging Hopper    | 1035-1440 | 368            | N.D.   | N.D.                                           | 0.03              | 0.46  |            |
| 10/12 | 1676          | P              | Compd. Charging Area                | 0715-1500 | 645            | N.D.   | N.D.                                           | 0.43              | 5.83  |            |
| 10/12 | 1663          | P              | Compd. Charging Area                | 0720-1500 | 635            | N.D.   | N.D.                                           | 0.07              | 3.92  |            |
| 10/12 | 1698          | A              | Compd. Charging Area                | 0721-1511 | 705            | N.D.   | N.D.                                           | 0.05              | 0.62  |            |

1. mg/m<sup>3</sup> - 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.  
 6.  $\mu$ l - microgram.

NIOSH CRITERIA:

1. Cadmium - 0.04 mg/m<sup>3</sup> (8-HR TWA.)<sup>5</sup>  
 0.20 mg/m<sup>3</sup> (Ceiling-15min)  
 2. Lead - 0.10 mg/m<sup>3</sup>

Limits of Detection:

1. Barium - 5.0  $\mu$ g<sup>6</sup>  
 2. Cadmium - 2.0  $\mu$ g  
 3. Lead - 5.0  $\mu$ g

TABLE V  
Summary of Environmental Sampling  
For Total Nuisance Particulate  
Kentile Floors  
South Plainfield, New Jersey

October 11-12, 1978

| Date  | Sample Number | Type Sample    | Job Classification or Location             | Sample Period | Volume (Liters) | Total Dust Concentration (mg/m <sup>3</sup> ) <sup>1</sup> |
|-------|---------------|----------------|--------------------------------------------|---------------|-----------------|------------------------------------------------------------|
| 10/11 | 3047          | A <sup>2</sup> | Blending Room-Rear Drum Support            | 0730-1455     | 667.            | 0.46                                                       |
| 10/11 | 3032          | P <sup>3</sup> | Blending Room&Incinerator-Fork Lift Driver | 0740-1430     | 468.            | 3.14                                                       |
| 10/11 | 3052          | P              | Blender Operator                           | 0725-1439     | 510.            | 1.04                                                       |
| 10/11 | 3041          | P              | Blender Operator                           | 0720-1452     | 517.            | 0.50                                                       |
| 10/12 | 3035          | P              | Blender Operator                           | 1045-1453     | 310.            | 1.77                                                       |
| 10/12 | 3038          | P              | Blender Operator                           | 1108-1451     | 576.            | 0.52                                                       |
| 10/12 | 3037          | A              | Blending Room-Rear Drum Support            | 0746-1456     | 645.            | 0.51                                                       |
| 10/12 | 3023          | P              | Blending Room&Incinerator-Fork Lift Driver | 0743-1440     | 559.            | 4.44                                                       |
| 10/12 | 3043          | P              | Blender Operator                           | 0748-1453     | 576.            | 1.61                                                       |
| 10/12 | 3059          | P              | Blender Operator                           | 1047-1451     | 310.            | 0.94                                                       |
| 10/12 | 3000          | A              | Blending Room-Inner Drum Support           | 1053-1456     | 309.            | 0.58                                                       |
| 10/11 | 3061          | P              | Process Room-Mixer Clean-up Man            | 0805-1505     | 555             | 2.58                                                       |
| 10/11 | 3031          | P              | Press Room-Scraper #1                      | 0750-1525     | 623             | 0.69                                                       |
| 10/11 | 3024          | A              | Process Room-Scraper #2                    | 0750-1500     | 645             | 7.33                                                       |
| 10/11 | 3048          | A              | Process Room-Pigment Scale Table           | 0745-1505     | 660             | 1.03                                                       |
| 10/11 | 3039          | P              | Process Room-Compounder                    | 0741-1455     | 576.            | 15.49                                                      |
| 10/11 | 3036          | A              | Process Room-Top of Mixer #1               | 0745-1454     | 644.            | 0.65                                                       |
| 10/11 | 3063          | P              | Process Room-Compounder                    | 0735-1505     | 641             | 15.18                                                      |
| 10/11 | 3025          | P              | Process Room-Pigment Scale Operator        | 0715-1505     | 705             | 0.99                                                       |
| 10/11 | 3057          | A              | Process Room-Top of Mixer Control Panel    | 0725-1450     | 668             | 0.67                                                       |
| 10/11 | 3029          | P              | Process Room-Compounder-at hopper          | 0740-1455     | 582             | 6.70                                                       |

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

ACGIH TLV:  
1. Total Dust 10.0 mg/m<sup>3</sup>



TABLE V  
Summary of Air Sampling  
For Total Nuisance Particulate  
Kentile Floors  
South Plainfield, New Jersey

(continued)

October 11-12, 1978

| Date   | Sample Number | Type Sample    | Job Classification or Location      | Sample Period | Volume (Liters) | Total Dust Concentration (mg/m <sup>3</sup> ) <sup>1</sup> |
|--------|---------------|----------------|-------------------------------------|---------------|-----------------|------------------------------------------------------------|
| 10/11  | 3028          | P <sup>2</sup> | Process Room-Mixer Operator         | 0720-1453     | 680.            | 1.15                                                       |
| 10/12  | 3053          | P              | Process Room-Compounder             | 0723-1454     | 624.            | 3.69                                                       |
| 10/12  | 3020          | A <sup>3</sup> | Process Room-Above Mixer #1         | 0730-1449     | 674             | 1.77                                                       |
| 10/12  | 3007          | A              | Process Room-Scraper #1             | 0736-1451     | 653             | 1.00                                                       |
| 10/12  | 3008          | A              | Process Room-Above Mixer #2         | 0730-1449     | 659             | 0.99                                                       |
| 10/12  | 3060          | P              | Scraper Operator                    | 0735-1447     | 603             | 0.88                                                       |
| 10/12  | 3004          | A              | Process Room-Pigment Scale          | 0727-1447     | 660             | 1.05                                                       |
| 10/12  | 3040          | P              | Process Room-Compounder             | 0720-1454     | 629             | 3.41                                                       |
| 10/12  | 3044          | P              | Process Room-Clean-up Man           | 0742-1500     | 563             | 0.82                                                       |
| 10/12  | 3064          | P              | Process Room-Mixer Operator         | 0705-1445     | 690             | 0.72                                                       |
| 10/12  | 3001          | P              | Process Room-Pigment Scale Operator | 0710-1449     | 651             | 1.08                                                       |
| 10/11  | 3042          | P              | Compound Charging Area              | 0722-1430     | 642             | 5.32                                                       |
| 10/11  | 3045          | P              | Compound Charging Area              | 0722-1430     | 642             | 1.88                                                       |
| 10/11: | 3050          | A              | Between two Compounders             | 0729-1431     | 633             | 0.52                                                       |
| 10/11  | 3018          | P              | Compound-Mixer Area                 | 0750-1450     | 675             | 0.09                                                       |
| 10/11  | 3046          | A              | Compound-Above Mixer Controls       | 0755-1447     | 618             | 0.24                                                       |
| 10/12  | 3005          | P              | Compound-Mixer Operator             | 0750-1504     | 599             | 0.12                                                       |
| 10/12  | 3009          | A              | Compound-Above Mixer Controls       | 0735-1504     | 674             | 0.06                                                       |

1. mg/m<sup>3</sup> - Approximate milligram of containment per cubic meter of air.
2. P - Personnel sample.
3. A - Area sample.

ACGIN TLV:

1. Total Dust 10.0 mg/m<sup>3</sup>