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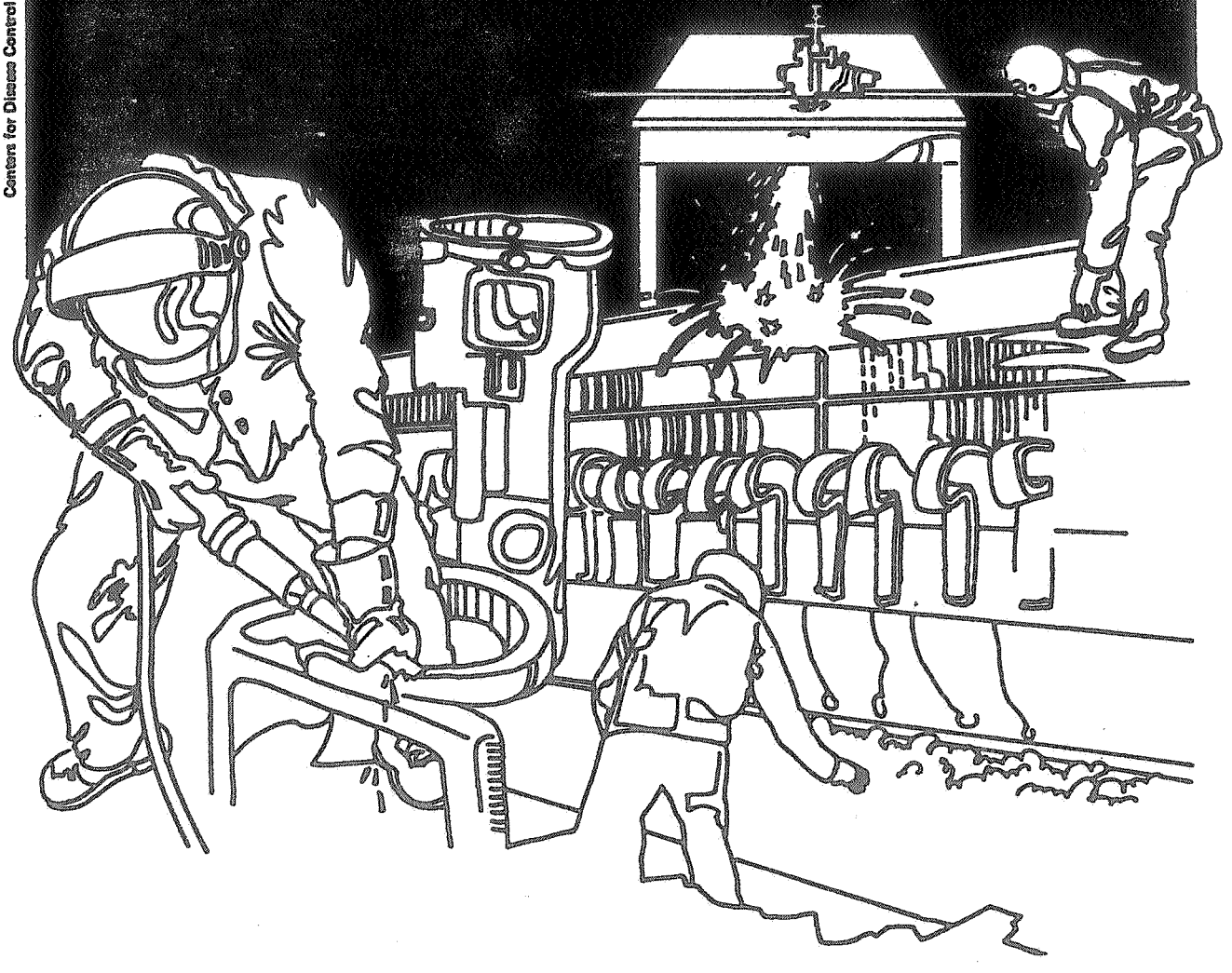

Health Hazard Evaluation Report

HETA 80-125-1180
TIMBER LAKE MANUFACTURING
ALTON, HAMPSHIRE

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 80-125-1180
September 1982
Timber Lake Manufacturing
Alton, New Hampshire

NIOSH INVESTIGATOR:
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I. SUMMARY

On April 29, 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request from Timber Lake Manufacturing Corporation, Alton, New Hampshire for a health hazard evaluation. The request stated that employees had been experiencing symptoms including dry nose, sore, raw throat, frontal headache, singular "pin prick" sensations, and excessive fatigue since October 1979. The company engages in contract stitching of down filled outer wear.

The only unusual event that preceded the onset of symptoms was a septic system failure that released raw sewage outside the building, and subsequent efforts to disinfect the area. No new materials or processes had been introduced to the manufacturing operation.

Local and State health officials were unable to determine a causative agent for the employees' complaints. The Center for Industrial and Institutional Development (CIID) at the University of New Hampshire performed analyses on all raw materials (down, nylon, elastic, thread, and shipping cartons), and several bulk air samples, using Gas Chromatography/Mass Spectrometry (GC/Mass Spec). The only contaminant identified was small concentrations of dichloroethylene, used as a spot remover.

A NIOSH industrial hygienist conducted environmental sampling on May 15, June 2-5, July 30-August 1, and August 8, 1980. Environmental sampling consisted of broad based screening methods using: colorimetric detector tubes (Table 1), activated charcoal, silica gel, porous aromatic polymer, and molecular sieve (GC/Mass Spec), and impingers employing water, methanol and sodium hydroxide as collection media for colorimetric or spectrophotometric analysis of unknowns. A direct reading Organic Vapor Analyzer (OVA) was used to screen for organic compounds. Additionally, samples were collected on florisil media and analyzed for nitrogen containing compounds using an experimental method developed by a private lab.

Laboratory analysis could not identify any compounds in the liquid media samples. Results of GC/Mass Spec. analyses revealed trace amounts of 1,1,1 trichloroethane, hexachloroethane, and various C_9-C_{12} alkanes. The direct reading instrument detected propane gas leaks at a connection outside the building and in the apartment above the business but repair of the leaks did not resolve the employee complaints. The nitrogen specific analysis, also a GC method, produced remarkable results. An aliquot of one of the samples, diluted 800 to 1 produced an extremely large peak at a very short retention time (indicating solvent fraction). Estimates of concentration were reported in the 5-10 milligrams per cubic meter (mg/M^3) range. Positive identification was not possible using this method, which suggests that analysis may not be possible using any GC method.

Company records indicated that symptoms began on October 22, 1979, two days after the sewage was treated with a "disinfectant". The medical complaints consisted of a burning sensation in the nostrils and eyes, and a dry throat. The symptoms progressed form eye, nose and throat irritation to frontal headaches, itchy skin, and extreme fatigue. The symptoms persisted until finally in June, 1981 the company moved into a new building and the problem resolved.

As a result of this investigation NIOSH could not identify a causative agent responsible for employee's complaints. However, the results of this evaluation indicate the source of the medical complaints to be unrelated to the Company and manufacturing process. This determination was made as a result of the elimination of symptoms after relocation of the company to a new building, without any change in the process. The information in this report suggests that the chemicals used to treat the sewage spill (although not identified) led to the employee complaints. Positive identification was not possible using available analytical techniques.

KEYWORDS: SICs 2329, 2339, Septic system spill, Sewage treatment, Eye, Nose and Throat Irritation, Skin Rash, Headache, Fatigue, Nitrogen Compounds.

II. INTRODUCTION -- STATEMENT OF REQUEST

On April 29, 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request from Timber Lake Manufacturing Corporation, (TLM) Alton New Hampshire, concerning eye, nose and throat irritation, headache and fatigue among employees in a stitching shop at the plant. The request noted that 22 employees had been experiencing symptoms since October, 1979. Prior to the request the company had engaged the services of: the State of New Hampshire, Bureau of Occupational Hygiene; Kendall Insurance Company; New Hampshire Insurance Group; and the University of New Hampshire Center for Industrial and Institutional Development (CIID). No causative agent had yet been identified.

NIOSH initially visited the site on May 15, 1980 to gather background information. Subsequent environmental and medical surveys were conducted June 2-5 and July 30-August 1, 1980. Additional site visits were made August 8, 1980, and September 3, 1981.

III. BACKGROUND

Timber Lake Manufacturing Corporation was founded in December, 1951 with the first employee on the payroll in January, 1952. The Company engages in contract stitching of down filled outer wear, employing 22 persons as of the time of this investigation. The plant is situated in a "U" configuration, which consists of three structures: a converted barn, a house, and a connecting building. All work is performed at street level except for the storage of down, which is on the second floor of the barn. The second floor of the house is an occupied residence. Prior occupants of the barn include a cork screw manufacturer and a livery stable.

This Company operated uneventfully until Wednesday, October 17, 1979, when a series of events seemed to lead to employee health complaints. It was reported that the septic system, which handles the sewage from the company, the residence upstairs, and the Alton House Restaurant next door, became inoperable. Raw sewage was being discharged into the courtyard between the company's two main buildings and overflowing into the cellar under the barn. Employees reported the odor as nauseating, and work was halted for the day. The local Board of Health inspected the site on October 18, 1979, and called for immediate treatment of the spill, with replacement of the septic system within three weeks. The health inspector advised against the use of chlorinated lime for treatment because of the confined space under the barn and possible chemical reactions.

The owner of TLM closed the plant October 18th and 19th. On October 19th, the owner noticed a white powder spread over the spill area. The landlord acknowledged that lime was used, but whether or not it was chlorinated lime could not be ascertained. Later that day a chemical company sprayed the area with what was reported to be a disinfectant. Attempts to identify the composition of the spray yielded conflicting reports. What was first reported by the distributer as a "quaternary ammonium compound" was later identified by the manufacturer as a combination of benzyl acetate and phenylethyl acetate. The latter being primarily a perfume, which possesses little or no disinfectant properties. Another important note is that once the area was sprayed, no odor was detected by any of the employees.

On Monday morning, October 22, 1979, employees reported for work as usual. Almost immediately after beginning their shift, employees began complaining of a burning sensation in their nostrils and eyes, and a dry throat. The symptoms got progressively worse and within one hour all employees went home. Symptoms disappeared shortly thereafter. On Tuesday, October 23, 1979, a repeat episode occurred. No odors were reported by any of the employees.

The company bookeeper began recording each incident of symptoms on October 23, 1979, in an effort to determine if there was any pattern. The reported symptoms were primarily subjective: headache, itch, eye irritation, dry throat, and fatigue. It is difficult to quantitate these types of symptoms. However, it was clear that all affected employees were reporting the same symptoms. It appeared that employees most affected worked in the finishing room (the connecting building between the barn and the main building). Employees in the barn (down room and quilt room) were seemingly unaffected. The barn section is the only section with a double floor. Employees in the main building were affected, but to a much lesser degree than the finishing room employees.

Of the 22 employees who worked in the plant, 20 were female. The two males (owner and maintenance) did not work in the building eight hours a day.

Between October, 1979, and June 1981, all female employees reported symptoms, and related them to the finishing room. Not all employees were affected from the beginning. Employees in the barn building (down room and quilting) did not report symptoms while working in their area, (at first). However, they indicated that they would experience sudden headaches and itching when they walked through the finishing room. During the course of the workday, all 8 of these employees would make several trips through the finishing room. By the summer of 1980, these employees were reporting irritation even at their work station.

The 8 employees in the main building and the 2 employees in the finishing room regularly (daily) reported symptoms. These employees also indicated that the source seemed to be in the finishing room. However, even when the finishing room was "isolated" with polyethylene sheets, the irritation remained in the main building.

The production supervisor and the office manager, who worked primarily in the main building but routinely traveled through all three buildings, also reported symptoms daily. Both indicated that it seemed to be worse in the finishing room.

New employees who began work after the new septic system was installed, did not report any irritation for the first few weeks of work. However, in all cases, new employees began feeling the same symptoms between 6 and 8 weeks after employment.

Another common complaint among employees was the general need for more sleep. Persons who would normally stay up to watch the 11 o'clock news were retiring for the night at 7:30 pm.

The owner indicated that he would experience eye irritation and fatigue when driving the company van whenever boxes of jackets were being delivered. He related several instances when he would turn on the car heater and the symptoms would get worse. He would become disoriented, and felt as if he was just a spectator watching life go by. The jackets were stored in the finishing room prior to being loaded in the van. He indicated that he would have to drive with the windows open, no matter what the outside temperature, in order to get some relief. On several occasions he had to stop the vehicle and get out and walk around to "wake up".

When the problem first began, employees stated that the symptoms would disappear shortly after leaving the building. As the problem went on unresolved, symptom relief took longer and longer. During the summer of 1980, when the plant shut down for vacation, employees indicated that they still felt the dryness for 5-7 days.

Employees also indicated that the irritation seemed to be exacerbated by heat. Several employees reported extreme itching of the face when they opened the oven at home, or were close to the fireplace or woodstove.

Employees at the contractor's company, who would handle the finished product for distribution, never reported any irritation. This company, located in Bennington, Vermont, also manufactured the same garments during this investigation. All of the raw materials were identical. No reports of adverse health effects were reported by employees. Likewise, there were no reports of irritation at any of the other contract stitching companies, producing the same garments.

As a result, health professionals from the State of New Hampshire Department of Health and Welfare, Bureau of Occupational Hygiene; Kendall Insurance Company; New Hampshire Insurance Group; and the University of New Hampshire, Center for Industrial and Institutional Development (CIID) were requested to look at the problem. Between October 31, 1979, and November 30, 1979, no cause for the health problems could be determined by the aforementioned.

During this time, a series of trial and error remedies were attempted. Sprinklers were placed under the barn to wash away the "white powder", (lime). They were run for a few days with no symptom relief. Fans were installed to bring in outside air: no relief. The fans were reversed to draw air out of the building: symptoms got worse.

A new septic system was installed between November 12 and November 22, 1979. A trench was excavated that ran from the courtyard, under the connecting building, to a leach field in back of the building. The contractor indicated that the soil was saturated with raw sewage throughout the courtyard.

Just prior to backfilling, a polyethylene sheet was installed under the finishing room floor. The contractor who performed this installation (in a 3 foot crawl space under the building) reported intense burning of the face and neck after only 20 minutes under the building. The contractor attributed this reaction to the presence of cat urine under the building.

During the period from November 18, 1979, through November 30, 1979, the finishing room employees were relocated to a building 13 miles away in Pittsfield, New Hampshire. They returned to TLM December 3, 1979 when the problem appeared to be clearing up. No more complaints were reported until mid-January, 1980. (Employees later indicated that the symptoms never left, even in Pittsfield, but they did not report them because they could not afford any more loss of income due to not working.)

Employees indicated that the irritation "gets worse" when the heat is on. The oil fired boiler was checked out and found in good order. Windows were opened during the winter months at employee request.

On February 12, 1980 the finishing room employees again were moved to Pittsfield. The finishing room was enclosed at both ends to isolate the suspected room. The room was then used for storage only. This effort appeared successful for a few days, but then the complaints returned. Finishers in Pittsfield complained of the irritation whenever they opened a box of material. Employees at TLM reported the irritant as "moving in waves that hit you unexpectedly and then go away".

The owner of TLM requested a NIOSH Health Hazard Evaluation in April, 1980.

IV. EVALUATION DESIGN AND METHODS

Prior to NIOSH's receipt of the request, NIOSH regional representatives met with the investigators from the State of New Hampshire and CIID to discuss evaluation procedures that had already been attempted. Information gathered at this meeting was used in this evaluation.

On May 15, 1980 NIOSH conducted a walk through survey of the plant and reviewed company records. Employees were interviewed at their work stations.

During the period of June 2 through June 5, 1980 environmental sampling was conducted both inside and outside the building. Colorimetric detector tubes were used to attempt to identify any possible airborne contaminants. The principle of detector tube operation is such that if the chemical specified on the tube is present in the air, then the color of the tube will change as air is drawn through it. The length of the color change stain is proportional to the concentration of the contaminant. NIOSH attempted to gain more sensitivity by drawing considerable more air through the tubes than is called for by the manufacturer. A list of the tubes used is contained in Table 1. Although not conclusive, this sampling strategy quickly eliminated several classes of chemicals from consideration for future sampling.

Bulk samples were collected of the soil under the connecting building and the liquid spot remover, and submitted for qualitative analysis. The soil sample was extracted with methanol and analyzed by Gas Chromatography (GC). The liquid sample was analyzed directly by Gas Chromatography/Mass Spectrometry (GC/MS).

Large volume air samples were collected in the three main rooms of the building by drawing air over solid sorbent materials: charcoal, porous aromatic polymer, silica gel, and molecular sieve. These samples were first qualitatively analyzed by GC, and the charcoal sample was concentrated and analyzed by GC/MS.

Between July 30 and August 1, 1980 additional environmental air samples were collected. Samples were collected on mixed cellulose ester filters for sulfuric acid (P&CAM 268)[1] and hydrazine analysis.

The hydrazine filter was extracted with HCL analyzed following the general analytical procedure for hydrazine outlined in P&CAM 248.

Samples were collected on silica gel and in methanol impingers for amine analysis according to P&CAM 221 (modified).

One air sample was collected in a 1.0N sodium hydroxide impinger solution and the pH was compared to a blank.

On August 1, 1980 employees complained of a smell of gas and were experiencing headaches and nausea. A gas leak was detected using an Organic Vapor Analyzer (OVA) at a connection outside the building and in the stove of the apartment over the main building. The Gas Company was notified and repaired the system on August 4, 1980.

On August 8, 1980 NIOSH returned to the plant at the request of the owner, who indicated that employees' headaches had worsened since the Gas Company had fixed the leaks. No gas leaks were detected using the OVA. Two bulk air samples were collected on this date on florisil media to be analyzed for nitrogen containing compounds by a private laboratory. The analytical method was an experimental method developed by this laboratory and is described in Appendix 1.

VI. RESULTS

A positive indication (color change) was observed in only three detector tubes: Acetic Acid, Formic Acid, and Dimethyl Acetamide. However, the color change observed was different than what was expected in all cases. The Acetic Acid and Formic Acid tubes, which contain the same chemical indicator, changed from purple to red. The expected change as called for by the manufacturer, is from purple to yellow. The manufacturer indicates that the red color change is indicative of a stronger acid being present. The length of the color change stain was very short considering the amount of air that was drawn through the tube, indicating that only a small quantity of the contaminant was present.

Likewise, the Dimethyl Acetamide (DMA) tube gave an unexpected color change: Yellow to green instead of yellow to blue). The manufacturer lists other amines as interferences. However, other amines were ruled out by the fact that no color change was observed on the amine indicators: Ammonia, Hydrazine, and Triethylamine. The DMA tube employs two chemical reactions to produce the indicated color change.

First, air containing DMA is drawn through a pre-tube which contains Sodium Hydroxide (NaOH). In this pre-tube DMA reacts with NaOH and releases a free amine. The free amine then reacts in the back-up tube, which contains bromphenol blue indicator, to produce the color change. Any attempt to interpret this information would be speculation at best. However, as with the acid tubes, only a minute quantity was indicated.

NIOSH ran the same tests out of doors and no reaction was observed on these three tubes.

All raw materials and several bulk air samples were analyzed by CIID prior to the NIOSH investigation. GC/MS analysis identified only one contaminant: dichloroethylene in very small quantities; used as spot remover.

Analysis of the spot remover by NIOSH indicated 1,1,1-Trichloroethane. Qualitative analysis of all the air samples revealed only trace amounts of: 1,1,1-trichloroethane, hexachloroethane, and alkanes (C_9-C_{12} range). These were identified in only one sample, the charcoal tube.

The soil sample was extracted with methanol and analyzed by GC but no peaks were detected.

The amine, the hydrazine and the sulfuric acid samples were below the limit of detection in each case. (Detection limits: amines - 0.01 milligrams per sample; hydrazine - 10 micrograms per sample; and sulfuric acid - 5 micrograms per sample).

The samples analyzed by the private lab for nitrogen containing compounds produced remarkable results. An aliquot of one of the samples, diluted 800 to 1 produced an enormous peak with a very low retention time (indicating the solvent fraction). An estimate of the concentration was reported in the 5-10 milligram per cubic meter range. Positive identification was not possible using this method.

Since the analytical method used could only detect nitrogen containing compounds, the chemist offerred several theoretical possibilities as to what compounds could produce the observed result: very volatile quarternary ammonium salts; amine salts including metal salts; isocyanate groups; and possibly, other nitro-alkane groups. He indicated that identification would entail a best guess (trial and error) practice at this point.

VII. DISCUSSION

The chemicals identified in the environmental evaluation were not present in quantities capable of producing acute or systemic health effects. However, an unknown chemical(s) was detected in significant quantity using an experimental, nitrogen specific detector. Attempts to identify this unknown were unsuccessful using available analytical techniques (GC, GC/Mass Spec, Spectrophotometry, and Colorimetry). The process of disinfecting the sewage spill was investigated and questions remain unanswered as to the exact chemicals that were used.

The "white powder" that was spread over the area by the landlord, was not positively identified. The landlord acknowledged that it was lime, but denied that it was chlorinated. The owner of TLM recalled seeing a bag labeled "chlorinated lime" in the area. There were also conflicting reports as to what was sprayed over the area by a chemical company on October 19, 1979. The chemical company was asked to treat the area with a disinfectant. When the State investigators asked the chemical company what was used, they were told "an odor eater". When NIOSH asked, a trade name was given. When NIOSH first contacted the manufacturer, the composition of the trade name product was given as a quaternary ammonium compound (the specific compound was not given).

Several days later a different agent of the manufacturer called NIOSH and reported that the composition was a combination of "benzyl acetate and phenylethyl acetate". This compound was researched and found to be primarily a perfume containing little or no disinfectant properties. This compound would mask the odor of the sewerage, making it smell different. The employees of TLM never reported an odor being present after the treatment. On the contrary, it was the absence of the sewage smell that was remarkable.

NIOSH conducted a literature search to identify chemicals that could be used as soil or sewerage treatment, and at the same time produce the results that were observed during the environmental and medical evaluations, ie: contains nitrogen, is relatively volatile, would cause skin irritation, would cause headache and fatigue.

This review produced one chemical that could meet all the criteria: methyl isothiocyanate[5] (C_2H_3NS). This chemical is used as a soil sterilizer or disinfectant, and is a powerful irritant. It was formerly used as a military poison, and is sometimes called methyl mustard oil[4]. It would produce similar results on the nitrogen detector, and the DMA detector tube. It produces skin and eye irritation and cyanosis (headache and fatigue). It would not have been detected using the analytical techniques that were employed during this investigation.

This information did not come to the invesigator's attention until after TLM had moved into its' new building. Therefore NIOSH did not attempt to positively identify this compound and it is offered here as merely speculation should the new occupants of the building experience health effects.

It was noted however, that upon moving to the new building, all employee complaints resolved. One last site visit was made on 9/3/81 to confirm the absense of symptoms by interviewing employees directly. Upon confirmation, NIOSH ended its investigation.

VIII. CONCLUSION

As a result of this investigation NIOSH could not determine the cause of employee health complaints. However, since the problem resolved itself upon moving the company to a new location, the source of the problem appears unrelated to the work process. The evidence gathered in this investigation suggests that the cause of employee health effects were related to the chemical(s) used to treat the sewage spill on October 19, 1979.

IX. RECOMMENDATIONS

The owner of TLM decided to build a new building and relocate the entire plant when it became apparent that efforts to identify a causative agent were not being successful. During the course of this investigation NIOSH made recommendations concerning ways to minimize contamination of the new building once the move began, ie: leaving behind all disposable material, like storage boxes, etc., washing all machine surfaces and workbenches prior to moving, and limiting the size of the inventory just before the move, so that new materials would be sent directly to the new building. These recommendations were implemented as much as possible and the move proved sucessful at resolving the problem.

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X. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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

Copies of this report have been sent to:

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TABLE 1

Draeger Detector Tubes Used 6/2/80

No Color Change After 15 Minutes @ 1 Liter Per Minute

Triethylamine
Dimethyl formamide
Ammonia
Cyanogen chloride
Hydrazine
Hydocyanic acid
Acetaldehyde
Diborane
Dimethyl sulfide
Ozone
Methyl Bromide
Phosgene
Methyl methacrylate
Carbon tetrachloride
Chloroprene
Epichlorhydrin
Hydrogen sulfide
Aniline
Hydrogen fluoride
Arsine
Carbon monoxide
Alkylchloroformates

Positive Indications

Acetic acid
Dimethyl acetamide
Formic acid

APPENDIX 1

Analytical Method for Nitrogen Compounds

Area air samples were collected in the finishing room using Thermosorb™ air cartridges containing 3 grams of 60/80 mesh magnesium silicate. The air samples were collected using MSA model G air pumps operating at 2 L/min. with a total air volume of 400 L. The contents of the cartridges were desorbed by backflushing with acetone (1-1.5 ml). Using a microliter syringe, a 3 uL sample of the acetone eluate was injected into the nitrogen detector.

The nitrogen detector consisted of a gas chromatograph interfaced to a TEA™ Analyzer equipped with a catalytic oxidative pyrolyzer for low temperature conversion of chemically-bound nitrogen to nitrogen oxides (NO) with subsequent detection with a standard TEA.