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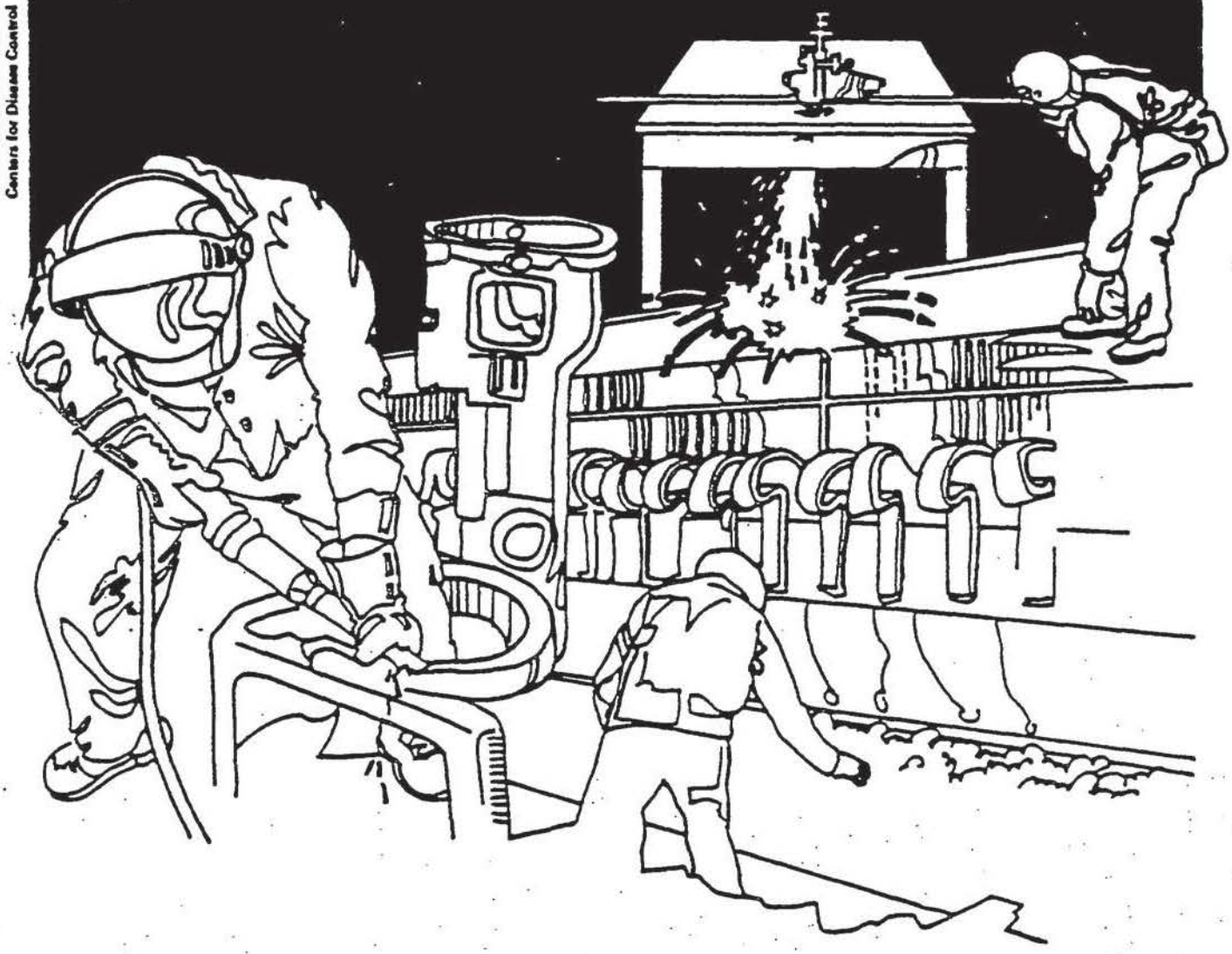

Health Hazard Evaluation Report

HETA 83-383-1480
PROGRESS FEDERAL SAVINGS & LOAN
BRIDGEPORT, PENNSYLVANIA

PREFACE

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

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

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

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I. SUMMARY

On August 5, 1983, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate the possibility of long term medical problems among employees following two insecticide applications (July 1982 and April 1983) at Progress Federal Savings and Loan, Bridgeport, Pennsylvania. A number of employees experienced symptoms such as headache, cough and hoarseness immediately after each application, and one employee reported persistent medical problems following the second application.

On September 23, 1983 and January 17, 1984, NIOSH investigators conducted an environmental and medical evaluation. Area air samples were collected to measure concentrations of chlorpyrifos (dursban), diazinon, organic vapors and formaldehyde. Wipe samples were obtained from selected surfaces and analyzed for dursban and diazinon residues. Seven of twenty-two workers were interviewed via a brief questionnaire to evaluate the occurrence of symptoms possibly related to the insecticide applications.

One of three air samples was positive for chlorpyrifos at a concentration of 0.02 micrograms per cubic meter (ug/m^3). All three air samples were positive for diazinon at concentrations that ranged from 0.06 to 0.13 ug/m^3. These concentrations were well below the occupational exposure guidelines of 100 ug/m^3 for diazinon and 200 ug/m^3 for dursban established by the American Conference of Governmental Industrial Hygienists (ACGIH). There are no current OSHA standards or NIOSH recommended standards for either substance. One of five surface wipe samples contained 0.003 ug of diazinon; the others were negative.

Total organic vapor concentrations ranged from 4-5 mg/m^3 and formaldehyde concentrations ranged from 0.02 to 0.03 parts per million (ppm). These concentrations are well within the range of levels usually found in office-type environments and, therefore, considered "trace" or "background" quantities.

A minimum of four persons had acute reactions following the first insecticide application and a minimum of three persons had acute reactions following the second applications. One individual has had persistent allergy problems since the second application, but we were unable unequivocally to establish a cause and effect relationship.

Based on the data collected, we find no evidence that current employees are experiencing any ongoing health problems attributable to the insecticide applications and there was no evidence of a current health hazard. Recommendations were made to apply insecticide during non-work hours and to ventilate the building afterwards.

KEYWORDS: SIC 6123 (Savings and Loan Associations)
Indoor-air, Dursban, Diazinon, Allergy, Chlorpyrifos

II. INTRODUCTION

In August 1983, NIOSH received a request for a health hazard evaluation from the management at Progress Federal Savings and Loan (PFS&L), Bridgeport, Pennsylvania. The requestor asked that NIOSH evaluate the workplace for evidence of substances that may be related to symptoms (primarily in one individual) of tightness in the chest, difficulty speaking, loss of concentration and exhaustion that were first experienced following the application of an insecticide (chlorpyrifos) in July 1982 and recurred following an application of diazinon in April 1983.

The work-site was evaluated on September 23, 1983. Preliminary results were forwarded by letter in December 1983. A follow-up environmental survey was conducted on January 17, 1984 to repeat formaldehyde sampling.

III. BACKGROUND

PFS&L is housed in a 6 year old, 2-story building with a basement. There are offices and a conference room in the basement; teller stations, lobby, offices and a vault on the first floor; and offices and a small kitchen on the second floor. At the time of the survey there were twenty-two employees.

In July 1982, Norristown Termite and Pest Control Inc., Norristown, Pennsylvania applied chlorpyrifos at the facility. The pesticide was a "wettable powder" and applied in a 1% water solution. Immediately following the application, which occurred at 10 a.m., one employee reported to have experienced symptoms that included nausea, headache, loss of voice, tightness in chest and difficulty speaking. From that point on, some of these symptoms occurred each time this employee went into the building. At least 3 other employees experienced one or more of these symptoms. Another incident of a similar nature occurred following another application of a different pesticide (diazinon, 1 1/2oz. to gallon water) in April 1983.

IV. METHODS

A. Environmental

Efforts concentrated on evaluation of the building with respect to airborne and surface contamination of chlorpyrifos and diazinon and airborne concentrations of organic vapors and aldehydes. The latter two substances were selected as indicators of overall air quality and are typically monitored in indoor-air type evaluations.

Because of a problem with "positive" blanks, it was impossible to interpret the data obtained to monitor airborne formaldehyde concentrations. Therefore, another survey was conducted on January 17, 1984 to re-sample for formaldehyde.

Air samples were placed in sets at three locations (near the receptionsts desk in the lobby, in the lobby managers office and on the 2nd floor in the Internal Auditors office). Each set contained sampling equipment to measure airborne concentrations of chlorpyrifos, diazinon, total organic vapors and formaldehyde.

1. Chlorpyrifos and Diazinon Air Samples

A sampling train was selected having a 13mm glass fiber filter up front for particulate followed in series with an ORBO-42 solid sorbent tube for vapor. The atmosphere was sampled at the rate of 1 liter per minute (lpm) for approximately 5 1/2 hours.

Both the sorbent tubes and filters were desorbed with toluene and analyzed via a gas chromatograph equipped with an electron capture detector. A 6 foot x 2 millimeter i.d. glass column packed with 3% OV-17 and 3% QF-1 on 100/120 mesh Chrom Q was used isothermally at 180°C and with a gas flow of 75 ml/minute. The limits of detection for the ORBO tubes were 0.02 ug/sample (diazinon) and 0.005 ug/sample (chlorpyrifos).

2. Chlorpyrifos and Diazinon (Wipe Samples)

A Whatman filter tab, moistened with toluene was used to wipe at 10 cm x 10 cm. area at the following locations and subsequently analyzed in a manner similar to that described in IV A(1) above.

Desk top, lobby receptionist area

Desk top, Assistant managers office, 1st floor

Working surface, teller station nearest wall

Desk top, 2nd floor, internal auditors office

Floor, 1st level, corner of safety deposit booth

3. Organic Vapors

Organic vapors were monitored using a standard, 150mg charcoal tube technique at the rate of 100cc/min for 5 1/2 hours. Analysis was in accordance with the provisions of NIOSH method P&CAM 127 using a 30 meter DB-1 bonded phase fused silica capillary column (splitless mode). One sample was further analyzed by GC/MS to identify components. The lower detectable limit was 0.01mg/sample for total hydrocarbons (using n-decane) and 0.001mg/sample for toluene.

4. Formaldehyde

Initially, air samples were collected and analyzed according to NIOSH method P&CAM 125 with a 1% sodium bisulfite solution in the impinger instead of water. The sampling rate was 1 lpm for 5 1/2 hours. The results were not interpretable because the blank samples (impinger solutions prepared in the field but not used for air sampling) contained levels of formaldehyde in excess of the air samples. Therefore, a follow-up visit was made on January 17, 1984 to re-sample for formaldehyde using solid sorbent tubes (150mg XAD-2 tubes impregnated with 5% dinitrophenylhydrazine hydrochloride) at a sampling rate of 200cc/min. The limit of detection was 0.3 ug/sample.

Each solid sorbent sample was desorbed with 3 ml of acetonitrite and analyzed using High Pressure Liquid Chromatography (HPLC) and Ultra Violet (UV @ 365mm) techniques. The column used was a 5 um Zorbax ODS.

B. Medical

During the September 1983 site visit, seven (of approximately twenty-two) current employees and one former employee were interviewed. The respondents were selected at random from various departments and locations in the building except that all persons who believed that they had reactions to the insecticide application were included. During the interviews, we administered a brief questionnaire to screen for the presence of any of sixteen symptoms compatible with acute organophosphate toxicity. These symptoms include; headache, weakness or fatigue, chest pain or tightness, abdominal pain, dizziness or faintness, nausea or vomiting, nervousness or drowsiness, sweating, cough, blurred vision, loss of appetite, breathlessness, nasal congestion or rhinorrhea, wheezing, myosis, and loss of voice. The former employee was interviewed with her physician, and a summary of her medical records was subsequently obtained and reviewed.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Pesticides

Diazinon and chlorpyrifos (Dursban) are organophosphate insecticides. Their acute toxicities derive primarily from their anticholinesterase effects. These symptoms typically include respiratory effects such as chest tightness, wheezing, and increased bronchial secretions; increased salivation and sweating; gastrointestinal symptoms such as increased peristalsis, nausea, vomiting, and diarrhea; bradycardia and cardiac conduction abnormalities: increased urination; neuromuscular effects such as fatigueability, weakness, twitching, and ventilatory failure; and central nervous system effects such as headache, giddiness, confusion, slurred speech, tremor, ataxia, seizures, respiratory and circulatory depression, and coma. Fatal outcomes are usually the result of asphyxia secondary to respiratory failure.[1,2]

Onset of symptoms is usually within minutes to hours of exposure, and the effects last one to five days. Because of the rapid metabolism and excretion of these substances, chronic poisoning from accumulation of the insecticides is not likely, although gradual incrementation of anticholinesterase effect could occur in instances of recurrent, low-level exposure. There have been reports of prolonged illness and/or delayed consequences (including neurotoxicity, liver dysfunction, cardiac problems, and behavioral changes) with some organophosphates, but not specifically with diazinon or chlorpyrifos.[2]

Diazinon shares the organophosphate effects outlined above, although the severity of its acute toxicity is inconsistent. This variability is thought to depend on the precise formulation used, the length of exposure to air, and possibly other factors. Diazinon has not been found to be irritating or sensitizing. It can, at least in animal models, produce hematological effects not usually seen with other organophosphates. These include reticulocytopenia and an increase in the myeloid/erythroid ratio in bone marrow stem cells. Diazinon has been found to be teratogenic in chickens, producing, among other effects, specific deformities in neck vertebrae.[3] It has not been found to be teratogenic in rabbits, hamsters, or rats. Data on human reproductive effects are lacking. The no-effect level in man is estimated to be 0.02 mg/kg/day.[1] The National Cancer Institute has conducted a carcinogenesis bioassay of diazinon. The results were negative and the substance is not believed to be a carcinogen.[7]

Chlorpyrifos has moderate acute toxicity with effects typical of organophosphates. In certain animal models, very high doses have produced a short-lived, reversible ataxia, but no organophosphate neurotoxicity has been demonstrated. There are no data demonstrating teratogenicity in animal studies[4] and no data demonstrating adverse reproductive effects in man. The no-effect level in man is estimated to be 0.03 mg/kg/day.[1]

NIOSH has not recommended an exposure standard for either of these pesticides and there are no applicable OSHA standards. However, the American Conference of Governmental Industrial Hygienists (ACGIH) has set exposure criteria, which are often used in evaluation of industrial environments, for both pesticides. These criteria are 100 ug/m^3 for Diazinon and 200 ug/m^3 for Dursban (Chlorpyrifos).

C. Formaldehyde

Formaldehyde is a colorless, flammable gas with a strong, pungent odor. The first symptoms noticeable upon exposure to formaldehyde (at concentrations ranging from 0.1 to 2.0 ppm) are burning of the eyes, tearing, and general irritation of the upper nasal passages. Higher exposures can produce coughing, tightening of the chest, a sense of pressure in the head and palpitations in the heart.[8,9] Dermatitis following expsoure to formaldehyde-containing resins is a well recognized problem.[8] Workers may develop redness and swelling of the skin of exposed surfaces.

The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) is 3 ppm for an 8-hour time-weighted average (TWA), 5 ppm for a ceiling concentration, and 10 ppm for a maximum peak for no more than 30 minutes during an 8-hour shift.[10] The current American Conference of Governmental Industrial Hygienists (ACGIH) (1982) ceiling Threshold Limit Value (TLV) for formaldehyde is 2 ppm.[11] ACGIH is currently proposing a change in the ceiling TLV to 1 ppm.[11] In 1976, based upon the irritant effects of formaldehyde, NIOSH recommended that employee exposure to formaldehyde vapor be controlled to a concentration no greater than 1 ppm for any 30-minute sampling period.[9] This recommendation has since been supplanted by the Current Intelligence Bulletin of December 23, 1980, in which NIOSH recommends, based on the chemical's potential carcinogenicity, reducing formaldehyde exposures to the lowest feasible levels.[13]

D. Organic Vapors

Organic vapors are released from dispersants and toners used in photocopying machines and telecopiers, from printing processes, and from certain cleaning compounds. Hydrocarbons can be irritants and, at high concentrations, are central nervous system depressants.

VI. RESULTS AND DISCUSSION

A. Environmental

1. Chlorpyrifos and Diazinon

Chlorpyrifos was detected in 1 of 3 air samples (lobby managers office) at a concentration of 0.02 ug/m^3. Diazinon was found in all three air samples at concentrations of 0.06 ug/m^3 (lobby managers office), 0.09 ug/m^3 (internal auditors office) and 0.13 ug/m^3 (lobby receptionist area). These concentrations are well below the ACGIH TLVs set at 100 ug/m^3 for diazinon and 200 ug/m^3 for chlorpyrifos.

One of the five surface wipe samples was positive for Diazinon. The sample obtained from the surface of a floor tile in the corner of the safety deposit booth contained 0.003 ug/100 cm^2 of Diazinon. There are no criteria with which to compare this number.

2. Organic Vapors

The 3 air samples for organic vapors were in the 4-5 milligram per cubic meter (mg/m^3) range. The major organic compounds detected were toluene and a branched alkane type compound, probably a $C_{10}H_{22}$ isomer. Both are commonly found in office environments. The concentrations detected are considered "background" levels.

3. Formaldehyde

Airborne formaldehyde concentrations for the three sampling locations were 0.02 ppm (receptionist area), 0.03 ppm (lobby managers office), and 0.02 ppm (internal auditors office). These concentrations are considered "background" levels and are within the range normally found in office areas.

B. Medical

The mean age of the current employees who were interviewed was 30 years (standard deviation = 8.3) and the mean duration of their employment was 4.3 years (s.d. = 2.9). All respondents were female.

Five of seven (71 percent) interviewees reported at least one acute symptom following the July 1982 chlorpyrifos application. Four (57 percent) reported more than three such symptoms from the list of sixteen. Similarly, five of seven (71 percent) reported at least one acute symptom following the April 1983 diazinon application with three (49 percent) reporting more than three such symptoms. The most frequently reported acute symptoms were cough, headache, loss of voice, and nasal congestion or rhinorrhea. Only one individual, the former employee, reported disabling acute symptoms, including some not reported by the current employees. All of the current employees whom we interviewed reported at least one symptom during the two-week period prior to our site visit, but only one person (14 percent) reported more than three such symptoms and this individual had an intercurrent upper respiratory infection. There had been no recent insecticide applications preceding our survey.

With the exception of the former employee, there were no reports of any persistent physical effects following the pesticide applications. One interviewee, however, did mention the possibility of mild behavioral changes (characterized by irritability, impatience, etc.) in some of the employees for a few weeks following the July 1982 chlorpyrifos application.

VII. DISCUSSION

We considered that the acute occurrence of more than three symptoms (from the group of sixteen compatible with organophosphate toxicity) indicated a reaction to the insecticide.[5] By this criterion, a minimum of four persons had reactions to the July 1982 chlorpyrifos application. Similarly, a minimum of three individuals suffered reactions to the April 1983 diazinon application. By contrast, only one individual reported the presence of more than three such complaints during the two-week period preceding our site visit (and this person reported an intercurrent viral upper respiratory infection). In general, these acute reactions were short-lived. There were anecdotal reports of mild behavioral changes in several employees which persisted for several weeks following the chlorpyrifos application. Such an effect following exposure to organophosphates has been reported elsewhere, although under different circumstances.[6]

We believe that the medical status of the former employee is idiosyncratic and must be considered separately from that of the other workers. Although her problems are chronologically associated with the pesticide applications, we cannot unequivocally attribute her illness to these events. Because of the specific nature of her problems, we do not believe that her situation has any implications for the health of the other bank employees.

Considering the results of the interviews in conjunction with those of the environmental sampling, we find no evidence that current bank employees are experiencing any ongoing health problems attributable to the pesticide applications in question. Similarly, we do not believe that there is any current health hazard in the bank offices resulting from the trace residues of the insecticides or any other substances determined to be present.

VII. RECOMMENDATIONS

1. Future insecticide application should be performed during non-work hours.

2. During application and immediately after, the air handling system should be operated in a mode so as to introduce the maximum amount of outside air until the "pesticide-like" odors subsides. (The odor is usually associated with the aromatic petroleum derivative used as the vehicle in the insecticide and not the active ingredient).

3. For the one individual who is experiencing continued allergic reactions, we can only recommend continued medical treatment and avoidance of situations and substances known to exacerbate her symptoms.

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