HETA 91-326-2278
JANUARY 1992
XOMOX CORPORATION
BLUE ASH, OHIO

NIOSH INVESTIGATORS:
Alan Echt, MPH, CIH
Faye T. Bresler, MD, MPH
Robert T. Hughes
Charles S. Hayden II

I. SUMMARY

On September 26, 1991, October 29, 1991, November 14, 1991, and February 13, 1992, investigators from the National Institute for Occupational Safety and Health (NIOSH) conducted a Health Hazard Evaluation (HHE) at the Xomox Corporation in Blue Ash, Ohio. This HHE was performed in response to an employer request concerning polymer fume fever in the Plastics Department.

Nine full-period single personal breathing zone (PBZ) air samples and five full-period single general area air samples were collected and analyzed for particulate fluorides and hydrogen fluoride (HF) in accordance with NIOSH Method 7902. The results for particulate fluorides were inconclusive: the amount of analyte recovered from some field blanks exceeded the amount recovered from air samples. Five of nine PBZ samples had detectable HF, with 8-hour TWA concentrations ranging from from 0.005 ppm to 0.010 ppm. Eight-hour TWA concentrations of HF in five area samples ranged from 0.004 ppm to 0.008 ppm. Sampling times for PBZ samples ranged from 176 minutes (for an employee who left early) to 420 minutes. PBZ samplers were capped and turned off or capped, turned off, and removed during breaks and at lunch. Sampling times for area samples ranged from 141 minutes (the pump failed at the end of that period) to 411 minutes. In both instances, 8-hour TWAs were calculated assuming that no exposure occurred during the unsampled period. While these results are less than the applicable evaluation criteria for HF, they indicate that some exposure to HF, a decomposition product of fluorocarbon polymers, is occurring. The area sample results indicate either that ovens, extruders, and cooling presses all contribute to exposure, or that the high velocity replacement air distributes contaminants throughout the work area.

Confidential health interviews were conducted with 11 employees of the Plastics Department. This represented a non-random sample of all plastics department employees, and included first-shift employees who were available on the day interviews were conducted. Symptoms that are consistent with classical polymer fume fever occurred in five of ten employees interviewed; partial polymer fume fever and/or isolated polymer fume fever symptoms occurred in another five employees. Smokers and non-smokers seemed to be similarly affected, although the sample size was small. (Polymer fume fever has been described as shaking chills, myalgias, shortness of breath, chest tightness, and malaise with or without a measured increase in body temperature. Smoking has previously been found to be correlated to the occurrence of polymer fume fever, presumably because polymer fume is generated by the burning polymer-contaminated cigarette.)

On the basis of the data obtained during this investigation, the NIOSH investigators determined that a health hazard exists at this facility due to exposures to the decomposition products of fluorocarbon polymers. This determination is based upon air sampling data indicating that exposures to low concentrations of hydrofluoric acid occur in the plastics department, and the occurrence of symptoms suggestive of polymer fume fever among workers in the plastics department. Based upon observations and tests of the ventilation system, the NIOSH investigators judged it to be ineffective in controlling emissions from the process. In order to effect a reasonable degree of control of these emissions, modifications must be made to the existing ventilation system. These modifications and other recommendations are described in section VIII of this report.

KEYWORDS: SIC 3491 (Industrial Valves), polymer fume fever, polytetrafluoroethylene (PTFE), fluorinated ethylene-propylene (FEP), perfluoroalkoxy (PFA), hydrogen fluoride, ventilaton, smoking.

II. INTRODUCTION

On September 26, 1991, October 29, 1991, November 14, 1991, and February 13, 1992, investigators from the National Institute for Occupational Safety and Health (NIOSH) conducted a Health Hazard Evaluation (HHE) at the Xomox Corporation in Blue Ash, Ohio. This HHE was performed in response to an employer request concerning polymer fume fever in the Plastics Department. Polymer fume fever in the Plastics Department was addressed in a previous NIOSH HHE at Xomox.[1]

The September 26 visit consisted of an opening meeting, a walk-through survey of the Plastics Department, and medical interviews with employees in that department. An evaluation of the Plastics Department ventilation was conducted on October 29, 1991. On November 14, 1991, NIOSH investigators conducted air sampling to evaluate employee exposures to polymer decomposition products. A closing conference was conducted on February 13, 1992.

III. BACKGROUND

Xomox Corporation is a manufacturer of industrial valves in a variety of sizes and applications. Polymer-lined valves are produced in the Plastics Department at Xomox. Forty employees work in the plastics department over three shifts. The portion of the Plastics Department included in this evaluation is enclosed on two sides by walls. Floor to ceiling, heavy, plastic curtains make up the other two sides. This portion of the Plastics Department includes mold heating ovens, extrusion presses, and mold cooling presses. Adjacent to this area are workstations for machining and assembling the valves. Other portions of the Plastics Department include a polytetrafluoroethylene (PTFE) sleeve room, polymer mixing operations, and the Oven Room. In addition to ovens, the Oven Room houses a stripping operation where polymer is removed from valves.

In the portion of the Plastics Department addressed in this HHE, valve bodies are enclosed in metal molds and heated in one of two ovens to a temperature of around 735°F. The other oven operates at approximately 800°F. The heated body/mold assembly is manually transferred (either hand carried or rolled on a cart) to one of five extrusion presses where it is filled under pressure with molten polymer at a temperature of 645 ± 10°F. The assembly is then manually transferred to a cooling press where it is cooled in a stream of room air. There is the potential for the decomposition products of fluorocarbon polymers to escape at each of these points. During this HHE, valves were lined with either perfluoroalkoxy (PFA), a mixture of fluorinated ethylenepropylene (FEP), PTFE, and pigment; FEP and pigment; a blend of PFA, PTFE, and pigment; or a mixture of PFA and pigment. Prior to this HHE the production process and ventilation system were remodelled for more efficient operation. These changes allow two ovens to operate at the same time. In addition to the polymers used in valve linings, a mold release spray containing fluorocarbons (Sprits GP Mold Release) was in use at the time of the survey.

Employees routinely ate and drank at their work stations. And, while smoking in the Plastics Department was strongly discouraged, it was permitted.

IV. MATERIALS AND METHODS

A. Environmental

No single analytical technique will detect all the decomposition products of fluorocarbon polymers. Hydrolyzable fluoride is a decomposition product of fluorocarbon polymers.* Air sampling in this HHE was directed at determining airborne concentrations of hydrolyzable fluoride.

Nine full-period single personal breathing zone air samples and five full-period single general area air samples were collected and analyzed in accordance with NIOSH Method 7902.[2] Samples were collected using two filter cassettes in series, connected via Tygon tubing to a personal sampling pump operating at a flow rate of 2 liters per minute. The first filter cassette, which contains a 37 millimeter diameter, 0.8 micron pore size mixed cellulose ester filter, is used to collect particulate fluorides. The second filter cassette houses a sodium carbonate-treated, cellulose pad, which collects hydrofluoric acid. Both the filter and the pad are analyzed by ion selective electrode. The minimum detectable concentration for the hydrogen fluoride sample set was 0.003 ppm, based upon an analytical limit of detection of 2.0 micrograms (µg) of fluoride per sample and a sample volume of 840 liters (L). The minimum quantifiable concentration for this set of samples was 0.007 ppm, based upon an analytical limit of quantitation of 4.7 µg of fluoride per sample and a sample volume of 840 L.

The minimum detectable concentration for the particulate fluoride samples was 0.001 ppm, based upon an analytical limit of detection of 1.0 µg of fluoride per sample and a sample volume of 840 L. The minimum quantifiable concentration for the particulate fluoride samples was 0.006 ppm, based upon an analytical limit of quantitation of 4.3 µg of fluoride per sample and a sample volume of 840 L.

B. Medical

Confidential health interviews were conducted with 11 employees of the Plastics Department. This represented a non-random sample of the first-shift plastics department employees, and was comprised of first-shift employees who were available on the day interviews were conducted. The purpose of the interviews was to assess individual work practices in regard to smoking and eating, and also to evaluate the occurrence of polymer fume fever occurring over the past two years. The two year cut-off was chosen to accomodate process and ventilation changes made two years ago.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure

---

*Hydrolyzable fluoride could include hydrogen fluoride, inorganic fluoride, carbonyl fluoride, or other organic forms of fluoride which are hydrolyzed in an alkaline solution.

to which most workers may be exposed up to ten hours a day, forty hours a week for a working lifetime without experiencing adverse health effects. However, it is 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 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 to the limit set by the evaluation criterion. These combined effects are often not considered by 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 the following: 1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), 2) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs), and 3) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs).[3,4,5] The OSHA PELs may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; in contrast, the NIOSH-recommended exposure limits are primarily based upon the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing those levels found in this report, it should be noted that employers are legally required to meet those levels specified by an OSHA PEL.
A time-weighted average exposure level (TWA) refers to the average airborne concentration of a substance during a normal eight- to ten-hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from brief high exposures.

A. Decomposition Products of Fluorocarbon Polymers

NIOSH recommends that exposure to the decomposition products of fluorocarbon polymers in the workplace be controlled through good work practices, engineering controls, and medical management.[6] Since no measurable environmental concentration of any single decomposition product of fluorocarbon polymers can ensure complete protection of worker health, NIOSH has not recommended an exposure limit.[6]

Fluorocarbon polymers include polymers of substituted polyethylene monomers of the general formula (XCX-XCF)n, where X can be fluorine, hydrogen, chlorine, carbon trifluoride (CF_3), or CF_3-CF_2-CF_2-O, and n is a natural number.[6] The decomposition products of fluorocarbon polymers are substances which are thermally generated from fluorocarbon polymers.[6]

The health hazard to workers exposed to the decomposition products of fluorocarbon polymers results from inhalation of dusts of undecomposed fluorocarbon polymers, from inhalation of the decomposition products, or from inhalation of a single or several decomposition products.[6] The major concern in occupational exposure to the decomposition products of fluorocarbon polymers is their potential for causing polymer fume fever (described below) and damage to the respiratory tract.[6]

The products liberated from fluorocarbon polymers by the application of heat vary with the polymer, the temperature to which it is exposed, and the ambient humidity.[6] Because there is insufficient information on which to establish a safe workplace environmental concentration, none is recommended by NIOSH.[6] Occupational exposure to the decomposition products of fluorocarbon polymers should be kept as near to zero as possible.[6] Since the decomposition of fluorocarbon polymers can lead to occupational exposure to inorganic fluorides, including hydrogen fluoride, NIOSH recommends workplace air monitoring for inorganic fluorides and hydrogen fluoride.[6] Merely adhering to evaluation criteria for inorganic fluorides and hydrogen fluoride, however, may not protect the worker from he adverse effects caused by other decomposition products.

The NIOSH REL and OSHA PEL for hydrogen fluoride (as fluorine) is 3 ppm, as an 8-hour TWA, with a STEL of 6 ppm.[3,4] The ACGIH TLV for hydrogen fluoride is a ceiling value of 3 ppm.[5]** The NIOSH REL, OSHA PEL, and ACGIH TLV for inorganic fluorides (as fluorine) is 2.5 milligrams per cubic meter, as an 8-hour TWA.[3-5]

B. Polymer Fume Fever

Classical polymer fume fever has been described as shaking chills, myalgias (muscle pain), shortness of breath, chest tightness, and malaise (a feeling of ill-health), with or without a measured increase in body temperature, which occurs near the end, or soon after the end, of a workshift; symptoms completely resolve within 24 hours.[7,8] A "partial" or "incomplete" polymer fume fever complex has also been described.[8] This complex is characterized by a combination of myalgias, headaches, chest tightness, throat irritation, and/or cough, but no shaking chill or measured increase in body temperature, and with symptoms subsiding within 10-30 minutes after exposure ceases.[8]

VI. RESULTS

A. Environmental

1. Ventilation Evaluation

** Although the TWA concentration provides the most satisfactory, practical way of monitoring exposures to airborne agents for compliance with exposure criteria, substances which are predominantly fast acting, and whose exposure criteria is based upon this response are best controlled by a ceiling limit that should not be exceeded. In contrast, TWAs permit excursions above the evaluation criteria provided they are compensated by equivalent excursions below the TWA criteria during the workday.

Replacement air*** was supplied to the Plastics Department through three large vertical ducts. Air was introduced through large grilles from floor level up to a height of about eight feet above the floor. The air was exhausted through a ceiling vent at the opposite end of the area. This arrangement resulted in excessively high room air velocities, some as high as 800 feet per minute (fpm). While the replacement airflow was not measured, it is assumed to be excessive based upon the high room air velocities. In addition, there were several large wall and floor mounted propeller fans. The combination of the replacement air system and the fans created high velocity crossdrafts in most of the area. These crossdrafts decreased the effectiveness of the local exhaust ventilation.

All five of the extrusion presses were equipped with local exhaust ventilation. The work area of one press was partially enclosed with a rear exhaust take-off. On the basis of a smoke-tube test, it appeared to work fairly well. Of the remaining presses, only two had canopy hoods, and the rest incorporated only partial enclosures. None worked well, as indicated by smoke tube tests. Capture velocities at the face of the enclosures were in the range of 50-60 fpm.

The ovens had canopy hoods over the doors at both ends. The electrically heated oven was in the path of the high velocity air from the replacement supply. A hanging curtain of plastic strips was used to shield the oven from this air flow, but was not effective: Only about half of the smoke released at a valve exiting the oven was captured. The remaining smoke appeared to be blown out by the replacement air. The other oven was gas-fired and was located outside of the replacement air path. It had two blowers, one supplying combustion air and one exhausting the products of combustion. When the oven doors were closed, the canopy hood appeared to be effective. However, when the door was open, airflow from the oven blew most of the smoke released from a smoke tube out of the hood.

The cooling stations utilized Vortex "transvectors" to supply cooling air across the hot valve body. The transvector used compressed air to induce a flow of room air onto the hot valve body. Any emissions emitted from the valve body during cooling would be blown into the room.

The exhaust system for the extrusion presses was poorly constructed, with sharp elbows, abrupt duct expansions, and poorly located duct entries. All of these deficiencies would adversely affect system performance.

2. Air Sampling

Table 1 summarizes the results of air sampling conducted for hydrogen fluoride (HF). The results for particulate fluorides were inconclusive: the

---

*** Replacement air is a ventilation term used to indicate the volume of controlled outdoor air supplied to a building to replace air being exhausted.

amount of analyte recovered from some field blanks exceeded the amount recovered from air samples. Five of nine PBZ samples had detectable HF, with 8-hour TWA concentrations ranging from from 0.005 ppm to 0.010 ppm. Eight-hour TWA concentrations of HF in five area samples ranged from 0.004 ppm to 0.008 ppm. In both instances, 8-hour TWAs were calculated assuming that no exposure occurred during the unsampled period. While these results are less than applicable evaluation criteria for HF, they indicate that some exposure to the decomposition products of fluorocarbon polymers is occurring. The area sample results indicate either that the ovens, extruders, and cooling presses all contribute to exposure, or that the high velocity replacement air ensures distribution of contaminants throughout the work area.

B. Medical

Ten of the 11 employees interviewed reported symptoms which have been associated with polymer fume fever. Five of these ten symptomatic employees had classical polymer fume fever episodes occurring during the past two years, four of whom had episodes during the past year. The frequency of classical polymer fume fever occurrence varied from a single episode to an employee's report that he, "can't count the number of times."

One employee described partial polymer fume fever, as defined above, with resolution of symptoms after exposure to fresh air. Five employees reported one to three polymer fume fever symptoms, three of whom reported occurrence of symptoms twice weekly, and one who reported symptom occurrence daily.

Four of the employees were non-smokers; a fifth employee occasionally smoked, but never at work. Two of these workers are affected by polymer fume fever symptoms twice weekly. Six workers smoked at work, within the plastics department; only two reported that they consistently washed their hands prior to smoking.

Information on food consumption was collected in ten interviews. All employees reported hand washing prior to eating. Four employees reported routinely eating within the department.

VII. CONCLUSIONS

Classical polymer fume fever occurred in five of ten employees interviewed; partial polymer fume fever and/or isolated polymer fume fever symptoms occurred in another five employees. Smokers and non-smokers seemed to be similarly affected, although the sample size was small. Smoking has previously been found to be correlated to the occurrence of polymer fume fever, presumably because polymer fume is generated by the burning polymer-contaminated cigarette.

Based upon observations and tests, the ventilation was ineffective in controlling emissions from the valve-lining process. In order to effect a reasonable degree of control, modifications must be made to the existing ventilation system. These modifications are described in the next section of this report.

Abatement of workplace exposure to fluoropolymer decomposition products, through improved ventilation and containment, should decrease the incidence of polymer fume fever. Smoking cessation in the plastics department should also decrease the overall frequency of polymer fume fever, but smoking cessation alone will not eliminate polymer fume fever.

VIII. RECOMMENDATIONS

1. In order to effect a reasonable degree of control, the crossdrafts, created by the propeller fans and the replacement air supply system, must be eliminated. Supplying the air at one end of the area and discharging it at the other is an acceptable practice. The air can be introduced at the 4 to 8 foot level, but it must be evenly distributed.

2. The canopy hood at the exit of the electrically heated furnace should be modified so that there is no gap between it and the furnace. Elimination of the excessive crossdraft caused by the replacement air should permit it to work effectively.

3. The combustion and exhaust air for the gas-fired furnace should be balanced to preclude air flow out of the furnace when the door is open. If this is accomplished, the canopy hoods should provide adequate control. Canopy hoods are not normally recommended for cold processes, but they can be suitable over hot processes such as exist here.

4. The extrusion presses should be enclosed to the maximum extent possible. This can be easily accomplished. Press 1525 is an example. Airflow should be set to achieve a velocity of 100 fpm through all enclosure openings.

5. Controlling emissions at the cooling stations present more of a challenge. Assuming that the measured emissions originate from the body/mold assembly, rather than brought over from other processes by the replacement air, enclosure should be considered. The enclosure could form a tunnel exhausted at one end. The transvectors should be retained within the tunnel. An alternative, but less desirable approach, would be some type of baffling to keep the cooling air from blowing into the room and using replacement air to dilute the emissions.

6. Control of emissions during manual transfer of the valve body/mold assemblies from the heating ovens to the extrusion presses and then to the cooling stations is a problem not readily solved by ventilation. An in-depth evaluation of work practices, such as how to hold the assembly, may be needed.

7. Elimination of crossdrafts and excessive room air velocities is mandatory if effective emission control is to be achieved. Enclosure of the extrusion presses, establishing 100 fpm enclosure air velocity, elimination of the canopy hood gaps, and balancing the gas-fired oven airflows are controls that can be readily implemented. When these changes are in place, further exposure sampling should be conducted to determine the contribution of cooling press emissions to overall exposure, and the need for their control.
8. Currently, employees eat in the production area. To reduce ingestion of contaminants, they should not be allowed to eat and drink in the work area.

Instead, eating and drinking should be done in an uncontaminated area removed from the production area. To reduce ingestion of contaminants, employees should wash their hands and faces prior to eating or drinking.

9. Smoking should be prohibited in the work area and smoking cessation encouraged. Tobacco products should be banned from work areas to avoid contamination by fluorocarbon polymers. Handwashing prior to smoking should be observed. The average temperature of the burning zone of a cigarette is 884°C, more than adequate to generate the polymer pyrolysis products which cause PFF.[9] Smoking contaminated cigarettes in the work area, or outside of the work area, can cause PFF.[10,11] Family members or friends are also at risk of developing PFF if they smoke contaminated cigarettes.[9]

   NIOSH recommends that workers should not be involuntarily exposed to tobacco smoke.[12] Exposure to environmental tobacco smoke (ETS) may be responsible for irritant symptoms and can exacerbate allergic symptoms. Further, NIOSH has determined that ETS poses an increased risk of lung cancer and possibly heart disease to occupationally exposed workers.[12] The best method for controlling worker exposure to ETS is to eliminate tobacco use from the workplace and to implement a smoking cessation program. Until tobacco use can be completely eliminated, the employer should make efforts to protect nonsmokers from ETS by isolating areas where smoking is permitted. Restricting smoking to smoking areas outside the building or in separate smoking areas with dedicated ventilation are two ways to accomplish this. Air from smoking areas should be exhausted directly outside and not recirculated within the building or mixed with the general dilution ventilation for the building. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recommends 60 cubic feet per minute (cfm) per person of outside or transfer air be supplied to the smoking area. A negative pressure should be provided to prevent airflow back into the non-smoking workplace.[12]

10. During the course of this investigation, the safety coordinator at the facility inquired about the proper respiratory protection for the decomposition products of fluorocarbon polymers. The NIOSH Criteria Document recommends the use of the respirators listed in Table 2 when necessary during emergencies or the performance of nonroutine maintenance or repair activities in which exposure to the decomposition products of fluorocarbon polymers is likely.[6]

IX. REFERENCES

1. NIOSH [1979]. Hazard evaluation and technical assistance report: Xomox Corporation, Cincinnati, Ohio. Cincinnati, Ohio: U.S. Department of Health, Education, and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health. NIOSH Report No. HETA 79-000-032, NTIS No. PB-80-149-602.

2. NIOSH [1989]. Eller PM, ed. NIOSH manual of analytical methods. 3rd rev. ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health

Service, Centers for Disease Control, National Institute for Occupational Safety and Health. DHHS (NIOSH) publication No. 84-100.

3. CDC [1988]. NIOSH recommendations for occupational safety and health standards 1988. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health. MMWR 37 (supp. S-7).

4. Code of Federal Regulations [1989]. 29 CFR 1910.1000. Washington, DC: U.S. Government Printing Office, Federal Register.

5. ACGIH [1992]. Threshold limit values and biological exposure indices for 1992-1993. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

6. NIOSH [1977]. Criteria for a recommended standard: occupational exposure to decomposition products of fluorocarbon polymers. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health. DHEW (NIOSH) Publication No. 77-193.

7. Kuntz WD, McCord CP [1974]. Polymer-fume fever. J Occup Med 16:480-482.

8. NIOSH [1981]. Hazard evaluation and technical assistance report: Chemica Fabrics Corp., North Bennington, VT. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HETA 81-129-1455, NTIS No. PB-85-185-189.

9. Rose CS [1992]. Inhalational fevers. Chapter 27. In: Rom WN, ed. Environmental and occupational medicine. 2nd ed. Boston, MA: Little, Brown and Company, p. 377.

10. Lewis CE, Kerby GR [1965]. An epidemic of polymer-fume fever. JAMA 191:375-378.

11. Albrecht WN, Bryant CJ [1987]. Polymer fume fever associated with smoking and the use of a mold-release spray containing polytetrafluoroethylene. J Occup Med 29:817-819.

12. NIOSH [1991]. Environmental tobacco smoke in the workplace: Lung cancer and other health effects. Cincinnati OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 91-108.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

Alan Echt, MPH, CIH
Industrial Hygienist
Industrial Hygiene Section

Faye T. Bresler, MD, MPH
Medical Officer
Medical Section
Hazard Evaluations and
Technical Assistance Branch
Division of Surveillance, Hazard
Evaluations and Field Studies

Robert T. Hughes
Chief, Control Section 3
Charles S. Hayden II
Mechanical Engineer
Control Section 3
Engineering Control Technology Branch
Division of Physical Sciences and
Engineering

Field Assistance:

Don Booher
Engineering Aid
Industrial Hygiene Section
Industrywide Studies Branch
Division of Surveillance, Hazard
Evaluations and Field Studies

Report Typed by:

Kate Marlow
Office Automation Clerk
Industrial Hygiene Section

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report may be freely reproduced and are not copyrighted. Single copies of this report will be available for a period of 90 days from the date of this report from the NIOSH Publications Office,
4676 Columbia Parkway, Cincinnati, Ohio 45226. To expedite your request, include a self-addressed mailing label along with your written request. After this time, copies may be purchased from the National Technical Information Service, 5285 Port Royal Rd., Springfield, Virginia 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Xomox Corp.
2. OSHA, Region V.

For the purpose of informing affected employees, 42 CFR 85.11 requires the employer to post copies of this report in a prominent place accessible to the employees for a period of 30 calendar days.

Table I
Air Sampling Results - Hydrogen Fluoride
Xomox Corporation, Blue Ash, Ohio
HETA 91-326
November 14, 1991

Sample Description	Sample Volume (liters)	Sampling Period (minutes)	Actual Time-Weighted Average Concentration (parts per million)	8-hour Time-Weighted Average Concentration (parts per million)
Production Assistant- Molder	790	395	0.008	0.007
Machine Operator	840	420	(0.006)	(0.005)
Production Assistant-Molder	818	409	0.012	0.010
Production Assistant-Molder	798	399	(0.006)	(0.005)
Production Assistant-Molder	796	398	(0.006)	(0.005)
Machine Operator	788	394	ND	ND
General Processing/ Machine Operator	352	176	ND	ND
Production Assistant-Molder	770	385	ND	ND
Machinist-Lathe	772	386	ND	ND
Area, Outside Hood, Large Oven	738	369	0.009	0.007
Area, Outside Hood, Oven 868	806	403	0.009	0.008
Area, Cooling Press 1521	822	411	0.006	0.005
Area, Extruder 1527	282	141	0.028	0.008
Area, Cooling Press 1523	802	401	(0.005)	(0.004)

Values in parenthesis indicate results between the minimum detectable concentration (MDC) and the minimum quantifiable concentration (MQC) and should be treated as trace quantities with limited confidence in their accuracy. The MDC for this sample set was 0.003 parts per million (ppm), based upon an analytical limit of detection of 2.0 micrograms (μg) per sample, based upon a sample volume of 840 liters (L). The MQC for this set of samples was 0.007 ppm, based upon a limit of quantitation of 4.7 μg per sample and a sample volume of 840 L. ND indicates results less than the MDC.

Table 2
Respirator Selection Guide for Decomposition Products of Fluorocarbon Polymers
Xomox Corporation, Blue Ash, Ohio
HETA 91-326

Condition	Respirator Type Approved Under Provisions of 30 CFR 11
Maintenance (Miscellaneous; 4-hour limit)	(1) Half-mask respirator equipped with combination acid-gas/organic-vapor sorbent and high-efficiency filter cartridge (2) Full-facepiece gas mask equipped with acid-gas/organic-vapor sorbent and high-efficiency filter canister, changed every 4 hours
Maintenance (Equipment breakdown or cleaning of distillation vessels, etc; no time limit)	Type C supplied-air respirator operated in demand, pressure-demand, or continuous-flow mode and equipped with full-facepiece, hood, helmet, or suit.
Firefighting	Self-contained breathing apparatus with full-facepiece operated in pressure-demand or other positive pressure mode