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HAZARD EVALUATION AND TECHNICAL ASSISTANCE REPORT NO. TA 79-32

XOMOX CORPORATION
CINCINNATI, OHIO

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Study Requested By:
Safety Coordinator
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Report Prepared By:
Dawn Gilles Tharr
Industrial Hygienist
Industrial Hygiene Section, IHS, HETAB

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D. Tharr

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ABSTRACT: Employee interviews were conducted, work practices were observed, and ventilation systems were inspected at the Plastic Department of the Xomox Corporation in Cincinnati, Ohio on May 30 and July 24, 1979. The evaluations were requested by the company's Safety Coordinator to determine if employee reports of polymer fume fever were due to exposure to decomposition products of Teflon fluorocarbon polymer (9002840). Because of the variety of products generated by fluorocarbon polymer decomposition, no sampling or analysis techniques were considered adequate, and no evaluation criteria for exposure levels exist. Results from employee interviews show that six of 15 workers experienced symptoms which they attributed to the work environment and three others reported some symptoms, including fever, chills, respiratory difficulties, and headaches. It is concluded that only the stripping operations area can be identified as a definite exposure area. It is recommended that a no smoking rule be enforced in all areas where polymers are handled and processed. Recommendations also are made for routine medical examinations, engineering controls to improve ventilation, use of respirators, and workplace hygiene.

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I. SUMMARY

The Hazard Evaluation and Technical Assistance Branch of the National Institute for Occupational Safety and Health (NIOSH) conducted an evaluation of the Plastic Department at Xomox Corporation where employees were allegedly experiencing polymer fume fever. Polymer fume fever is the result of exposure to the decomposition products of fluorocarbon polymer. Because of the multiplicity of the decomposition products of fluorocarbon polymers, no sampling and analytical method is recommended nor has an environmental limit been established for these pyrolysis products. NIOSH recommends that occupational exposure to the decomposition products be maintained as near to zero as possible through the use of engineering and administrative controls and by strict adherence to work practices that will minimize contact with the pyrolysis products or with potentially pyrolyzable dust. Employee interviews were conducted, work practices observed and ventilation systems checked as a means of evaluating workers' job related health problems and potential exposure to fluorocarbon polymer decomposition products.

Interviews with employees revealed a history of symptoms consistent with polymer fume fever. Symptoms reportedly occur on an irregular basis, seldom affecting more than one individual at a time and do not appear to be linked to any variation in the process. Observations and measurements of air flow indicate areas where ventilation would be appropriate or where the present ventilation systems show deficiencies. Some work practices also indicate room for improvement.

Recommendations concerning work practices and modifications of the existing ventilation systems are presented in this report.

II. INTRODUCTION AND PURPOSE

At the request of the Safety Coordinator, Xomox Corporation, the National Institute for Occupational Safety and Health (NIOSH) conducted an evaluation of the Plastic Department at Xomox. The purpose of the survey was to determine if employees were experiencing polymer fume fever as a result of exposure during the manufacturing of Teflon® lined valves.

III. ENVIRONMENTAL EVALUATION

A. Process and Facility Description

The Plastic Department at Xomox manufactures Teflon® lined valves. The department has been operating for approximately 6 years with no major changes and presently employs about 15 workers. Two types of polymers are used. The majority of the linings are made from fluorinated ethylenepropylene (FEP). Used on an irregular basis, as orders demand,

is perfluoroalkoxy (PFA). (In a separate air conditioned room, polytetrafluoroethylene (PTFE) sleeves are made. This area is separated from the remainder of the Plastic Department and it is believed to have no effect on the problems experienced in the main department areas.)

Standard molding procedures are followed in the processes conducted in the main Plastic Department area. Specific process details will not be described for proprietary reasons. In addition to the molding operations, an oven is located in the same area. The oven is used to preheat molds. The oven is closed except when loading or removing parts and is exhausted to the outside.

Another section of the Plastic Department is the Oven Room. This area houses six ovens. Polymer parts are cured in this area. In addition, defective parts are reclaimed by stripping the polymer material off. Parts are placed in the reclaim oven and heated to make the polymer flexible. After the parts have been in the oven for about an hour, they are removed and the polymer is immediately cut and stripped manually from the metal. The stripping operation is conducted on a work bench outside the Oven Room in the main Plastic Department area. No local ventilation is provided for this procedure. The ovens are vented to the outside and the larger ovens have exhaust hoods located over the oven doors.

In addition to the Plastic Department workers, several maintenance men are also periodically in the department to repair the machines and ovens.

Respirators approved for Teflon are available to all workers. The use of a respirator is left to the discretion of the individual employee, except in the case of an emergency.

B. Evaluation Methods

An initial walk-through survey was conducted in the Plastic Department at Xomox on May 17, 1979. Information was collected on the materials used in the area and process details were obtained. A return visit was made to the company on May 30, 1979, to interview employees concerning work-related health problems. Ventilation and noise level measurements were also made. A third visit was made on July 24, 1979, to observe in detail the work practices used in the department and again check the local exhaust systems. An interim report on the findings of the evaluation was forwarded to the company on June 20, 1979.

C. Toxicology and Environmental Standards

Fluorocarbon polymers are extremely inert as to physiologic action, but their decomposition products can be quite the opposite. The major concern in occupational exposure is the potential for causing polymer fume fever and damage to the respiratory tract. The greatest danger to workers is from inhalation. Adverse effects can result from exposure to dusts of undecomposed polymers, from exposure to the decomposition products or from exposure to a single or several decomposition products. Polymer fume fever is characterized by headache, aching joints, general malaise, cough, shivering, chills, fever and possible chest discomfort. Polymer fume fever does not occur directly upon exposure but requires several hours to appear. Symptoms usually pass within 12-48 hours.

The decomposition products of fluorocarbon polymers depends not only on the chemical composition of the intact polymers but also on the conditions under which they are decomposed. The temperature to which the polymer is subjected, the atmosphere in which decomposition occurs and the material of the vessel used can alter the kinds and quantities of the decomposition products formed. Because of the multiplicity of the decomposition products, no sampling and analytical method is recommended nor has an environmental limit been established for these decomposition products. Because there is insufficient information on which to establish a safe workplace environmental concentration, it is recommended that employers and employees take all possible steps to keep exposures as near to zero as possible. NIOSH recommends that occupational exposure to the decomposition products be maintained as low as possible through the use of engineering and administrative controls and by strict adherence to work practices that minimize contact with the pyrolysis products or with potentially pyrolyzable dust.

IV. RESULTS

Interviews with employees provided information on what the workers felt were job related health problems. A total of 29 present and past employees of the Plastic Department and maintenance men who work periodically in the Plastic Department were interviewed. Of the 29 individuals interviewed 15 were presently employed in the Plastic Department. Six of the presently employed workers reported having symptoms they felt were work related, 5 workers reported experiencing some symptoms, 3 workers had had problems in the past but not recently and one worker who had been in the department for 6 weeks reported no work related health problems. The symptoms reported included fever, chills, fatigue, breathing difficulties, tightness in the chest, headache and aching joints. Symptoms reportedly occured after leaving work and passed during the night or the following day. Symptoms reportedly occur on an irregular basis, seldom affecting more than one worker at a time and did not appear to be linked to any known variation in the process. Thirteen of the workers felt they only experienced symptoms or had more severe symptoms when working with PFA, however symptoms were not experienced everytime PFA runs were made. It was also noted that nine of the fifteen workers were smokers and fairly evenly distributed in the groups described above.

Of the 29 workers interviewed, seven were maintenance men who periodically work in the Plastic Department. Four of the maintenance men reported experiencing symptoms, two reported slight problems and one man reported experiencing no problems. The symptoms reported by most of the maintenance men included shortness of breath, lightheadedness and sometimes nausea. The symptoms usually occurred while in the area and dissipated when leaving the area and breathing "fresh air." The six workers with symptoms related their problems mainly to the ovens. Five of the seven maintenance workers are smokers.

Seven former Plastic Department workers were also among the 29 employees interviewed. Three of these workers reported experiencing numerous influenza - like symptoms while working in the department, one worker reported experiencing mild symptoms and three reported no problems.

The noise level measurements (made at the request of the Safety Coordinator for Xomox) are presented in Table 1. NIOSH recommends an 8-hour time weighted average (TWA) exposure level of 85 dBA for new installations. The current OSHA standard is 90 dBA on an 8-hour TWA.

V. DISCUSSION AND RECOMMENDATIONS

The results of the employee interviews indicate that two separate problems may exist in the Plastic Department. Presently employed workers in the department describe symptoms consistent with polymer fume fever. Maintenance workers describe different symptoms which occur while in the area and dissipate when leaving. The two situations are discussed below.

The main Plastic Department area appears to have adequate general ventilation. This appears to be supported by the fact that individuals, rather than groups of workers, experience the symptoms of polymer fume fever at which reportedly is widely spaced intervals (weeks or even months apart). The pattern of occurence of symptoms suggests exposure may be the result of slight variations in operating procedures, possible malfunctions in equipment resulting in elevated operating temperatures and/or unusual close proximity of the worker to the equipment resulting in increased exposure. One specific area of concern is the stripping operation. Because of the nature of the process of stripping and the number of workers reporting problems associated with this process, it should definitely be considered a source of exposure. Several other areas or operations which result in potential exposure to decomposition products have been identified as well as the lack of following some elementary work practices associated with the handling of polymers. Identification of potential problem areas and recommended controls follow.

1. The main hazard of fluorocarbon polymers is from the products of pyrolysis to which workers may be exposed when the polymers are heated in processing or when tobacco contaminated with polymer dust is smoked. For this reason, it is essential that a no-smoking rule be enforced in all areas where polymers are handled and processed. Smoking materials should not be carried into these areas at any time.

2. The Criteria Document on "Decomposition Products of Fluorocarbon Polymers" recommends that medical surveillance be made available to workers occupationally exposed to decomposition products of polymer. It recommends preplacement examinations including medical and occupational histories and a physical examination with particular attention being made to the respiratory system. Periodic examinations may be given at the discretion of a responsible physician. Such examinations should give special attention to the respiratory tract.

3. All equipment should be thoroughly cleaned to remove one polymer before starting to work with another polymer. Residue of one polymer could decompose at the higher operating temperature required for another polymer.

4. When filling the hoppers of the extruders, care should be taken to minimize the production of dust. If work practices can not be altered to bring about this reduction, the workers should wear a respirator or local exhaust should be installed.

5. The polymer in the molds is carried in close proximity to the operators breathing zone. A modification in work procedure should be made to eliminate this practice.

6. During nonroutine maintenance or when malfunction are occuring with equipment that involves the presence of polymer at elevated temperatures, workers should wear respirators.

7. Local ventilation should be provided for the stripping operation. Such a system could consist of a slotted hood located on the wall behind the stripping bench. This system would draw the polymer fumes away from the worker.

To reduce the risk of an individual experiencing polymer fume fever, the exposure to decomposition products must be reduced. The most obvious method is through local exhaust ventilation. The following recommendations should be considered carefully to determine if the reduction in potential exposure would justify the financial investment.

8. The induction heater may contain residual polymer from previous runs which can potentially decompose during the heating cycles. Local exhaust could be provided to capture any fumes that are released.

9. Fumes accumulated during production of parts can be released when the presses are opened. This would be particularly true if for some reason a system overheated. To control this, each press would have to be equipped with an elephant trunk exhaust hood or similar positive exhaust system. A more economic system may be the use of a portable exhaust unit which could be used in situations where a known problem exists and maintenance or extra work procedures are required.

Many of the problems reported in the Plastic Department are associated with the Oven Room. The maintenance men work on top of the ovens while they are in use to change elements or do other repair work. During this time they are exposed to the heat and fumes that are associated with the operation of the ovens. Most of the men reported at some time experiencing shortness of breath, lightheadedness and nausea while in the Oven Room which later dissipated when leaving the area. These symptoms are not suggestive of polymer fume fever but do indicate the possibility of

a health as well as a safety problem. Several steps can be taken to improve the situation. Ventilation measurements made at the ovens indicated a totally ineffective system. No air flow was measured at any of the ovens. Ventilation measurements taken on two separate days at the reclaim oven indicated no air flow. The ventilation provided is either totally inadequate or not operating. In addition, during our visit, parts lined with PFA were being reclaimed. The oven was set at 580^{0} F, yet the PFA on several parts had "melted" together. This should not occur at 580^{0} F, indicating the temperature regulating system was malfunctioning or inaccurate. It is recommended that the following program be instituted in the Oven Room to improve the existing conditions.

10. Adequate general ventilation should be provided in the Oven Room.

11. Ovens should be fitted with an automatic temperature cutout to prevent overheating.

12. The temperature-regulating systems should be calibrated and checked at regular intervals.

13. Ventilation on the ovens should be upgraded. Ovens should be operated at negative pressures relative to the room with a 100 foot per minute design face velocity for exhaust.

14. Maintenance should be conducted, unless in case of an emergency, only when the ovens are cold.

15. When maintenance is performed on "hot" ovens, respirators should be worn.

16. A portable exhaust system should be made available in the oven room to provide additional ventilation for changing elements, welding operations, etc. where there is a potential for increased exposure.

17. Ovens should be cleaned frequently to prevent any accumulation of polymers which could degrade during normal heating of the ovens.

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VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Dawn Gilles Tharr
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office:

Jerome P. Flesch
Acting Chief
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Report Typed By:

Christa Scapicchio
Clerk-Typist
Industrial Hygiene Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

TABLE 1

Noise Level Measurements
Plastics Department
Xomox Corporation
Cincinnati, Ohio

May 30, 1979

Location	Sound Level*
Plastics Department Beside Machine 9	85-87 dBA
Center of Injection Area Between Presses	86-87 dBA
Center of Injection Area Between Presses	90-91 dBC
Entrance to Conveyor Oven (Transfer Machine Side)	89-92 dBA
Entrance to Conveyor Oven (Opposite Transfer Machines)	86-87 dBA
Exit of Conveyor Oven	89-91 dBA
Between Wabash Transfer Machines	94-97 dBA
Center of Oven Room	89-90 dBA
Center of Oven Room	91-92 dBC
Between Oven Room and TFE Room	81-83 dBA
Center of TFE Room - (Machines Off)	68-71 dBA
Center of TFE Room - (Machines On)	80-82 dBA
Blending Room - (Blinders Off)	86-87 dBA
Doorway Into Plastics Department	85-86 dBA

*Slow Response