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OCCUPATIONAL HEALTH EVALUATION FOR INORGANIC MERCURY AT CFB BOR--ETC(U)
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OCCUPATIONAL HEALTH EVALUATION FOR INORGANIC MERCURY AT CFB BORDEN - BUILDING A-171,

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TABLE OF CONTENTS

ABSTRACT

An occupational health evaluation of the Aircraft Instrument Laboratory, Rooms 117A and B of Building A171, CFB Borden was carried out to determine if a potential toxic hazard existed because of numerous small spills of inorganic mercury over a period of years.

Atmospheric inorganic mercury vapour levels were measured, and personal monitoring, by passive dosimetry was carried out; mercury levels were found to be below or at the recommended TLV of 0.05 mg/m^3.

Recommendations are given regarding safe operating procedures to be followed in the use of inorganic mercury.

INTRODUCTION

Background

As the result of numerous minor spills of elemental mercury in the Aircraft Instrument Laboratory of Building 171, CFB Borden, the DCIEM Health Sciences Section was tasked by the Directorate of Preventive Medicine to determine if personnel employed in this facility are exposed to hazardous levels of mercury contamination.

Prior to the actual atmospheric air monitoring, which was conducted on two separate days, approximately five man-days were spent in cleaning up 6-8 ounces of mercury from bench tops, cracks in floor tiles and return ventilation ducts in the two laboratories.

Routes of Entry and Symptoms

Mercury and inorganic compounds of mercury may be absorbed through the skin, gastrointestinal tract and the lungs. The principal source of occupational mercury poisoning is mercury vapour with exposure to mercury compounds occurring less frequently.

Acute exposure to high levels of mercury vapour affects the respiratory system and is manifested by pneumonitis, bronchitis, chest pains, dyspnea and coughing. Chronic exposure to low levels of mercury may go unnoticed by the individual or be attributed to other causes except for the tremor. This is particularly true with erethism which is characterized by irritability, outbursts of temper, excitability, headache, fatigue and indecision. A deterioration of legibility of handwriting may be an early sign of mercury absorption (1).

A Mercury Standard - Threshold Limit Value (TLV)

Because of the prevalence of non-specific signs and symptoms in the general population which can be associated with mercury intoxication, it is difficult, if not impossible, to establish a level at which no effects are observed. The problem is further complicated because of the limitations of the sampling and analytical methods on which the air levels are based.

However, many workers have shown that a significant occurrence of signs of mercury toxicity occurs at atmospheric levels below 0.1 mg/m^3. This has demonstrated the need for an environmental standard to protect the health of the employee; thus a Threshold Limit Value (TLV) of 0.05 milligrams per cubic meter (2) has been established.

METHODS

General

At the time of the survey, Rooms 117A and 117B were being used as an Aircraft Instrument Laboratory and Classroom facility respectively. Although mercury had not been used in Room 117B, monitoring was carried out in this room because of its close proximity to the main calibration laboratory. Spot sampling readings of Room 117A were taken as indicated in Figure 1 which also shows approximate laboratory dimensions and the location of mercury-containing calibration instruments.

Instrumentation

Atmospheric air concentrations of inorganic mercury vapour were determined using a Bacharach mercury vapour monitor. The principle of operation of this instrument is based on a sample of air being drawn through an absorption chamber which contains a photoresistive element on one end and a ultraviolet source on the other. Increasing or decreasing concentrations of mercury vapour are detected by fluctuations in transmission of ultraviolet radiation through the chamber and are displayed on a meter connected to a Wheatstone bridge circuit.

Calibration is done by introducing a sample of air containing a known concentration of mercury vapour through the sampling probe of the instrument. Known concentrations of mercury were prepared by dilution of the equilibrium vapour phase (head space over liquid mercury) concentration over the expected working range for atmospheric monitoring. This procedure was carried out prior to each series of readings at the selected sampling points.

Mercury Vapour Monitors

At the start of the workday - 0800 hours - mercury dosimeter badges (manufactured by the Anatole J. Sipin Co., Inc., New York) were attached to the workdress of four subjects working in the area of concern. Three of the selected subjects were students and the other was a member of the instructor staff. These monitors were located as close to the subjects breathing zone as possible. At 1600 hours, the monitors were removed, sealed and forwarded to the Sipin Company for analysis. The principle of operation of these badges as stated by the company is as follows: "In use, mercury vapour permeates through a membrane and is absorbed on a specially formulated substrate. At the end of the exposure period the badge is forwarded to a central laboratory for analysis by flameless atomic absorption spectrophotometry" (3).

RESULTS

Atmospheric Air Monitoring

Results obtained from the two days of spot monitoring in Room 117A are shown in Table 1. Further clean-up of areas in which elevated readings were obtained took place prior to the readings obtained on Day 2. Cleaning was carried out by means of a commercially-available mercury spill kit. On the second day only one area (Duct 3) continued to provide readings approximately at the TLV level following extensive clean-up procedures. No hazardous levels of mercury vapour were detected in Room 117B.

Mercury Vapour Monitors

Results of personal monitoring using the Sipin Dosimetry badges for a full 8-hour workday are as follows:

Monitor Code	Wearer	TLV-mg Hg/m^3
602	Instructor	.026
603	Student	.035
605	Student	.018
640	Student	.026
643	Student	.052

DISCUSSION AND RECOMMENDATIONS

From the results obtained, pertinent to measurements conducted on Day 2 in Room 117A by both the direct read-out instrument and the Sipin Mercury badges, it was evident that mercury vapour was present at levels below or very close to the TLV. From these results it is concluded that a toxicity hazard from inorganic mercury did not exist at the time of the survey.

Spot sampling in the vicinity of Duct 3 continued to give a mean value at the TLV level. Further clean-up is required in this area to reduce the level to below the recommended standard.

All values obtained for the Sipin Monitoring badges are below the recommended standard with the exception of Monitor Code 643. This value is borderline and is considered not to be significantly different from the TLV based upon the range of analytical reproducibility stated by the company.

Although levels obtained during this evaluation are not considered to be a toxic hazard, a potential hazard exists whenever mercury is used. A list of recommended practices for the safe handling of mercury is included as Annex A. This list has been reproduced with the permission of the Occupational Branch of the Canada Safety Council (4).

ACKNOWLEDGEMENTS

The authors wish to acknowledge the administrative assistance provided by Sgt. J. Dupel and his staff, Prevention Medicine Section, CFB Borden.

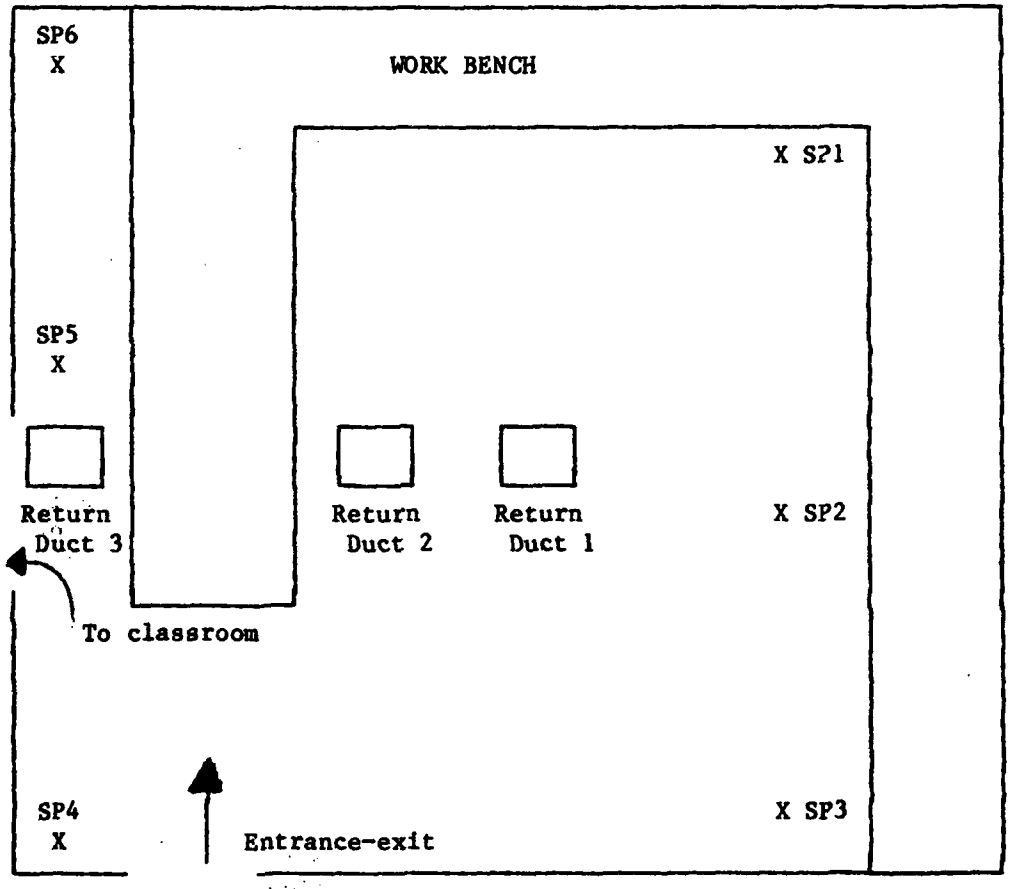
TABLE 1

Inorganic Mercury Concentrations (mg/m^3)
Instrument Calibration Laboratory Room 117A

Sampling Points	Day 1	Day 2
1	<0.005	<0.005
2	<0.005	<0.005
3	<0.005	<0.005
4	<0.005	<0.005
5	0.04 - 0.10	0.02
6	0.08 - 0.10	0.02
Return Ducts		
1	0.02	0.02
2	0.04	0.02
3	0.04 - 0.10	0.04 - 0.06

REFERENCES

1. Occupational Health Branch, Data Sheet No. 9, Ontario Ministry of Labour. April, 1977.
2. Criteria for a recommended standard...occupational exposure to inorganic mercury - US HEW - HSM 73-11024.
3. Technical Information Sheet - Sipin Environmetrics Mercury Dosimeter Badge - Anatole J. Sipin Co., Inc., New York, New York, U.S.A.
4. Canada Safety Council Data Sheet - Mercury, 1978 - Preventive Measures.



Room Dimensions - Approximately 920 M^2

Figure 1
Room 117A - Aircraft Instrument Laboratory

ANNEX A

Safety Precautions for the Safe Handling of Inorganic Mercury

(Reproduced with the permission of the Canada Safety Council)

a. Primary precautions should concentrate on maintaining concentrations of mercury below recommended exposure limits. These precautions may take the form of proper process controls, thorough ventilation measures, safe handling techniques, and good housekeeping. In situations where recommended exposure limits are exceeded, proper approved personal protective equipment should be used and the particular process involved should be monitored and modified until the concentrations are lowered below such limits.

b. Mercury has a high affinity for loosely woven fabrics and may adhere to shoe soles. Thus, it may be brought home and the workers family could be exposed. Consequently, it is imperative that all employees change into special clothes at work and shower and change into street clothes upon leaving. It is the responsibility of the employer to provide adequate personal hygiene facilities, including street clothes lockers, in all areas where mercury contamination is possible.

c. All areas where mercury is handled should be fully enclosed whenever possible, provided with suitable ventilation, and have admittance restricted to allow only authorized personnel entry. All work surfaces should be of an impervious material, free from cracks and joints, and be easy to clean. Benches where liquid mercury is handled should be designed such that they slope away from the employee, have raised edges and sides, and have a water-filled collecting trough at the back. Where spillage on the floor may be a problem, the floors should slope gently to a central sump where mercury can be collected under water until it is recovered and reclaimed. Periodically hosing down the work area with water will aid in preventing accumulation. All mercury collecting points (troughs, sumps) should be emptied regularly.

d. All spills, regardless of size, should be cleaned up immediately with a vacuum cleaner equipped with interchangeable charcoal filters to prevent the escape of mercury vapours. This means dry sweeping is an unacceptable cleaning method. Vacuum cleaners may also be equipped with a water trap to collect liquid mercury for reuse. Spill areas should subsequently be treated with calcium sulphide or sodium thiosulphate wash to neutralize mercury that may have been missed. This treatment is also useful on surfaces that are not easily vacuumed (e.g. a carpeted floor in a dentist's office). Air samples should be taken after cleaning in order to determine if the decontamination is complete.

ANNEX A (cont'd)

e. All containers of mercury and mercury compounds should be properly labelled and kept closed. Exposed surface areas should be kept at a minimum, and whenever possible covered with a layer of water or oil. All conditions that could cause mercury to be heated should be avoided.