HAZARD EVALUATION AND TECHNICAL ASSISTANCE REPORT
HETA 89-139-L2025
TAMCO
ETIWANDA, CALIFORNIA
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Hazard Evaluations and Technical Assistance Branch
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I. INTRODUCTION

In February 1989, NIOSH received a request for a health hazard evaluation at TAMCO, Etiwanda, California. The requestor was concerned about exposures to inorganic lead among Melt Shop workers at the steel mill. On May 17, 1989, NIOSH representatives met with company and employee representatives to discuss the request. Copies of the OSHA Lead Standard 1910.1025 were provided and discussed. An environmental and medical survey was conducted on May 18, 1989. At that time, it was recommended that dry sweeping of Melt Shop dust be replaced with high-efficiency vacuum cleaning. Individual blood lead results were reported to participating employees by mail on June 6, 1989, and summary results were reported to the company by telephone on June 6, 1989. Environmental results and recommendations for further air sampling were reported to the requestor and the company by telephone on July 18, 1989.

II. BACKGROUND

TAMCO operates a continuous casting minimill with an electric arc furnace that produces steel reinforcing bar and rod from scrap steel, mostly from scrapped automobiles. The mill started production in 1957 and employs about 110 workers over three shifts. Approximately 105 employees work in production and maintenance, and 6 work in the scrapyard.

III. MATERIALS AND METHODS

A. Environmental

On May 18, 1989, an environmental survey was conducted to determine employee exposure to airborne lead. During this survey personal breathing-zone (PBZ) air samples were collected on 20 of the 34 dayshift workers. Samples were collected using battery-powered sampling pumps operating at 2.0 liters of air per minute for approximately 7 hours. The pumps were attached by Tygon tubing to the collection media (37-millimeter, 0.8-micron pore size, mixed-cellulose ester membrane filters contained in 3-piece plastic cassettes).

The samples were analysed for lead and other metals by simultaneous scanning inductively coupled plasma emission spectroscopy according to NIOSH method 7300.[1]

B. Medical

All non-management employees working the dayshift on 5/18/89 were invited to participate in the survey. The survey consisted of: 1) a self-administered questionnaire, 2) a medical and occupational history, 3) a limited physical examination, and 4) a blood sample analyzed for lead and free erythrocyte protoporphyrin (FEP).

The questionnaire was designed to gather demographic information and symptoms associated with lead poisoning. The medical and occupational history, and limited physical examination was performed by a NIOSH physician trained in internal and occupational medicine. The limited physical examination consisted of an inspection of the employee's gums for signs of lead exposure (Burtonian lead line).[2]

The blood leads and FEPs were analyzed in a laboratory approved by the Occupational Safety and Health Administration (OSHA), based on proficiency testing for blood lead analysis.[3] The blood leads were determined by anodic stripping voltametry, and FEPs were determined by photofluorometric techniques.[4]

IV. EVALUATION 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 important, however, 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 often are 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 becomes 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 (TLVs), and 3) the U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) occupational health standards [Permissible Exposure Limits (PELs)]. A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday.

A brief discussion of the toxicity and evaluation criteria for inorganic lead follows. A summary of the lowest blood levels causing observable effects in adults is listed in Table 1.

A. Toxicological

Inhalation (breathing) of lead dust and fume is the major route of lead exposure in the industrial setting. A secondary source of exposure may be from ingestion (swallowing) of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. Absorbed lead can damage the kidneys, peripheral and central nervous systems, and blood forming organs (bone marrow). These effects may be manifested as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, cognitive impairment, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women. There is some evidence that lead can also impair fertility in occupationally exposed men.[5]

The blood lead test is one measure of the amount of lead in the body and is the best available measure of recent lead absorption. Adults not exposed to lead at work usually have a blood lead concentration less that 30 ug/dl; the average is less than 15 ug/dl.[6,7] In 1985, the Centers for Disease Control (CDC) recommended 25 ug/dl as the highest acceptable blood level for young children.[8] Since the blood lead concentration of a fetus is similar to that of its mother, and since the fetus's brain is presumed to be at least as sensitive to the effect of lead as a child's, the CDC advised that a pregnant woman's blood lead level be below 25 ug/dl.[8] Recent evidence suggests that the fetus may be adversely affected at blood lead concentrations well below 25 ug/dl.[9] There is evidence to suggest that levels as low as 10.4 ug/dl affect the performance of children on educational attainment tests, and that there is a dose-response relationship with no evidence of threshold or safe level.[10] Aside from fetal effects, lead levels between 40-60 ug/dl in lead-exposed workers indicate excessive absorption of lead and may result in some adverse health effects. Levels of 60-100 ug/dl represent unacceptable elevations which may cause serious adverse health effects. Levels over 100 ug/dl are dangerous and require medical treatment.

Free erythrocyte protoporphyrin (FEP) levels measure the effect of lead on heme synthetase, the last enzyme involved in the process of heme synthesis. FEP levels increase abruptly when blood lead levels reach about 40 ug/dl, and they tend to stay elevated for several months. The FEP can also be elevated as a result of iron deficiency. A normal FEP level is less than 50 ug/dl.[11]

B. Occupational Exposure Criteria

The current OSHA PEL for airborne lead is 50 ug/m^3 calculated as an 8-hour TWA for daily exposure.[12] In addition, the OSHA lead standard establishes an "action level" of 30 ug/m^3 TWA, which initiates several requirements of the standard, including periodic exposure monitoring, medical surveillance, and training and education. For example, if an employer's initial determination shows than any employee may be exposed to more than 30 ug/m^3, air monitoring must be performed every six months until the results show two consecutive levels of less than 30 ug/m^3 (measured at least seven days apart). The standard also dictates that a worker with blood lead levels greater than 60 ug/dl, or averaging more than 50 ug/dl, must be removed from further lead exposure until the blood lead concentration is at or below 40 ug/dl. Removed workers have protection for wages, benefits, and seniority for up to 18 months.[12] The evaluation criteria and principle health effects of the other metals detected during this survey are listed in Table II.

V. RESULTS AND DISCUSSION

A. Environmental

1. Lead

Twenty workers had full-shift air lead exposures ranging from less than 3 to 31 ug/m^3, with a mean of 12 ug/m^3 (Table III). All exposures were below the OSHA action level of 30 ug/m^3, except for one worker who was relining ladles with refractory material. His air lead exposure was 31 ug/m^3. The OSHA PEL for lead is 50 ug/m^3.

2. Other Metals

The concentrations of the other elements that were found in the air samples were below the OSHA PELs. Also, they were all below the applicable NIOSH recommended exposure limits except for metals that NIOSH considers to be potential occupational carcinogens. These included arsenic, cadmium, and nickel. NIOSH has not identified thresholds for carcinogens that will protect 100% of the population and, therefore, recommends that exposure be reduced to the lowest possible level. One worker who was welding water panels had a full-shift PBZ air concentration of 10 ug/m^3 of arsenic and 1.1 ug/m^3 of cadmium. Welding air samples were not collected inside the welding helmets; therefore, actual exposures may have been lower. The OSHA PEL for arsenic is 10 ug/m^3, with an action level of 5 ug/m^3.

A worker who was using a manual oxy-acetylene torch to cut scrap steel had a full-shift PBZ air cadmium concentration of 35 ug/m^3. The current OSHA PEL for cadmium oxide fume is 100 ug/m^3. However, OSHA is proposing that the PEL for cadmium be reduced to either 1 ug/m^3 or 5 ug/m^3 as an 8-hour TWA.[13]

Six Melt Shop workers had full-shift air nickel exposures ranging from 1.2 to 39 ug/m^3, with a mean of 8.3 ug/m^3. The OSHA PEL for nickel is 1000 ug/m^3. Also, 11 workers were exposed to chromium levels ranging from 1.3 to 5.0 ug/m^3. The OSHA PEL for chromium is 1000 ug/m^3. However, a portion of this total chromium may have included chromium VI, which NIOSH considers to be carcinogenic. A separate sampling and analytical procedure is required to detect chromium VI.

B. Medical

1. Blood Lead and FEP

Twenty-two of the 34 (65%) hourly employees consented to have their blood analyzed for blood lead and FEP. All 22 employees had blood lead levels less than 24 ug/dl (mean = 18 ug/dl). All 22 employees had FEP levels below 25 ug/dl (mean = 19 ug/dl).

2. Limited Physical Examinations and Questionnaires

Thirty-three of the 34 (97%) hourly employees participated in the questionnaire and limited physical examination. None of these 33 employees had evidence of lead poisoning on physical examination (Burtonian lead line on the gums). The questionnaire was designed to elicit symptoms consistent with lead poisoning. Given that no individual had a blood lead level reported to cause symptoms in adults, these symptom questionnaires were not analyzed.

VI. CONCLUSIONS

On the basis of the data collected during the survey, no health hazard was found to exist from employee exposure to lead in the steel mill operations at TAMCO. All airborne exposures to lead were below the OSHA PEL, and the medical survey revealed no evidence of lead poisoning. All blood lead levels were below those known to cause adverse health effects in non-pregnant adults, and all FEP levels were within the normal range. Further sampling is needed for some maintenance operations (e.g. relining refractory) where exposures may exceed the OSHA action level.

There was a potential cancer risk from exposure to components of welding fumes (arsenic and cadmium) and melt shop dust (nickel) detected during the survey. The following recommendations should be used to reduce exposures as low as possible.

VII. RECOMMENDATIONS

A. Melt Shop Dust

Periodic monitoring for airborne lead is needed whenever there is a possibility of any employee exposure at or above the OSHA action level of 30 ug/m^3. During our survey, one worker was found to be exposed to 31 ug/m^3 of lead while relining refractory. Therefore, the OSHA lead standard requires that this job be monitored for airborne lead every six months. OSHA requires monitoring at this frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level at which time the employer may discontinue monitoring for that employee. Also, whenever there has been a production, process, control or personnel change which may result in a new or additional exposure to lead, or whenever the employer has any other reason to suspect a change which may result in new or additional exposures to lead, additional monitoring shall be conducted.[12]

Housekeeping plays a major role in controlling exposure to Melt Shop dust, which contains lead, nickel, and chromium. A regular housekeeping program should be established to ensure that all work areas are periodically cleaned. Dust which has accumulated on surfaces can be reintroduced into the air, thereby increasing exposures. The dry sweeping methods that were being used during our survey should be replaced by vacuum cleaning. This equipment should be fitted with high efficiency particulate air (HEPA) filters to prevent small particles of lead, nickel, and chromium from escaping in to the workplace air.

Food, beverages, or tobacco should not be used or stored in lead-contaminated areas. These items can become contaminated with lead and cause subsequent absorption of lead through ingestion or inhalation during eating, drinking, or smoking. Employees should eat their lunch in a lunchroom separate from the assay lab. All protective clothing should be removed prior to entering the lunchroom, and hands and face should be thoroughly washed.

Wherever lead dust is present, there is a possibility that the employee's skin and clothing may become contaminated. This can lead to subsequent inhalation or ingestion of the lead, which can substantially increase the employee's overall absorption of lead. In addition, lead contamination on skin or clothing may be transported to other areas of the facility, and possibly to the worker's home where secondary exposure of family members can occur. In one recent study, blood lead levels were found to be markedly higher in household members residing in homes of workers with occupational lead exposure than in homes of people not occupationally exposed to lead.[14] In order to prevent this secondary source of lead exposure, the appropriate use of dedicated work clothing is required.

B. Welding and Thermal Cutting Fumes

During our survey, one worker may have been exposed to arsenic concentrations above the OSHA action level of 5 ug/m^3. However, this sample was collected outside the welding helmet. Studies have shown that welding fume concentrations average about 3.5 times lower inside the welding helmet.[15] Therefore, sampling should be conducted by positioning the sample inlet inside the helmet within 50 millimeters to the left or right of the welder's mouth and making sure the sample is returned to that position each time the helmet is donned for welding throughout the workshift.[15] The air exposure monitoring requirements of the OSHA Arsenic Standard 1910.1018 are the same as in the previously discussed OSHA Lead Standard. Depending on the types of steel being welded, exposure monitoring should include cadmium, chromium, chromium VI, manganese, nickel, vanadium, zinc, and iron.[15] The evaluation criteria and principle health effects of these metals are listed in Table II.

Portable local exhaust ventilation units with flanged hoods and flexible ducts are available for welding at remote sites. The hood face should be placed at a 0- to 45-degree angle to the work surface and positioned on the side opposite the welder. The use of a flexible duct system requires that the welder be properly instructed to keep the duct hood close to the emission source and to ensure that the duct is not twisted or bent.[15]

For scrap burners that move over a wide area, respirators may be the only practical means of controlling exposures. Positive-pressure airline respirators afford adequate protection but involve the inconvenience of carrying the hose line. Some scrap burning operations can be done by automated machines that are operated remotely, thereby reducing operator exposures to fume and noise. Shear machines can also be adapted to certain scrap operations to eliminate fume exposure.[16]

C. Respiratory Protection

Respirators were not being used at the time of our visit, and were not necessary for compliance with current OSHA Standards. If a decision is made to use respiratory protection in the future, a comprehensive program must be adopted to ensure the effective function of respirators. In accordance with OSHA 1910.134, this program must include a written standard operating procedure which addresses respirator selection, training, fitting, testing, inspection, cleaning, maintenance, storage, and medical examinations.

For exposure to metal dusts and fumes at concentrations up to 10 times the OSHA PEL, half-facepiece respirators fitted with HEPA filters can provide adequate protection. However, NIOSH recommends that only the most protective respirators by used for exposure to potential occupational carcinogens. These are supplied-air, positive-pressure respirators with a full facepiece.

VIII. REFERENCES

1. National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods. 3rd ed. Cincinnati, Ohio. DHHS (NIOSH) publication no. 84-100, 1984.

2. Zenz, Carl (ed.), Occupational Medicine: Principles and Practical Applications, 2nd edition, Year Book Medical Publishers, Chicago, 1988.

3. USDOL-OSHA, OSHA Analytical Lab, OSHA List of Laboratories Approved for Blood Lead Analysis. June 1989. Salt Lake City, Utah.

4. Blumberg WE, Eisinger J, Lamola AA, Suckerman DM. Principles and Application of Hematoflurometry. J. Clinical Lab Automation 1984;4(1): 29-42.

5. Landrigan I. Popecu HI, Gavanescu O, et.al. Reproductive ability of workmen occupationally exposed to lead. Arch Environ Health 1975;30:396-401.

6. Mahaffey K, Annest J, Roberts J, Murphy R: National Estimates of Blood Lead Levels. United States, 1976-1980. NEJM 1982;307:573-9.

7. Annest J, Dirkle J, Makuc C, Nesse J, Bayse D, Kovar M: Chronological Trends in Blood Lead Levels Between 1976 and 1980. NEJM 1983;308:1373-7.

8. Centers for Disease Control. Preventing Lead Poisoning in Young Children: Centers for Disease Control, 1985.

9. Needleman HL, Gatsonis CA. Low-level lead exposure and the IQ of children. A meta-analysis of modern studies. JAMA 1990;263:673-678.

10. Fulton M, Hepburn W, Hunter R, Laxen D, Raab D, Thomson G: Influence of Blood Lead on the Ability of and Attainment of Children in Edinburgh. Lancet 1221-25, 1987.

11. Cullen MR, and Rosenstock L: Clinical Occupational Medicine. W.B. Saunders Company; Philadelphia, PA 1986.

12. Occupational Safety and Health Administration. Occupational exposure to lead--final standard (29 CFR Section 1910.1025 - Lead). U.S. Department of Labor, Federal Register 1978 Nov 14:53007.

13. Occupational Safety and Health Reporter. The Bureau of National Affairs, Inc. Volume 19, No. 34, January 31, 1990.

14. Grandjean P, Bach E: Indirect Exposures: The Significance of Bystanders at Work and at Home. American Industrial Hygiene Journal, Volume 47, 1986.

15. National Institute for Occupational Safety and Health. Criteria for a Recommended Standard - Welding, Brazing, and Thermal Cutting. Cincinnati, Ohio. DHHS (NIOSH) publication no. 88-110-1084.

16. Cralley LV, and Cralley LJ. Industrial Hygiene Aspects of Plant Operations - Volume 1, Process Flows. Macmillan Publishing Co; New York, NY 1984.

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X. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from the NIOSH publications office at the Cincinnati, address. Copies of this report have been sent to:

A. TAMCO
B. Occupational Safety and Health Administration - Region IX
C. NIOSH Regional Offices/Divisions
D. California Department of Health

For the purposes of informing affected employees, copies of the report should be posted in a prominent place accessible to the employees, for a period of 30 calendar days.

TABLE I

Lowest Blood Lead Levels Reported To Cause Health Effects In Adults

Blood Lead Level	Health Effect
100-120 ug/dl	Central Nervous System Toxicity (Encephalopathy)
100 ug/dl	Chronic Renal Damage
80 ug/dl	Low Blood Count (Anemia)
60 ug/dl	Pregnancy Complications
50 ug/dl	Decrease Hemoglobin Production
	Mild Central Nervous System symptoms
40 ug/dl	Decrease Peripheral Nerve Conduction
	Pre-term Delivery
30 ug/dl	High Blood Pressure

TABLE II
Evaluation Criteria for Metals (ug/m^3)
TAMCO
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Contaminant	OSHA PEL	ACGIH TLV	NIOSH REL	Principle Health Effects
Arsenic	10	200	lowest possible level	weakness, nausea, nose and throat irritation, perforated nasal septum, skin lesions, neurological damage, lung and skin cancer
Cadmium	100	50	lowest possible level	upper respiratory irritation, lung and kidney damage, lung cancer
Nickel	1000 (insoluble compounds)	1000 (insoluble compounds)	lowest possible level	eye, nose, and throat irritation; allergic contact dermatitis; lung and nasal cancer
Chromium Chromium VI	1000 100 (ceiling)	500 50	- lowest possible level	allergic contact dermatitis, ulceration and perforation of the nose, lung cancer (chromium VI)
Vanadium	50	50	50 (ceiling)	eye, nose, and throat irritation; skin lesions; pulmonary edema; bronchitis
Manganese	1000 (fume) 5000 (dust)	1000 (fume) 5000 (dust)	-	heavy chronic exposure causes neurological disturbances similar to Parkinson's disease
Zinc oxide	5000 (fume) 10000 (dust)	5000 (fume) 10000 (dust)	5000 (fume)	metal fume fever
Iron oxide	10000	5000	-	chronic exposure may cause a non-impairing lung condition known as siderosis

TABLE III

Air Lead Exposures
TAMCO
Etiwanda, California
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May 18, 1989

Job/Location	Sample Time	Concentration (ug/m^3)
Reline refractory	7:35a - 2:30p	31
Stocker outside	7:40a - 2:30p	22
Stocker inside and outside	7:50a - 2:32p	21
First Helper (Control Room)	9:00a - 2:35p	9.1
Second Helper	7:53a - 2:35p	15
Ladleman	8:07a - 2:30p	10
Billet Control	8:10a - 2:42p	ND
Pulpit Operator	8:15a - 2:40p	3.9
Utility Man	8:12a - 2:40p	ND
Caster	8:05a - 2:30p	7.8
Casting Operator	8:07a - 2:38p	7.7
Maintenance (welding water panel)	8:26a - 2:15p	8.6
Maintenance (cutting and welding ring panels)	8:29a - 2:15p	21
Bag House Operator	8:32a - 2:54p	12
Tundishman	9:34a - 2:30p	10
Scrap Crane Operator	8:44a - 2:20p	7.3
Burner (cutting-up scrap)	8:46a - 2:00p	19
Scrap Truck Driver	8:51a - 2:45p	4.2
Third Helper	9:07a - 2:35p	17
Ladle Crane Operator	9:20a - 2:50p	9.1
Evaluation Criterion		50

*ND = non-detectable (<3 ug/m^3)