HETA 86-438 & 86-534
July & November
BONDAR-CLEGG
LAKEWOOD, COLORADO & SPARKS, NEVADA

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I. In July, 1986 and November, l986 the National Institute for Occupational Safety and Health (NIOSH) received requests from management of Bondar-Clegg, in Lakewood, Colorado and Sparks, Nevada to evaluate exposures to lead in two fire assay laboratories. Fire assay labs fire assay samples at approximately 2500°F

On July 22, l986 an environmental evaluation was conducted at the Lakewood, Colorado facility and on February l8, 1987 an environmental and medical evaluation was performed at the Sparks, Nevada facility. The environmental investigation at both facilities consisted of measuring the breathing zone and general room air concentrations of lead, taking ventilation measurements inside the facility, and a thorough evaluation of the exhaust stacks and other parts of the ventilation system located on the roof of the buildings. The medical monitoring at the Sparks, Nevada facility consisted of blood lead (PbB) and Free Erythrocyte Protoporphyrin (FEP), brief physical examinations, completion of questionnaires to identify work history, symptoms, job satisfaction, perception of health status as related to one's job, medical conditions, regularly used medications, and demographics, of persons with whom participants live. The local exhaust ventilation, and the fresh air intake system at both facilities need to be improved. In addition, the respirator program was evaluated and found inadequate. Work clothing, including work shoes need to be changed. Showers should be taken after work and other clean clothes and shoes worn home to prevent exposing other members of workers households to lead.

Five breathing zone and three general room air samples were collected and analyzed for lead at the Lakewood, Colorado facility. All eight samples exceeded the evaluation criteria of 0.05 mg/M^3. The highest concentration was 0.6 mg/M3 and the lowest was 0.l mg/M3. The average concentration was 0.32 mg/M3. Nine of the l4 samples (64 percent) collected and analyzed for lead at the Sparks, Nevada facility exceeded the evaluation criteria. The highest concentration was 0.49 mg/M3 and the lowest was 0.0l mg/M3. Seven of these samples were breathing zone and seven were general room air samples.

Ten workers at the Sparks, Nevada facility received medical evaluation. All ten workers' blood lead levels were within the OSHA regulatory limits of 50 ug/dl for medical removal, however, three workers were over 40 ug/dl which is the limit for returning to a job that involves lead exposure. Three free erythrocyte protoporphyrin concentrations (an indicator of lead absorption) exceeded 50 ug/dl, the upper limit of "normal". Most of the workers at the Sparks, Nevada facility were transferred from the Lakewood, Colorado facility since the NIOSH environmental evaluation in July of l986.

On the basis of environmental and medical data, it was determined that a health hazard existed from over-exposures to lead during the fire assay procedures at Bondar-Clegg, at the Lakewood, Colorado and Sparks, Nevada facilities. Recommendations for correcting this hazard are included in Section VIII of this report.

Keywords: SIC: 7397 (commercial testing laboratories) Assaying service, gold, lead, litharge, blood lead and FEP.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received two requests (one in July, l986 and one in November l986) from Bondar-Clegg in Lakewood, Colorado and Sparks, Nevada to evaluate lead exposures among workers in their fire assay laboratories. Since the Lakewood, Colorado facility was partially closed and most of the workers were transferred to Sparks, Nevada, the two studies were combined into one report. Environmental evaluations were performed in the Lakewood, Colorado and Sparks, Nevada facilities. Since most of the workers were transferring to the Sparks, Nevada facility the medical evaluation was delayed until transfers were completed.

III. BACKGROUND

The Colorado and Nevada facilities of Bondar-Clegg are Canadian owned. There are usually six or seven workers involved with the laboratory procedures during the firing of the assay samples, which are in most cases, gold assays. Each basic charge or assay contains 60 grams of litharge (lead oxide). The litharge is placed into a crucible with the assay material using a large measuring spatula. This process introduces lead dust into the air and into the breathing zone of the worker. During the process of performing the gold assay, all the litharge is vaporized, since the furnace temperature exceeds 2000°F. On a normal work day l00 pounds of litharge is totally vaporized. Part of the vaporized lead is ventilated to the outside of the building. During this evaluation some of the lead vapor remained unventilated and contaminated the room which resulted in excessive environmental exposures.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

A total of twenty-two breathing zone and general room air samples were collected at the two facilities and analyzed for lead. These samples were collected on mixed cellulose ester membrane filters (AA) using vacuum pumps operated at 2.0 liters per minute. The analyses were done according to NIOSH P&CAM l73. Ventilation measurements were made using a velometer. Air flow and movement were checked using smoke tubes. All of the workers present during the evaluation were interviewed.

B. Medical

Ten workers were available for medical evaluation. These workers comprised the majority of those workers who were environmentally evaluated in the Colorado facility and all the workers in the Nevada facility of Bondar-Clegg. The medical evaluation included: blood lead (PbB) and free erythrocyte protoporphyrin (FEP), brief physical examinations, completion of questionnaires to identify work history, symptoms, job satisfaction, perception of health status as related to one's job, medical conditions, regularly used medications, and demographics of persons with whom participants live.

Blood leads were determined utilizing anodic stripping voltammetry. FEP's were determined by photofluorometric techniques.

V. 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, 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 exposure limits, 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 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.

Environmental Exposure Limits
8-Hour Time-Weighted Average (TWA)

	mg/M^3
Lead---------- OSHA	0.05
NIOSH	O.05
ACGIH	0.05

mg/M^3 = milligrams of substance per cubic meter of air.

B. Toxicology and Medical Criteria for Lead[1,2]

Inhalation (breathing) of lead dust and fume is the major route of lead exposure in industry. 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 interferes with red blood cell production and may affect the kidneys, peripheral and central nervous systems, the blood forming organs (bone marrow), and reproductive system.

Blood lead levels below 25 micrograms/deciliter (ug/dl) whole blood are considered to be levels which may result from daily environmental exposure. Individual PbB's between 25 - 40 ug/dl are in excess of national averages, but are not associated with readily indentifiable signs or symptoms. Lead levels between 40-60 ug/dl in lead-exposed workers indicate excessive absorption of lead and may result in more readily clinically identifiable adverse health effects. Levels of 60-100 ug/dl represent unacceptable elevations which may cause serious adverse health effects. Blood lead levels over 100 ug/dl are considered to be extremely dangerous and often these workers require hospitalization and medical treatment.

The Occupational Safety and Health Administration (OSHA) standard for lead in air is 50 ug/M^3 calculated as an 8-hour time-weighted average for daily exposure. However, according to the standard, blood lead and protoporphyrin levels must be monitored at least every 6 months for workers exposed to air lead levels above 30 ug/M^3 for more than 30 days per year, and at least every 2 months if the worker's last blood lead was at or exceeded 40 ug/100 g whole blood. The standard also dictates that workers with blood lead levels greater than 60 ug/100 g whole blood must be immediately removed from further lead exposure if these levels are confirmed by a follow-up test. Workers with average lead levels of 50 ug/100 g of greater must also be removed. Removed workers have protection for wage, benefits, and seniority for up to 18 months or until they can safely return to lead exposure areas.

VI. RESULTS AND DISCUSSION

A. Environmental

Results of the environmental samples for inorganic lead are presented in tables l and 2. Airborne concentrations of lead in the Lakewood, Colorado facility ranged from 0.l to 0.6 mg/M3; all the samples exceeded the evaluation criteria. The average for eight samples was 0.32 mg/M3. Fourteen breathing zone and general room air samples were collected in Sparks, Nevada. Nine of the l4 (64 percent) exceeded the evaluation criteria. The highest concentration was 0.49 mg/M3 and the lowest was 0.0l mg/M3. The average for the l4 analyses was 0.ll. The exhaust hoods over the three furnaces in Sparks, Nevada need to be lowered and a larger exhaust fan motor installed so that the capture velocity will be improved. The more enclosed the hoods are the better they will work. Additional makeup ventilation air is needed to correct the negative pressure inside the facility. This will also improve the operation of the exhaust fans. Since overexposures to lead were found, a respirator program that complies with the OSHA regulations outlined in 1910.134 must be instituted until effective engineering controls are installed.

B. Medical

There were no positive physical examination findings and no significant reporting of symptoms in the study participants. Nine of the ten workers examined had blood leads in excess of the national average, approximately 17 ug/dl, for persons ages 24 - 65 years old. Three of the workers in the fire assay department had lead levels that prohibit them from working in an area where they can be exposed to lead; these levels were 49, 43, and 48 ug/dl. Three FEPs were also above 50 ug/dl which is the upper limit for "normal". The elevated levels were 57, 69, and l92 ug/dl. The latternost figure, 192 ug/dl, is consistent with the workers' PbB and chronic exposure (6 years).

Medical monitoring of the workers should be continued and should conform with that presented in the March ll, l983, revised OSHA Safety and Health Standards (29 CFR l9l0, section l9l0.l025). FEP may be substituted for zinc protoporphyrin (ZPP). However, one should maintain consistency of the type of test (FEP or ZPP) and choice of analytic laboratory should be maintained for comparable results and minimization of systematic error (inter-laboratory variability).

VII. CONCLUSIONS

Based on the high environmental levels of lead and the excessive blood lead and FEP levels we concluded that a health hazard exists at these facilities. With continued exposure, more of the workers are going to have elevated blood lead and FEP levels. The furnace area where the highest lead exposure occurs is designated as a respirator area. None of the workers in this area had ever been fit tested for what size respirator to wear. All workers were wearing approved disposable respirators. A good respirator program that complies with OSHA regulations outlined in 1910.134 should be started immediately. Engineering controls should be continually made to eliminate exposure.

VIII. RECOMMENDATIONS

l. Ventilation improvements (local and general) throughout both facilities must be made in order to eliminate overexposure to lead dust and lead fumes.

2. Until ventilation is installed, a respirator program that complies with OSHA requirements outlined in l910.l34 should be initiated immediately.

3. All workers should be advised of the toxic properties of lead exposure.

4. All workers in the assay department should shower and change clothes and shoes before leaving the work place. This prohibits them from taking the dirty (leaded) clothing home and exposing other members of the household.

5. All workers in the assay department should wash their hands thoroughly before eating or smoking. Eating and smoking should be prohibited in the assay, furnace and prep area. Cigarettes should not be on a person while he is working with the litharge, since they can be contaminated with the lead.

6. Clean work habits should be continually stressed to all employees. This will assist in eliminating some of the lead exposures.

IX. REFERENCES

1. Occupational Safety and Health Administration. OSHA Safety and Health Standards. 29 CFR 1910.1025. Lead. Occupational Safety and Health Administration, Revised 1983.

2. International Labor Office, Encyclopedia of Occupational Health and Safety, 3rd. (Revised) Ed. Geneva: International Labor Office. 1983. pp. 1200-1205.

3. Alessio, L., Bertazzi, P.A., Monelli, O., Foa, V., "Free Erythrocyte Protoporphurin as an Indicator of the Biological Effect of Lead in Adult Males. II. Comparison between Free Erythricyte Protoporphyrin and Other Indicators of Effect." International Arch. Occup. and Envirn. Health. 37: 89-105 (1976).

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XI. DISTRIBUTION AND AVAILABILITY

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Copies of this report have been sent to:

1. Bondar-Clegg.
2. U.S. Department of Labor/OSHA - Denver Region.
3. NIOSH - Denver Region.
4. Colorado State Department of Health.
5. State Designated Agency.

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

Table I

Breathing Zone and General Room Air Concentrations of
Lead at
Bondar-Clegg
Lakewood, Colorado
July 22, 1986

Sample #	Job	Location	Sampling Time	mg/M^3 Pb
100	Foreman	Fire Assay	6:53a - 2:57p	0.2
101	Chemist	Fire Assay	6:57a - 3:01p	0.8
102	Chemist	Fire Assay	6:58a - 2:45p	0.4
103	Chemist	Fire Assay	6:59a - 3:02p	0.6
104	Chemist	Fire Assay	7:01a - 1:45p	0.29
105	General Area	Furnace Top	7:04a - 3:00p	0.09
106	General Area	Work Bench	7:14a - 2:58p	0.09
107	General Area	Furnace Area	7:15a - 2:59p	0.1
Evaluation Criteria				0.05

Laboratory Limits of Detection .002 mg/filter

Table II

Breathing Zone and General Room Air Concentrations of
Lead at
Bondar-Clegg
Sparks, Nevada
February 18, 1986

Sample #	Job	Location	Sampling Time	mg/M^3 Pb
100	Chemist	Oven # 1	6:56a - 2:05p	0.13
101	Chemist	Oven # 2	6:57a - 2:06p	0.11
102	Tech. II	Parting Rm.	6:58a - 2:11p	0.02
103	Weighing	Weighing Rm.	6:59a - 11:40a	0.055
104	Weighing	Weighing Rm.	7:00a - 2:08p	0.22
105	General Area	Lunch Room	7:03a - 2:07p	0.004
106	Supervisor	All Areas	7:04a - 11:56a	0.01
107	General Area	Furnace 1	7:07a - 2:12p	0.49
108	General Area	Furnace 2	7:16a - 1:40p	0.18
109	General Area	Furnace 3	7:20a - 1:40p	0.04
110	Stir & Cupel	Furnace 3	7:25a - 2:04p	0.12
111	General Area	Outside Prep.	7:30a - 2:15p	0.03
112	General Area	Prep area	7:30a - 1:45p	0.08
113	Weigh Bench	Prep area	7:30a - 2:00p	0.10
Evaluation Criteria				0.05

Laboratory Limits of Detection mg/filter = 0.002

FINAL DRAFT

END OF TELECOMMUNICATIONS SESSION