WALK-THROUGH SURVEY REPORT:
CONTROL TECHNOLOGY FOR METAL RECLAMATION INDUSTRIES

AT

GNB Incorporated
Frisco, Texas

REPORT WRITTEN BY:
Ronald M. Hall
Gary S. Earnest

REPORT DATE:
March 31, 1994

REPORT NO.:
ECTB 202-13a

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Division of Physical Sciences and Engineering
4676 Columbia Parkway, Mailstop R5
Cincinnati, Ohio 45226

PLANT SURVEYED:	GNB Incorporated 7471 South 5th Street P.O. Box 250 Frisco, Tx 75034
SIC CODE:	3341
SURVEY DATE:	March 31, 1993
SURVEY CONDUCTED BY:	NIOSH/DPSE Ronald Hall Scott Earnest James Jones
EMPLOYER REPRESENTATIVES CONTACTED:	Larry Eagan, Director South Central Region Billy King, Environmental/Quality Control Manager Alfred Whitsell, Health and Safety Supervisor
EMPLOYEE REPRESENTATIVES CONTACTED:	No Union
MANUSCRIPT PREPARED BY:	Bernice L. Clark Deanna L. Elfers

DISCLAIMER

Mention of company names or products does not constitute endorsement by the Centers for Disease Control and Prevention.

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), a federal agency located in the Centers for Disease Control and Prevention under the Department of Health and Human Services, was established by the Occupational Safety and Health Act of 1970. This legislation mandated NIOSH to conduct research and education programs separate from the standard setting and enforcement functions conducted by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. An important area of NIOSH research deals with methods for controlling occupational exposure to potential chemical and physical hazards.

The Engineering Control Technology Branch (ECTB) of the Division of Physical Sciences and Engineering has been given the lead within NIOSH to study and develop engineering controls and assess their impact on reducing occupational illness and injury. Since 1976, ECTB has conducted a large number of studies to evaluate engineering control technology based upon industry, process, or control technique. The objective of each of these studies has been to document and evaluate control techniques and to determine their effectiveness in reducing potential health hazards in an industry or at specific processes.

This study of metal reclamation (and specifically lead reclamation) is being undertaken by ECTB to provide control technology information for preventing occupational disease in this industry. The lead reclamation industry has historically had high occupational lead exposures which can result in neurotoxic disorders and disorders of reproduction. These two work-related diseases have been targeted by NIOSH under the "ten leading work related diseases and injury" initiative. This list was based upon frequency of occurrence, severity of effect, and likelihood of developing effective preventative strategies.

The goal of this research study is to identify, evaluate, and disseminate practical and cost effective control methods which reduce exposures to lead. The study will be accomplished by identifying and evaluating existing control methods used in metal reclamation industries. The results of these field evaluations will be presented in-depth survey reports. Information on control methods will be disseminated in scientific and trade journal articles, and handbooks for use by workers, owners and operators, the OSHA consultation program, and other safety and health professionals.

As part of this overall study, a walk-through survey was conducted at GNB Incorporated in Frisco, Texas. The purpose of this survey was to identify and qualitatively evaluate potentially effective controls and work practices. It also helped to familiarize NIOSH researchers with the process, potential exposures, and related health risks in the lead reclamation industry (secondary lead smelters).

PLANT DESCRIPTION

GNB Incorporated is a secondary lead smelter that operates 365 days a year 24 hours a day. The facility recycles approximately 20,000 batteries a day.

Spent batteries are purchased by GNB Incorporated and brought to the recycling facility by commercial trucks.

Batteries recycled by the plant consist mainly of automobile batteries. Lead and plastic from spent batteries are reclaimed. The lead is recycled on site. The plastic (polypropylene) is washed and placed in commercial trailers to be transported to a contract plastic recycling facility. There the plastic is formed into pellets and shipped to the GNB battery manufacturing facility to be used for new battery cases. The reclaimed lead is sold to various industries and also used by GNB to manufacture new batteries.

PROCESS DESCRIPTION

Spent batteries, (batteries at the end of their usable life) are brought to the plant by commercial truck. The truck backs up to the battery breaking area to unload the batteries which are on pallets. The pallets are removed from the truck by a forklift and placed on a hydraulic table. One side of the hydraulic table is elevated and the batteries are fed by a screw conveyor to an automated hammer mill where the batteries are ground up whole. The battery acid (electrolyte) drains from the batteries and is collected at the waste water treatment plant where it is neutralized. The ground up pieces go to a flotation separator where the lead bearing material and recyclable plastic are separated. Recyclable plastic is loaded into the back of a commercial trailer. This trailer then takes the plastic to the contract plastic recycling facility.

Lead bearing material goes to the raw materials storage building where it is later fed to the reverb furnace. Paste material that collects in the bottom of the flotation separator is fed to a densifier. A mud-like material containing lead exits the bottom of the densifier where it is collected and then sent to the raw material storage building.

In the raw materials storage building a front end loader is utilized to feed lead bearing material to a hopper. The lead bearing material is conveyed out of the hopper into a kiln where it is dried. After the lead bearing material is completely dried it is conveyed into the reverb furnace and melted down into elemental lead.

Slag drains out of the furnace into a pot which is located at the furnace in an enclosed ventilated booth. Slag pots (full of slag) that are removed from the enclosed ventilated booth are placed under a canopy hood to cool. Elemental lead is tapped off the reverb furnace into alloy pots (located in the refinery area). The lead in the refinery process is agitated, skimmed, and drossed to remove impurities. After the lead has been drossed it is pumped (using a centrifugal pump) to a kettle located in the casting area and alloyed to specifications then it is poured into ingots. Slag from the reverb furnace, dross material from the alloy pots, and oversized plant scrap material are fed to the blast furnace. Slag is tapped off the side of the blast furnace to a pot located in an enclosed ventilated booth. The slag then proceeds to the slag treatment area of the plant. Lead that is tapped off the side of the blast furnace is alloyed and refined. It is then cast into ingots. Dross is skimmed off the ingots by hand. The ingots are bound, placed on pallets using a hand-operated, hydraulic lift, and stored until shipment.

POTENTIAL HAZARDS

Workers in this secondary lead smelter are potentially exposed to lead and arsenic.

Lead

Lead adversely affects a number of organs and systems. The four major target organs and systems are the central nervous system, the peripheral nervous system, kidney, and hematopoietic (blood-forming) system.[1] Inhalation or ingestion of inorganic lead can cause a range of symptoms and signs including loss of appetite, metallic taste in the mouth, constipation, nausea, colic, pallor, a blue line on the gums, malaise, weakness, insomnia, headache, irritability, muscle and joint pains, fine tremors, and encephalopathy. Lead exposure can result in a weakness in the muscles known as "wrist drop," anemia (due to shorter red blood cell life and interference with the heme synthesis), proximal kidney tubule damage, and chronic kidney disease.[2-3] Lead exposure is associated with fetal damage in pregnant women.[1-3] Finally, elevated blood pressure has been positively related to blood lead levels.[4-5]

Inorganic Arsenic

Inorganic arsenic is strongly implicated in respiratory tract and skin cancer and has been determined to be a potential occupational carcinogen by NIOSH.[6-7] Inorganic arsenic has caused peripheral nerve inflammation (neuritis) and degeneration (neuropathy), anemia, reduced peripheral circulation, and increased mortality due to cardiovascular failure in workers who have been exposed to inorganic arsenic through inhalation, ingestion, or dermal exposure.[3]

CONTROL TECHNOLOGY

PRINCIPLES OF CONTROL

Occupational exposures can be controlled by the application of a number of well-known principles including engineering measures, work practices, and personal protection. Engineering measures are the preferred and most effective means of control. These include material substitution, process and equipment modification, isolation and automation, and local and general ventilation. Control measures also may include good work practices and personal hygiene, housekeeping, administrative controls, and use of personal protective equipment such as respirators, gloves, goggles, and aprons. Table I summarizes the spectrum of control measures.

Each of these approaches must be considered when developing a comprehensive, effective control strategy; however, their optimum application varies from case to case. Built-in design modifications are the preferred method of control because they generally are not dependent on human behavior.

TABLE I[8]

METHODS OF CONTROL

SOURCE	PATHWAY	RECEIVER
Material substitution	Housekeeping	Training and education
Process change	General exhaust ventilation (Roof fans)	Worker rotation
Process enclosure	Dilution ventilation (Supplied air)	Worker enclosure
Process isolation	Increase worker/ source distance	Personal monitoring
Wet methods	Continuous area monitoring	Personal protective equipment
Local ventilation	Maintenance programs	Maintenance programs
Maintenance programs		

Additionally, monitoring and maintenance of controls, and education and commitment of both workers and management are important ingredients of a successful control system.

ENGINEERING CONTROLS

GNB Incorporated employs local exhaust ventilation, partial enclosures, and enclosed ventilation systems in the reverb furnace operations, blast furnace operations, and casting and refinery area. In addition, HEPA-filtered half-mask respirators are worn in production areas of the plant.

The battery breaking operation is an automated system that shreds the batteries whole then feeds the material to a flotation separator. The flotation separator is an automated system that separates the lead bearing material and plastics. Lead bearing material goes to the raw material storage building where it is picked up with a front end loader (equipped with an enclosed air conditioned cab) and emptied in the feed hopper. The feed hopper is ventilated with a ventilated booth. An enclosed conveyor feeds the material from the feed hopper to the kiln. An enclosed conveyor feeds the dried lead material from the kiln to the reverb furnace. The reverb furnace has ventilation hoods on the slag tap, lead tap, and lead well. The slag off the reverb furnace is caught in a pot located in an enclosed ventilated booth.

After the pot fills with slag it is placed under a ventilated canopy hood were the slag then cools. Lead is tapped directly from the reverb furnace to the refinery alloy pots in the refinery area. Canopy hoods cover the top of each of the alloy pots located in the refinery area. Workers use a shovel to remove dross from the top of the alloy pots. A dross container (one located at each alloy pot) collects the dross that is skimmed off the lead. This container is located in an enclosed ventilated booth. A pump moves the lead from the alloy pots to a casting machine. The casting machine pours the lead into ingots. The blast furnace has ventilation hoods on the slag and lead taps that are similar to those on the reverb furnace.

RESPIRATOR PROTECTION PROGRAM

A respirator protection program, has been set up based on the Occupational Safety and Health Administration's (OSHA) lead standard[9]. This program was set up to reduce worker exposure to lead to below the mandated PEL.

WORK PRACTICES AND HYGIENE

GNB Incorporated has strict policies on personal hygiene. When employees arrive at work they enter the clean area of the locker room where they are supplied clean uniforms and a clean respirator for the day. After the work shift employees enter the dirty side of the locker room where they remove the dirty uniforms and respirator. Uniforms are laundered off site so that clean ones are provided for each shift. Respirators are also cleaned after each shift. Mandatory showers are taken by each employee before entering the clean side of the locker room. No eating or smoking is permitted in the work areas. Employees vacuum clothes and wash their hands and face thoroughly before entering the break room.

INCENTIVE PROGRAMS

In an effort to reduce blood lead levels and promote good personal hygiene and work practices among full-time employees, GNB Incorporated uses an incentive bonus program. This program is outlined in Table II.

Table II

GNB Incentive Bonus Program

Blood Lead Level (BLL)	($) Bonus Awarded Every Two Months
<20	125
21-25	100
26-30	75
31-35	50
>36	0

An employee with a blood lead level (BLL) below 20 $\mu g/dl$ receives a bonus of $125. If the employee has a BLL between 21 to 25 $\mu g/dl$ $100 bonus is awarded. Employees that have BLL between 26 to 30 $\mu g/dl$ receive a $75 bonus. If the employee has a BLL between 31 to 35 $\mu g/dl$ a bonus of $50 is rewarded.

Employees that have BLL above 36 $\mu g/dl$ do not receive a regular bonus. A special bonus can be earned if the employees BLL is at least two points lower than the individual's previous 6 month average.[10]

AIR MONITORING

The company has their own air monitoring program that consists of personal air sampling conducted at the plant. An evaluation of the company's personal air lead results (from 09/29/92 to 04/01/93) was performed. Personal air lead data was averaged by job title and ranged from 28 $\mu g/m^3$ to 565 $\mu g/m^3$ with acid neutralization (water treatment) workers having the lowest average and furnace charge-maker workers having the highest average. Averages of the personal exposure data are listed by job title in Table III.

Table III

Averages of Personal Exposure Data

Job Title	Average Lead Exposure $\mu g/m^3$
Furnace Charge-maker	565
Caster	482
Furnace Operators and group leaders	335
Bag House Operators	198
Battery Breakers and Group Leaders	174
Refiners	184
Mechanics A & B	131
Janitors	56
Material Handlers (interplant)	35
Acid Neutralization (Water treatment)	28

Air samples for arsenic have been taken by the company. Metallic arsenic is used as an alloy agent in the refinery area. The company indicated that air samples analyzed for arsenic have been consistently below the detection limit of 0.3 $\mu g/m^3$. The company also indicated that detector tube samples taken for arsine and stibine were consistently nondetected (0.025 ppm detection limit).

PERSONAL PROTECTIVE EQUIPMENT

Half-mask respirators (with HEPA filters) and uniforms are worn by employees in all production areas of the plant. In addition, hearing protection, hard hats, safety shoes, safety glasses, and gloves are worn by employees in production areas. Face shields and heat protective clothing are worn during furnace operations and casting and alloy pot operations.

CONCLUSIONS AND RECOMMENDATIONS

Workers throughout the production areas of the plant are potentially exposed to high concentrations of lead. GNB Incorporated employs local exhaust ventilation, enclosed ventilated booths, partial enclosures, and automated operations through-out production areas of the plant. Various occupational safety and health programs are used at the plant including occupational and safety training, a respirator protection program, various hygiene programs, and blood lead monitoring programs.

The companies air lead data indicated that workers in the plant have the potential to be exposed to air lead levels greater than 500 $\mu g/m^3$. According to OSHA LEAD Standard (29 CFR 1910.1025) half mask respirators are not satisfactory in controlling worker exposures greater than 500 $\mu g/m^3$; therefore, proper respiratory protection must be used by workers with the potential to be exposed to high concentrations of lead.

Further evaluation of the company's air lead levels will be done. The results of this evaluation will be compared to similar evaluations done on other air lead data collected in the industry. The results from this comparison will be used to identify smelters with the most effective engineering controls. An in-depth study will be conducted at the smelter with the lowest air lead level's. Blood Lead Level (BLL) data collected during the walk-through survey will also be evaluated and compared to other BLL in the industry. The results of the BLL comparison will be used to identify smelters in the industry with the most effective occupational and incentive programs. An in-depth study will be conducted at the plant with the lowest BLL (indicating the most effective occupational and incentive programs) to evaluate occupational and incentive programs.

REFERENCES

1. Doull J, Klaassen CD, Amdur MD [1980]. Casarett and Doull's Toxicology 2nd Ed. New York, NY: MacMillan Publishing Co., Inc.

2. NIOSH [1972]. NIOSH criteria for a recommended standard . . . occupational exposure to inorganic lead. 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. HSM 73-11010.

3. NIOSH [1981]. Occupational health guidelines for chemical hazards. 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)/DOL (OSHA) Publication No. 81-123 and supplements 88-118, 89-104.

4. Kristensen TS [1989]. Cardiovascular diseases and the work environment--a critical review of the epidemiologic literature on chemical factors. Scand J Work Environ Health 15:245-264.

5. Pirkle JL, Schwartz J, Landis JR, Harlan WR [1985]. The relationship between blood lead levels and blood pressure and its cardiovascular risk implications. Am J Epid 121(2):246-258.

6. NIOSH [1975]. Criteria for a recommended standard-occupational exposure to inorganic arsenic; new criteria-1975. 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) Pub. No. 75-149.

7. NIOSH [1982]. NIOSH testimony to U.S. Department of Labor: comments at the OSHA arsenic hearing, July 14, 1982. NIOSH policy statement. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health.

8. Plog BA [1988]. Fundamentals of industrial hygiene. 3rd ed. Chicago, IL: National Safety Council, p. 458.

9. CFR [(OSHA Lead Standard 29 CFR § 1910.1025) 1978]. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

10. GNB Incorporated [1993]. Blood Lead Bonus Qualifications Program, Frisco, Tx.