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

AT

Exide/General Battery Corporation
Reading, Pennsylvania

REPORT WRITTEN BY:
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National Institute for Occupational Safety and Health
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SIC CODE:	3341
SURVEY DATE:	June 17, 1993
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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 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 Exide/General Battery Corporation in Reading, Pennsylvania. 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

Exide/General Battery Corporation (smelter division) is a secondary lead smelter that operates three shifts a day for seven days a week. The smelter

division is in operation for a total of 351 days a year. The facility shuts down two weeks out of the year for maintenance purposes. The facility recycles approximately 20,000 to 25,000 batteries a day. Spent batteries are purchased by Exide/General Battery Corporation and brought to the recycling facility by commercial trucks.

Batteries recycled by the plant consist mainly of automobile batteries. Lead and plastic (polypropylene) from spent batteries are reclaimed. The lead and plastic are recycled on site. The plastic is formed into pellets and shipped to an Exide/General Battery Corporation manufacturing facility to make new battery cases for the company. The reclaimed lead is used by Exide facilities in manufacturing 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. The forklift takes the pallets to the battery shredder and tilts them so the batteries fall into the shredder. The shredder grinds up the batteries whole. The battery acid (electrolyte) drains from the batteries and is collected in a storage tank where suspended material ia allowed to settle. After the suspended solids have settled, the clear liquid is treated at an on-site waste water treatment plant. The ground up pieces of lead and plastic are conveyed to another shredder then conveyed to a flotation separator were the lead bearing material and the plastic that can be recycled are separated. Plastic that can be recycled is loaded into the back of a commercial trailer and taken to the plastic recycling facility located on site.

Lead bearing material is conveyed to an enclosed and ventilated raw materials storage building where it is later fed to a reverberatory furnace. In the raw materials storage building a front end loader is utilized to load a feed hopper at the top of each blast furnace. The reverberatory furnace is fed by a ram which in turn is fed by an automated conveyor that is also fed by a feed hopper that receives material from a front end loader. There are two reverberatory furnaces and two blast furnaces at the facility. The reverberatory furnaces are utilized in manufacturing soft lead. Automobile batteries are the main source of feed material for the reverberatory furnaces. The blast furnaces are mainly used in manufacturing hard lead. Large commercial batteries, slag (from the reverberatory furnaces), and dross material are the main source of feed material for the blast furnaces.

Slag drains out of the reverberatory furnaces into pots located at each furnace in an enclosed ventilated booth. A front end loader places empty slag pots in front of an enclosed ventilated booth. An automated pusher is utilized to position the empty pots as each pot is filled. The pots full of slag are then pushed out of the enclosed ventilated booth. A canopy hood is located directly beside the enclosed ventilated booth. The pots full of slag sit under the canopy hood until they cool. Lead containing slag from the reverberatory furnaces becomes feed material for the blast furnaces. Pots utilized to collect slag from the blast furnaces are also located in an

enclosed ventilated booth. Slag pots (full of slag from the blast furnaces) are removed by a forklift from the enclosed ventilated booth and placed under a canopy hood to cool. After the slag has cooled, it is placed in storage until it is disposed of in a landfill.

Elemental lead is tapped off the furnaces into alloy pots (located in the refinery area). Elemental lead is tapped into 3,800 lb hog molds from one of the reverberatory furnaces. The hog molds are placed in storage and fed to the alloy pots when needed. Lead in the refinery process is treated, agitated, skimmed, and drossed to remove impurities. After the lead has been drossed and alloyed to specifications it is pumped (using a vertical centrifical pump) to a casting machine where it is poured into ingots. Dross is skimmed off the ingots by hand. This process is performed in a fresh air supplied booth. The ingots then proceed through a cooling station where water is sprayed on them to cool them down. The ingots are then bound and placed on pallets (using a hand-operated hydraulic lift). A forklift takes the pallets (loaded with ingots) to a storage area where they are stored until shipment.

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

ENGINEERING CONTROLS

Exide/General Battery Corporation employs local exhaust ventilation, employee rotation (administrative control), partial enclosures, clean rooms, and enclosed ventilation systems in the reverb furnace operations, blast furnace operations, and casting and refinery area. In addition, HEPA-filtered full face respirators are worn in production areas of the plant.

TABLE I[1]		
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		

Forklifts (used to move the pallets in the battery breaking area) are equipped with HEPA filtered enclosed cabs. 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 is conveyed to the raw material storage building under negative pressure where it is picked up with a front end loader (equipped with a HEPA filtered enclosed cab) and emptied into a bucket elevator. An automated ram system feeds the furnaces. Workers (located in control rooms) monitor feed material going into the furnaces with the use of video cameras and monitors. All furnace feed points and automated conveying systems are ventilated.

The furnaces have ventilation systems on the slag tap, lead tap, and lead well. The slag tapped off the furnaces is captured in pots located in enclosed ventilated booths. Pots (full of slag) are removed from the enclosed ventilated booths and cooled under ventilated canopy hoods. Lead is tapped directly from the furnaces to the refinery alloy pots, under ventilation, in the refinery area. One reverb furnace tap lead directly into a 3,800 lb hog mold that is located in an enclosed ventilated booth. The hog molds cool and then are placed in storage until they are fed to the refinery alloy pots. 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. Lead is pumped from the alloy pots to a casting machine. The casting machine is an automated system that pours the lead into ingots. A ventilated air shower was located in the casting area. Workers stand under the air

shower and skim the lead that has been poured into ingots. Ingots are placed on pallets using a hand-operated hydraulic lift. Forklifts are then utilized to move the pallets.

RESPIRATOR PROTECTION PROGRAM

A respirator protection program, has been set up based upon the Occupational Safety and Health Administration's (OSHA) lead and respirator standard[2]. This program was set up to reduce worker exposure to lead to below the mandated PEL.

WORK PRACTICES AND HYGIENE

Exide/General Battery corporation 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 coveralls 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 coveralls and respirator. Coveralls are laundered on site everyday 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, Exide/General Battery Corporation uses an incentive bonus program. This program is outlined in Table II.

Table II

Exide/General Battery Corporation Incentive Bonus Program

Blood Lead Level (BLL) μg/dl	Bonus ($) per month
<33	75
34-44	50

An employee with a blood lead level (BLL) below 33 μg/dl receives a bonus of $75 a month. If the employee has a BLL between 33 to 44 μg/dl $50 bonus is awarded.

Employees with BLL's higher than 40 μg/dl have their BLL tested monthly. Employees that have BLL's in the range of 30 to 40 μg/dl have their BLL tested every two months. Employees with BLL's lower than 30 μg/dl have their BLL tested every three months.

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 November 92 to August 93) was performed. Personal air lead data was averaged by job code in each production department and ranged from 26 $\mu g/m^3$ to 451 $\mu g/m^3$ with plastic reclamation department workers having the lowest average and blast furnace workers having the highest average. Averages of the personal exposure data (for workers in production departments) are listed by department in Table III. Job codes are provided in Table III (for each department) and listed in Appendix A.

Table III

Averages of Personal Air Lead Exposure Data in Production Areas

Department	Average exposure $\mu g/m^3$	Job Code
Baghouse	75	N911
Blast Furnace	451	N010,N011,N012 N051,N052
Maintenance	100	N822,N823,N824 N826,N827
Plastic	26	N061,N071,N072
Refinery	363	N031,N032
Reverberatory Furnace	363	N021,N022
Shipping	56	N841
Smelter (molding and furnace area)	132	N980,N981,N982
Waste Water Treatment	124	N912,N913
Yard Area	190	N041,N043,N044 N045,N046,N047 N048,N049

Arsenic air samples have also been taken at this facility. The Exide/General Battery Corporation indicated that a total of 125 air samples had been collected for arsenic analysis. Exide also indicated that the analytical results for the 125 air samples collected for arsenic analysis reported 124 of them to be below the OSHA PEL of 10 $\mu g/m^3$. One of the samples was above the OSHA PEL with a analytical result of 11 $\mu g/m^3$.

PERSONAL PROTECTIVE EQUIPMENT

Full face respirators (with HEPA filters) and protective clothing are worn by employees in all production areas of the plant. In addition, hearing protection, hard hats, safety shoes with metatarsal guard, 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. Appropriate protective clothing is also worn around battery breaking or acid handling operations.

CONCLUSIONS AND RECOMMENDATIONS

Workers throughout the production areas of the plant are potentially exposed to elevated air lead levels. Exide/General Battery Corporation employs local exhaust ventilation, enclosed ventilated booths, partial enclosures, and automated operations throughout production areas of the plant. Various occupational safety and health programs are used at the plant including occupational health and safety training, a respirator protection program, various hygiene programs, and blood lead monitoring programs.

Further evaluation of the company's air lead levels will be accomplished. 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 levels. 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. Plog BA [1988]. Fundamentals of industrial hygiene. 3rd ed. Chicago, IL: National Safety Council, p. 458.

2. 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.

APPENDIX A

JOB CODE	DESCRIPTION
N010	Blast Furnace Operator
N011	Blast Furnace Operator #1
N012	Blast Furnace Operator #2
N021	Reverb Furnace Operator
N022	Reverb Attendant (ATT)
N031	Refine/Mold
N032	Refine/Treat
N041	Yard/Pallet Rep
N043	Yard/Battery Break
N044	Yard/Sanitation Shredder
N045	Yard/Jockey
N046	Yard/Trojan
N047	Yard/General Laborer
N048	Yard/Supervisor
N049	Yard/Heavy Equip Operator
N051	Blast Furnace ATT #1
N052	Blast Furnace ATT #2
N061	Plastic/MA
N071	Plastic Repr/Extr
N072	Plastic Repr/Helper
N822	Maintenance Supervisor
N823	Maintenance Man
N824	Maintenance Helper
N826	Maintenance Machinist
N827	Electrician
N841	Shipping
N911	Baghouse ATT
N912	Waste Water Treat Opr
N913	Dewatering Opr
N980	Smelter/Helper
N981	Smelter/Production Supervisor
N982	Smelter/Misc Supervisor