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

AT

East Penn Manufacturing Company Inc.
Lyon Station, Pennsylvania

REPORT WRITTEN BY:
Ronald M. Hall

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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:	East Penn Manufacturing Co. Inc. Lyon Station, PA 19356
SIC CODE:	3341
SURVEY DATE:	June 16, 1993
SURVEY CONDUCTED BY:	NIOSH Ronald Hall, DPSE Bob Hughes, DPSE Janie Gittleman, DSHEFS
EMPLOYER REPRESENTATIVES CONTACTED:	Richard A. Leiby, Jr. Vice President Metals Operations David W. Shea Plant Manager, Smelter Troy Greiss Environmental Health Safety
EMPLOYEE REPRESENTATIVES CONTACTED:	No Union
MANUSCRIPT PREPARED BY:	Deanna L. Elfers Bernice L. Clark

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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 East Penn Manufacturing in Lyon Station, 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

East Penn Manufacturing (smelter division) is a secondary lead smelter that operates 7 days a week, 343 days a year. Smelter operations shut down two weeks in July and 8 holidays throughout the year. The facility recycles approximately 20,000 batteries a day. Spent batteries are returned to East Penn Manufacturing from its battery customers by commercial trucks.

Batteries recycled by the plant are mainly automobile batteries. Lead, sulfuric acid, and plastic from spent batteries are reclaimed. The lead and sulfuric acid are recycled on site. The plastic (polypropylene) is washed and placed in commercial trailers to be transported to plastic recycling facilities which manufacture new battery cases for the company. The reclaimed lead and sulfuric acid are used by the company in manufacturing new batteries.

PROCESS DESCRIPTION

The following process information was obtained from Leiby RA [1992].(1)
Spent batteries (batteries at the end of their usable life) are brought to the plant by commercial trucks. In the battery breaking area, batteries stacked on pallets are removed from trucks by forklift and placed on a work platform. The batteries are then manually removed from the pallets and placed on a roller track. This track feeds a series of conveyors which turn the batteries on their sides and carries them through a slow speed saw that cuts off the tops. Electrolyte from the batteries is collected and pumped to storage at the Acid Reclaim Department in a closed system. Lead bearing material is extracted from the battery cases (using a group extractor) and conveyed to the material storage building. The tops and empty battery cases are conveyed to a recovery unit. A flotation separator is used to separate the lead bearing material from the plastic (polypropylene). The polypropylene sold to East Penn's current case and cover suppliers is recycled for the manufacture of cases and covers for new batteries.

The lead bearing material in the material storage building is moved to a vibratory feeder capable of holding up to 30 tons of charge material by a front end loader. Charge material is vibrated into a weigh bucket and discharged in front of a pusher feeder which in turn feeds it to the reverbatory furnace. This material sits on a drying shelf inside the furnace were it is dried by radiation and convection from the furnace gases and walls before being smelted. The principle objective of this furnace is to reduce the lead compounds to metallic lead and oxidize alloying agents to produce a slag.

Slag is tapped from the furnace into 2,400-lb molds. After the slag cools, it is taken to the material storage building. Slag (from the reverbatory furnace) and industrial battery cells are the main feed material for the blast furnace. The blast furnace is fed with an automated feeding and weighing system. The feed stock for the blast furnace is charged in proportions designed to yield antimony levels in the bullion close to refined metal specifications. The slag and matte from the blast furnace can be reprocessed through the blast furnace as a separate campaign to create a residual discard slag.

Lead tapped off the reverberatory furnace goes into a 75-ton kettle and drossed. The lead is then pumped to a refinery kettle were it is alloyed and drossed according to specifications. The lead is then pumped to a casting machine where it is cast into 70-lb ingots.

Lead from the blast furnace is tapped into 2,600-lb ingots. The 2,600 lb ingots from the blast furnace are placed in storage and fed to the alloying kettles as needed. This lead is also alloyed to specifications and pumped to the casting machine where it is cast into 70-lb ingots. The lead ingots are used by East Penn Manufacturing to manufacture new batteries.

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 in the human body. The four major target organs and systems are the central nervous system, the peripheral nervous system, kidney, and hematopoietic (blood-forming) system.[2] 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.[3-4] Lead exposure is associated with fetal damage in pregnant women.[2-4] Finally, elevated blood pressure has been positively related to blood lead levels.[5-6] The occupational exposure criteria for inorganic lead in air is the current OSHA permissible exposure limit (PEL) 50 $\mu g/m^3$.[7]

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.[8-9] 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.[4] The NIOSH REL for inorganic arsenic the is 2 $\mu g/m^3$ ceiling; the OSHA PEL is 10 $\mu g/m^3$.[10-11]

CONTROL TECHNOLOGY

East Penn Manufacturing (Smelter Division) employs automation, local exhaust ventilation, partial enclosures, and enclosed ventilation systems in the reverberatory furnace operations, blast furnace operations, and casting and refinery area to reduce employee exposure to lead. In addition, HEPA-filtered half-mask respirators are worn in production areas of the plant.

ENGINEERING CONTROLS

Examples of the use of automation and ventilation controls include the following: 1) The battery dismantling operation is an automated system that cuts the tops off the batteries, the saws are located in enclosed ventilated booths; 2) The lead plates are separated from the battery cases in an enclosed ventilated group extractor; 3) A conveyor feeds the cases to a flotation separator which recovers the plastic that can be recycled; 4) Some of the highest exposures in the plant are in the raw material storage building. Lead bearing material goes to the raw material storage building which is separated from the other areas of the plant; 5) A front end loader (equipped with a HEPA filtered air conditioned cab) is utilized to move the lead bearing material in the material storage building; 6) Lead bearing material is placed on an automated vibratory feeder that vibrates the material into a weighing bucket; 7) The weigh bucket deposits the lead bearing material in front of an automated ram feeder which feeds the reverberatory furnace; 8) Dust collected in bag houses is conveyed and discharged in front of the ram feeder that feeds the material to the furnace; 9) Furnace charging operations are controlled by a programmable controller located in a control room next to the charging equipment; 10) Slag is tapped from the furnace into 2,400-lb molds under an enclosed ventilated hood; 11) Lead is tapped from the furnace into enclosed ventilated kettles; 12) Lead is drossed in the kettles by using an automated drossing machine; 13) Lead is pumped into kettles located in the refinery area; 14) Kettles in the refinery area are enclosed and ventilated; and 15) Lead is pumped to a ventilated casting machine and cast into 70-lb ingots.

RESPIRATOR PROTECTION PROGRAM

A respirator protection program has been established according to the Occupational Safety and Health Administration's (OSHA) lead standard.[7] This program was designed to reduce worker exposure to lead to below the mandated PEL.

WORK PRACTICES AND HYGIENE

East Penn (Smelter Division) 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 work clothes or 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 work clothes, then the respirator. Mandatory showers are taken by each employee before entering the clean side of the locker room. Work clothes are laundered on site everyday so that clean ones are provided for each shift. Respirators are also cleaned after each shift. 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, East Penn Smelter Division uses an incentive bonus programs.

Blood Lead Level Bonus Program

An employee with a blood lead level (BLL) below 25 μg/dl receives a bonus of $25 a week. If the employee has a BLL between 25 to 34 μg/dl, a weekly $15 bonus is awarded. Employees that have BLL grater than or equal to 35 μg/dl do not receive a bonus.

Air Lead Bonus Program

An air lead bonus program has been in place at the plant since July of 1991. Air samples for the bonus program are taken separate from compliance samples. Both bonus program samples and compliance samples are compared when calculating the air lead bonuses. Air samples are taken in each job category during each shift every month. If a sample exceeds 100 $\mu g/m^3$ no bonus is awarded. If the sample result is 50 to 100 $\mu g/m^3$ than a bonus of $50 is rewarded to workers in the job category on the shift where the sample was taken. If the sample result is less than 50 $\mu g/m^3$ a bonus of $100 is rewarded to workers in that job category on that shift.

AIR MONITORING

The company has an air monitoring program that consists of personal air sampling conducted at the plant. Personal air lead data from June 1992 to May 1993 were averaged by department and shown in Table 1. The values ranged from 3 to 257 $\mu g/m^3$; acid refinery workers had the lowest average and front-end loader operators, the highest average.

Arsenic air samples are taken by the company in the alloying/pots area and the industrial battery breaking area of the smelter. Averages of arsenic personal exposure data (from April to October of 1993) were calculated for these areas. The arsenic personal exposure time-weighted-averages ranged from 0.10 to 1.14 $\mu g/m^3$ in the industrial battery breaking area and ranged from nondetected to 6.16 $\mu g/m^3$ in the alloying/pots area.

PERSONAL PROTECTIVE EQUIPMENT

Half-mask respirators (with HEPA filters) and work clothes or coveralls 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.

Table 1	
Personal Exposure Data	
Department	Average Lead Exposure Data ($\mu g/m^3$)
Reverberatory	52
Blast	78
Refinery	72
Pollution Control	27
Clean up in smelter area	55
Casting	42
Auto Battery Breaking	71
Hammer Mill	133
Industrial Battery Breaking	110
Front End Loader Operators	257
Acid Refinery	3
Maintenance	95
Baghouse	26

CONCLUSIONS AND RECOMMENDATIONS

Workers in production areas of this plant are potentially exposed to high concentrations of lead. East Penn Manufacturing (Smelter Division) employs local exhaust ventilation, enclosed ventilated booths, partial enclosures, and automated operations through-out production areas of the plant. The raw material storage building is separated from other areas of the plant. This isolation helps to prevent lead contamination from the raw material storage area to the other areas in the plant. 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.

Further statistical analysis of East Penn air lead levels and air lead levels collected from other smelters will be done. The results from this analysis 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.

A similar evaluation will be conducted on Blood Lead Level data (BLL) collected from East Penn and other smelters. The results of the BLL analysis will be used to identify smelters in the industry with the most effective occupational hygiene and incentive programs. An in-depth study will be conducted at the plant with the lowest BLL (indicating effective occupational and incentive programs) to evaluate occupational and incentive programs.

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