Walk-through Survey Report
of
Standard Industries, Inc.
(Reliable Battery Company)
San Antonio, Texas

Survey Date
December 7, 1978

Report Written By
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Survey Conducted By

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Date of Report
November 16, 1979

Industrial Hygiene Section
Industry-wide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Center for Disease Control
Cincinnati, Ohio

PLACE VISITED:	Standard Industries, Inc. San Antonio, Texas
DATE OF VISIT:	December 7, 1978
PERSON(S) MAKING VISIT:	Mark Young, Industrial Hygienist, NIOSH Jay Beaumont, Epidemiologist, NIOSH Bob Goldsmith, Epidemiologist, Enviro Control, Inc.
PERSON(S) CONTACTED AT PLANT:	Butch Dubinski, Industrial and Safety Engineer Richard Kaufman, Personnel Manager
UNION:	Local 1014, International Union of Electrical Workers
ACKNOWLEDGEMENTS:	Dick Kupel, NIOSH, DPSE Chuck Geraci, Ph.D., NIOSH, DPSE Bruce Allen, UBTL, Salt Lake City, Utah
STANDARD INDUSTRIAL CLASSIFICATION OF PLANT:	S.I.C. 3692 - Primary (lead-acid) batteries

PURPOSE OF SURVEY

The purpose of this walk-through survey was to gather preliminary information to determine whether this site is suitable for in-depth industrial hygiene and/or epidemiological research involving occupational exposure to sulfuric acid mist.

ABSTRACT

NIOSH and its contractor, Enviro Control, Inc. conducted a fact-gathering industrial hygiene/epidemiological walk-through survey of Standard Industries, Inc. (Reliable Battery Company), San Antonio, Texas on December 7, 1978 as part of the "Mortality and Industrial Hygiene Study of Workers Exposed to Sulfuric Acid" (Contract No. 210-78-0102). Information was gathered to determine the suitability of including this site in the in-depth aspects of this study. Personnel records were assessed and a general industrial hygiene evaluation which included general area sampling was accomplished. The estimated cohort for the epidemiology portion of the study could not be determined due to lack of records. Possible confounding exposures included arsine and stibine. NIOSH/Enviro Control, Inc. does not recommend this site for the inclusion in the in-depth epidemiological or the industrial hygiene phase of this study.

INTRODUCTION

The EPA and its Community Health and Environmental Surveillance System (CHESS) report (1970-71) studied seven U.S. cities for community exposure to air contaminants. One community had a primary exposure to sulfur oxides and particulates. The findings of the CHESS report suggest that exposures to sulfur pollutants need further study in terms of exposure levels and morbidity and mortality.

Also, the Proceedings of the Computer-based Conference on "Human Response to Sulfur Pollutants" at Brookhaven Laboratory (1974) showed that sulfates and sulfuric acid could have a possible carcinogenic and/or co-carcinogenic effect.

To further delineate health effects of sulfuric acid (H_2SO_4) mist exposure, NIOSH is conducting a retrospective cohort mortality study of a population occupationally exposed to sulfuric acid mist. In-depth industrial hygiene evaluations will also be performed in an attempt to establish cause and effect relationships.

Enviro Control, Inc. has been contracted by NIOSH to perform the epidemiological aspects of this study. NIOSH has dual responsibility to monitor the contract and conduct all industrial hygiene evaluations. As part of the contract, a walk-through survey of Standard Industries (Reliable Battery Company) was conducted by members of NIOSH/Enviro Control, Inc. Personnel records were assessed and an industrial hygiene evaluation was conducted. As part of the I.H. survey, general area samples were collected for sulfuric acid mist, stibine (SbH_3), and arsine (AsH_3). Pertinent observations, conclusions, and recommendations based on this data are presented in this report.

DESCRIPTION OF THE FACILITY

Standard Industries, a family-owned multi-business corporation, originally began as the Reliable Battery Company in 1918. Reliable became a subsidiary of Standard Industries in 1978. Reliable Batteries were first produced in a small building located on San Pedro Avenue, San Antonio, Texas. Three years later, Reliable moved across the street into a two-story house. In 1978, the company moved to the present location on Nelson Road, approximately fifteen miles from downtown San Antonio.

The Nelson Road site has three major (11 total structures) buildings, located on a 230-acre tract (Appendix 1). The three buildings combine to provide a total of 300,000 square feet of floor space. The main building houses the corporate offices, labs, cafeteria, and the total battery production areas. The remaining two buildings shelter the fiberglass operations.

Reliable manufactures approximately 3,000 lead-acid storage batteries a day ranging from 35 to 150 pound sizes. Car size batteries (35-40 lb.) comprise 60% of the total production at the Nelson Road facility. Reliable also produces batteries on private contract.

DESCRIPTION OF WORKFORCE AND PERSONNEL RECORD KEEPING SYSTEM

The Nelson Road plant has a total workforce of 275 employees (60% Hispanic) of which 130 hourly wage earners work in battery manufacturing. There are 43 male workers that have direct work involvement with H_2SO_4. (Job titles, descriptions and shift assignments are described in Appendix 2). The plant operates three shifts dividing the workforce with 250 workers on day shift, 20 on swings, and 5 on midnights. Local 1014, International Union of Electrical Workers represent the wage earners.

The record keeping system consists of a 4-drawer file of active workers and an 8-drawer file of terminated workers from 1975 to present. Older records are stored at the old plant. No information before 1961 could be found in any of the old files. It is estimated that even if records exist, only a few workers would qualify for study, since operations were quite small before 1960.

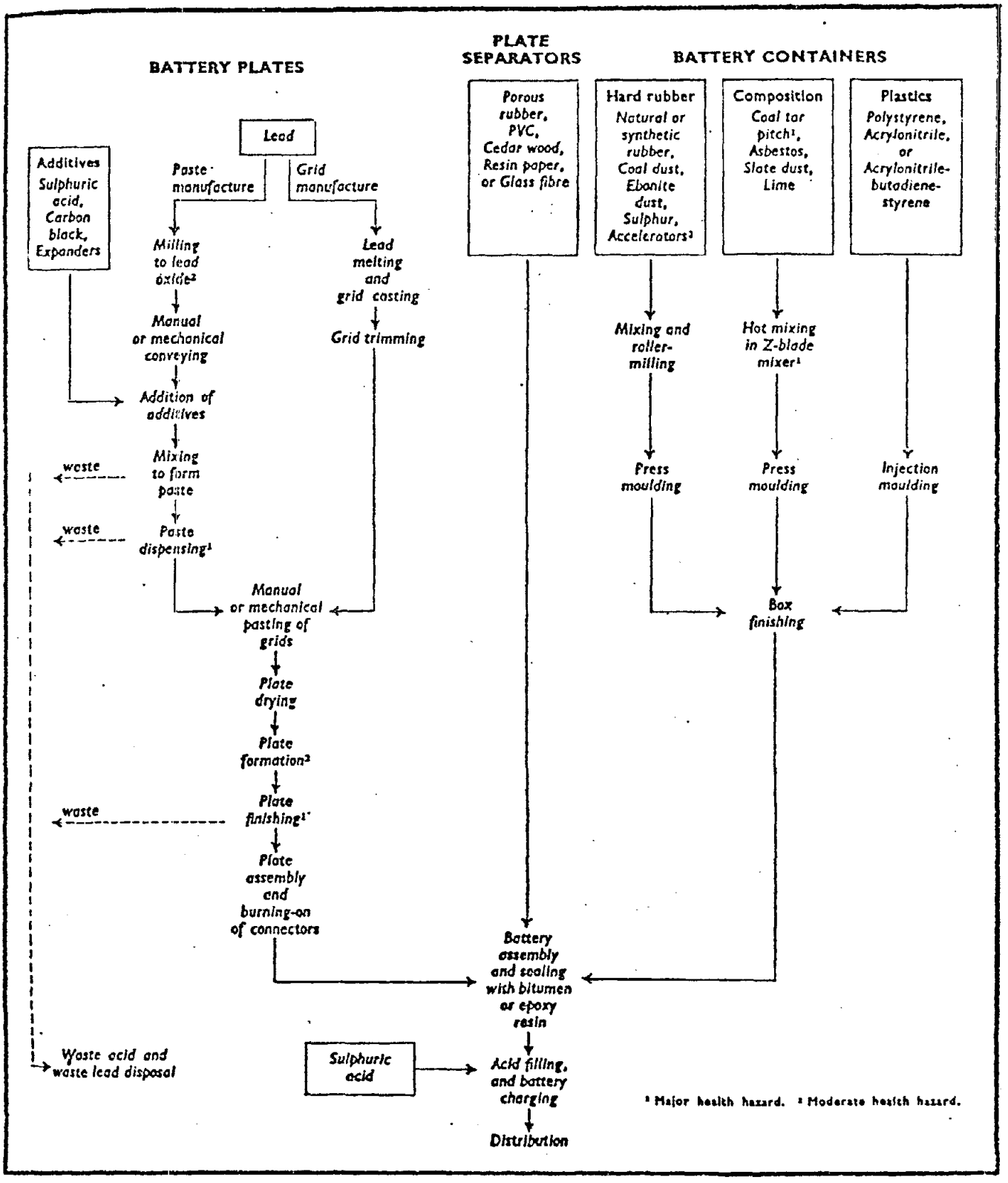
DESCRIPTION OF PROCESS

Materials and Manufacturing Processes

A lead-acid battery consists of positive and negative plates, separators, electrolyte and container. Both negative and positive plates have an inactive lead alloy grid which supports the active material and provides an electrical pathway. A lead oxide-sulfate paste is bonded to the grids and activated in the forming process. In the forming process, the positive plates are oxidized to lead peroxide as the negative plates are reduced to lead. Separators keep the negative and positive plates apart. Depending on battery type, assembly of the battery can take place before or after the forming process. The battery manufacturing flow diagram is given in Figure 1.

Figure 1

Flow Chart - Lead-Acid Battery Manufacture*



* Encyclopedia of Occupational Health and Safety, International Labor Office, McGraw-Hill, New York, N.Y., 1976. Vol. I, pp. 160-164.

Oxide Manufacturing

Lead oxide or Litharge(PbO) is the basic material used in the paste applied to form battery plates. Litharge is produced by the Barton process (located in the area designated oxide mill, see Appendix 1). The Barton process oxidizes lead by agitating molten lead in a pot with baffles, creating a lead aerosol. Some 48,000 pounds of PbO is produced daily.

Grid Casting

The lead alloy used in grid manufacture contains 5-7% antimony, .1-1% arsenic and small amounts of tin to increase strength and reduce corrosion. Grids are gravity cast in iron molds at 500°C. After hardening and removal from the mold, they are cooled and then trimmed. There are 18 grid casting machines located in the grid casting area producing a total of 780,000 battery grids daily (Appendix 1).

Paste Mixing, Pasting, and Plate Curing

The lead oxide-sulfate paste is prepared by mixing stoichiometrically insufficient amounts of sulfuric acid with lead oxide. Expanders are added to the paste for the negative plates to permit activation at low temperatures, discharge at high rates, and to inhibit plate shrinkage. The paste is mixed in 2,000-pound batch sizes in water-cooled mixers. The automated pasting machine produces about 200 pasted grids a minute. Each plate is then cured by passing through ovens to dry. Paste mixing, pasting, and plate curing is done in the plate pasting area (Appendix 1).

Battery Assembly

Nine assembly lines in this area take finished battery plates and separators and begin the initial stages of assembly. Battery plates, negative and positive, with separators between are stacked into groups. The number of plates in a group is then slipped into a partitioned area in the battery container to make up one battery cell. The cells are connected by molding the connection together. The connected groups are then dropped into the battery container automatically. Next, the walls separating each battery cell are sealed by surrounding the wall slots between cells with polypropylene. This process is called injection molding and is the only installation of its kind in the United States. A heat seal machine is then used to melt the cover and container together. Finally, the lead posts are welded in place and each battery is tested under air pressure for leaks. Approximately 3,000 batteries are assembled each day.

Plate Formation

Plate formation is the process which simultaneously converts the inactive lead oxide-sulfate to active lead peroxide (positive plates) and metallic lead (negative plates). This initial charge given to the battery is accomplished by passing direct current through the plates while in the finished container. This process is carried out in a one step procedure

using a high concentration of acid so that when formation is complete, the specific gravity is at the correct value. Batteries formed in this process are shipped in the "wet" state. After the batteries are properly charged, they are cleaned, labeled, and packaged.

DESCRIPTION OF PAST EXPOSURES

Worker exposure measurements for H_2SO_4 mist have not been taken at this new facility. Personal sampling for lead-in-air is established hygiene policy. A complete personal sampling record system is maintained.

The old installation (San Pedro Avenue) had general area and personal sample measurements for Pb, As, H_2SO_4 mist and PVC taken by Texas Employers Insurance. Copies of these reports were not available but could be obtained.

DESCRIPTION OF MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

Standard's (Nelson Road plant) medical program provides a local physician for all pre-employment and periodic physicals. The physician also handles blood samples for lead, emergency, and personal care for all employees. A L.V.N. and a R.N. are employed full time at the plant for the first and second shifts respectively.

The industrial hygiene, health and safety programs are overseen by the corporate industrial and safety engineer. Standard is currently seeking an industrial hygienist for the corporate level. Industrial hygiene measurements are performed by Texas Insurance Company. The corporation is also completing the requirements for a certified lab to analyze blood leads. Plant nurses are responsible for the respirator program which entails training usage, fit testing, and daily cleaning of all respirators. Other protective equipment provided by the company include uniforms, safety glasses, shoes and gloves. Wash rooms, locker rooms with showers and separate air-conditioned eating facilities are also provided.

INSPECTION OF THE PLANT

This plant appeared well kept and well ventilated. Stringent housekeeping and work practices were in effect. The general air ventilation system circulates 100,000 cubic feet per minute of fresh air continuously during operating hours. There is additional air ventilation installed in the pasting department to reduce lead in air.

H_2SO_4 mist was slightly detectable by odor in certain areas (Appendix 3). (General area samples were taken in those areas of detection).

Employee eating facilities were separate, air conditioned, and well maintained.

DESCRIPTION OF SURVEY METHODS

General area samples were taken in three areas (Appendix 1,2, 3). Samples were taken for H_2SO_4 in Area I; Acid Room and in Area II; Battery Charging. Area III; Battery Assembly, was sampled for H_2SO_4, SbH_3 and AsH_3.

Barometric pressure, relative humidity and atmospheric temperature were recorded.

Sampling and Analytical Procedures

Sulfuric Acid (H_2SO_4)

Sulfuric acid mist samples were collected at a calibrated flow rate of 1.5 lpm using MSA Model G sampling pumps in conjunction with 37 mm, 0.8 micron pore size, AA Millipore filters as a collection medium. Sampling time for all acid samples was approximately three hours (Appendix 3). Refer to Sampling Data Sheet #S174 "NIOSH Manual of Sampling Data Sheets" (1977 Edition).

These samples were analyzed for sulfuric acid with a Dionex Model 10 ion chromatograph.

Sulfuric acid was extracted from the AA-filters with 10 ml of deionized water added to each scintillation vial with subsequent sonification for 45 minutes. Blanks were run concurrently with the samples; the average calculated amount of H_2SO_4 in the blanks is subtracted from the reported results of samples.

A series of working sulfate standards covering the range 0.5-50. ppm was prepared to construct a calibration curve.

Ion chromatograph conditions employed were as follows: 3 mm X 500mm separator column preceeded by a pre-column; 6 mm X 250mm suppressor column; 3.0mM. $NaHCO_3$/2.4 mM Na_2CO_3 eluent, 30% eluent flow rate, and 3 umhos detector setting. Under these conditions, a retention time of 18 minutes was observed.

Samples were reported in the units of micrograms (ug) H_2SO_4/m^3. The limit of detection is 5 ug/filter.

Stibine (SbH_3)

Stibine samples were collected at a calibrated flow rate of 200 cc per minute using DuPont P-200 sampling pumps in conjunction with standard, commercially available 150 mg. charcoal tubes as a collection medium. The sample duration for all samples was approximately three hours. Refer to Sampling Data Sheet #S243 "NIOSH Manual of Sampling Data Sheets" (supplement to 1977 edition).

The stibine samples were prepared in a mixture of concentrated HNO_3, $HClO_4$ and H_2SO_4 heated to fumes of H_2SO_4, fumed vigorously to expel $HClO_4$ diluted to 25 ml with 1:1 HCl and analyzed by Atomic Absorption Spectrophotometer (A.A.S.) by a hydride generation method.

Sample results were reported in nanograms (ng) Sb/sample. The limit of detection is 25 ng Sb/sample. Concentrations are reported as mg of SbH_3/m^3.

Arsine (AsH_3)

Arsine samples were collected at a flow rate of 200 cc per minute using DuPont P-200 sampling pumps in conjunction with standard, commercially available 150 mg. charcoal tubes as a collection medium. The sampling time for all samples was approximatley three hours. Refer to Sampling Data Sheet #S229 "NIOSH Manual of Sampling Data Sheets" (1977 Edition).

The arsine samples were prepared by wet ashing with a mixture of concentrated HNO_3, $HClO_4$ and H_2SO_4. Excess HNO_3 and $HClO_4$ was removed by heating to fumes of H_2SO_4. The samples were then diluted to 25 ml with 1:1 HCl and analyzed according to the method of Pierce et al, J. Applied Spectroscopy, 30, 39 (1976).

The sample results were reported in ng As/sample. The limit of detection of As is 50 ng/sample. Concentrations were reported as mg of SbH_3/m^3.

RESULTS

General area sample measurements are shown on the Sampling Summary Sheet (Appendix 3). The samples were analyzed by Utah Biomedical Test Laboratory, Salt Lake City, Utah.

Analytical results indicate presence of H_2SO_4, SbH_3 and AsH_3 in respective areas. Measurements of H_2SO_4 range from .03 to .04 mg/m^3; SbH_3 at .007 mg/m^3 and AsH_3 at .005 mg/m^3.

These air samples indicate the exposures to expect as an aide in planning necessary in-depth sampling strategy. These general area measurements represent an approximate three hour sampling time and should not be confused with time weighted averages.

CONCLUSION

Worker exposures to H_2SO_4 mist prior to 1960 cannot be determined at this new facility. Because of site relocation in 1978 and installation of new equipment, estimated H_2SO_4 exposures prior to 1960 is not feasible. General area samples confirm confounding contaminants that could complicate findings of health effects due to H_2SO_4 exposure.

A retrospective cohort study of workers at this plant is also not feasible because of inadequate personnel records prior to 1960.

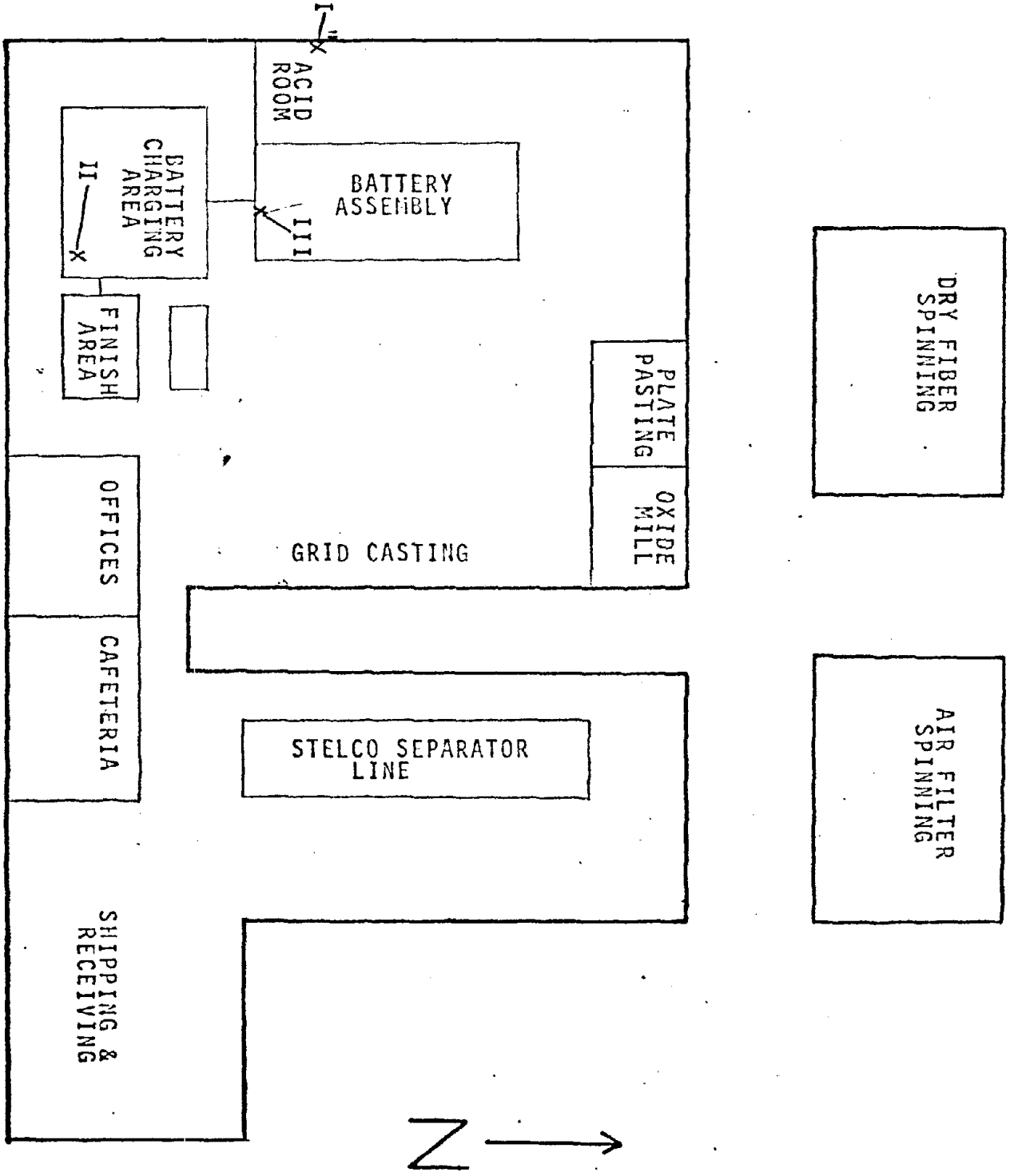
RECOMMENDATIONS

NIOSH/Enviro Control, Inc. does not recommend this site for inclusion in the in-depth mortality or industrial hygiene phase of this study.

APPENDIX 1 - PLANT DIAGRAM

STANDARD INDUSTRIES (NELSON ROAD FACILITY)

SAN ANTONIO, TEXAS



APPENDIX 2

Area of Potential H_2SO_4 Mist Exposure (see Appendix 1)	Job Title and Description	No. of Workers Per Shift	Total	General Area Samples Taken
Area I. Acid Mixing Room	Acid Mixer: Responsible to mix H_2SO_4 to proper concentrations. Mixer insures mixing operation functions properly and checks quality control.	1 - 1st shift 1 - 2nd shift	3	1
Area II. Battery Charging	Charging Room Attendant: Responsible to fill batteries with H_2SO_4 for plate formation. Batteries must be loaded on manual conveyor, filled, charged and unloaded.	10 - 1st shift 10 - 2nd shift	20	1
Area III. Battery Assembly	Finishers (second assembly) Batteries are emptied, refilled with H_2SO_4, cleaned, labeled and boxed.	14 - 1st shift 6 - 2nd shift	20	3

APPENDIX 3

NIOSH

Sampling Summary Sheet

Date : June 19, 1979

Plant : Standard Industries, Inc.

San Antonio, Texas

Average Temperature: 60°F

Atmospheric Pressure: 29.93"

Relative Humidity: 93%

Date 19 78	Sample No.	Area Sampled	Time Start	Time Stop	Sample Volume (liters)	Total Weight (ug)	Concentration H_2SO_4 mg/m³	Concentration AsH_3 mg/m³	Concentration SbH_3 mg/m³
12/7	8SA	I. Acid Room	10:26	13:38	288.0	10	.03		
12/7	9SA	II. Battery Charging	10:38	13:56	297.0	11	.04		
12/7	10SA	III. Battery Assembly	10:43	13:45	273.0	9	.03		
12/7	ASA	III. Battery Assembly	10:45	13:49	34.8	.23			.007
12/7	BSA	III. Battery Assembly	10:47	13:52	35.0	.16		.005	
12/7		Blank (Charcoal)	As / Sb	--	--	<50 ng / <25 ng			
12/7		Blank (Filter)	--	--	--	<5			