Walk Through Survey Report
As Part of the Sulfuric Acid Study

at

Inland Steel Company
Indiana Harbor Works
E. Chicago, Indiana

Survey Date
March 21, 1979

Report Written By
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Date of Report
August 3, 1979

Survey Conducted By
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Worker exposure to sulfuric-acid (7664939) mist was studied at the Inland Steel Company (SIC-3312) in East Chicago, Indiana, on March 21, 1979. The company was under consideration for inclusion in a NIOSH study of the health effects of occupational sulfuric-acid mist exposure. Approximately 112 of the employees at this facility were assigned to the pickling operations that were surveyed. The company had a safety and industrial hygiene program. Medical services were provided by 4 full-time physicians, 16 nurses and 5 paramedics. Personnel records furnished demographic information and department assignments. Past exposures to sulfuric-acid were not recorded, and current exposure data was not available. The author recommends that this workforce be included in the sulfuric-acid mist study.

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PLACE VISITED:	Inland Steel Company E. Chicago, Indiana
DATE OF VISIT:	March 21, 1979
PERSON(S) MAKING VISIT:	Mark Young, Industrial Hygienist, NIOSH Jeff Leveton, Epidemiologist, Enviro Control, Inc.
PERSON(S) CONTACTED AT PLANT:	G. Lundie, Director, Safety & Plant Protection D. Casassa, Senior Safety Engineer J. Smith, Safety Engineer Wm. Koenig, Industrial Hygienist
UNION:	T. Mills, Base Rate Chairman, U.S.W.A., Local 1010
STANDARD INDUSTRIAL CLASSIFICATION OF PLANT:	S.I.C. 3312 - Blast Furnaces, Steel Wor and Rolling and Finishing Mills

PURPOSE OF SURVEY

The purpose of this walk-through survey was to gather preliminary informatic 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 Inland Steel Company, E. Chicago, Indiana 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 indepth aspects of this study. Personnel records were assessed and a general industrial hgyiene evaluation was accomplished. The estimated cohort for the epidemiology portion of this study is approximately 1238 workers. NIOSH recommends this site for inclusion in both the indepth industrial hygiene and epidemiological phases of this study.

INTRODUCTION

The EPA in 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, 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 characterize the exposures that may have occurred in the study population.

Enviro Control, Inc. has been contracted by NIOSH to perform the epidemiological aspects of this study. NIOSH had dual responsibility to monitor the contract and conduct all industrial hygiene evaluations. As part of the contract, a walk-through survey of Inland Steel Company was conducted by members of the NIOSH/Enviro Control, Inc. Personnel records were assessed and a preliminary industrial hygiene evaluation was conducted. Observations, conclusions, and recommendations based on this data are presented in this report.

HISTORY AND DESCRIPTION OF FACILTIY

Inland Steel at East Chicago, Indiana acquired its land in 1901 and began producing steel in 1902. The plant has numerous buildings (located on approximately 2,000 acres. Plant additions (including a landfill into Lake Michigan) are and have been on-going since the plant opened.

Among other products, Inland manufactures non-fabricated steel (slabs, blooms, billets) and wide flanged beams for construction.

DESCRIPTION OF WORKFORCE AND PERSONNEL RECORD KEEPING SYSTEM

The Inland Steel Plant currently supports an active workforce of some 24,100 employees of which 18,000 are hourly wage earners and 6,100 are administrative. A total of 298,576 individuals have worked at Inland since 1902. At present, there are 274,476 inactive workers. At the time of this site visit, 112 workers were engaged in pickling operations (batch and continuous). Job titles and descriptions are detailed in Appendix 2. With respect to the total (active and inactive) worker population, we can potentially expect to find 1238 people occupationally exposed to sulfuric acid. (Estimate of prevalence is 0.4 percent).

Information is lacking in this report due to the fact that not enough time was alloted to Inland representatives to clear this visit with management. Consequently, documentation of this site visit reflects mostly general information gained verbally. The following summarizes other important considerations.

- A "yellow master sheet" follows individual workers to all jobs ever held while employed. When a worker is terminated, this document is retained in a central inactive file.
- Records began to be computerized at Inland in 1953. Job information was not available on the computer until 1968.
- Prior to 1946, index cards replaced "yellow master sheets."
- A file exists on "job most frequently worked" by department for all workers (as per Equal Employment Opportunity guidelines).

Inland presently runs 21 shifts a week (3 per day) with most of their operations. United Steelworkers of America, Local 1010 represents the wage earners.

DESCRIPTION OF PROCESS

During the hot-working of rolling of steel, the steel surfaces react with oxygen to form iron oxides or mill scale. Varying quantities of ferric oxide (Fe_2O_3), ferroferric oxide (Fe_3O_4), and ferrous oxide, (FeO) or in layers,

depending on the conditions of hot working, i.e., temperature, cooling rate, and access of oxygen to the steel surface. In order to further process the steel, i.e., drawing, coldworking, plating, etc., the mill scale must be removed.

Pickling is one of the most economical methods of accomplishing scale removal. Sulfuric acid has been used traditionally for pickling. However, since 1966, Inland has used hydrochloric acid in their continuous pickling processes. Presently, H_2SO_4 is used by Inland only in the two batch pickling operations.

Principles of Pickling

Sulfuric acid removes mill scale by reacting with the iron oxides to form ferric and ferrous sulfate. The following reactions occur during pickling:

$$FeO + H_2SO_4 \text{ ---------- } FeSO_4 + H_2O \quad (1)$$

$$Fe_2O_3 + 3H_3SO_4 \text{ ---------- } Fe_2(SO_4)_3 + 3H_2O \quad (2)$$

$$Fe + H_2SO_4 \text{ ---------- } FeSO_4 + H_2 \quad (3)$$

$$Fe + Fe_2(SO_4)_3 \text{ --------- } 3FeSO_4 \quad (4)$$

$$Fe_2(SO_4)_3 + H_2 \text{ ---------- } 2FeSO_4 + H_2SO_4 \quad (5)$$

Ferrous sulfate is the predominate sulfate formed in pickling. This occurs due to the faster rate of reaction of ferrous oxide with sulfuric acid than the reactions of ferric oxide and ferroferric oxide with sulfuric acid. Also, the ferric sulfate formed in equation (2) has a tendency to go to ferrous sulfate as given in equations (4) and (5). Hydrogen gas is formed in the reaction of metallic iron and sulfuric acid, causing bubbling and sulfuric acid mist.

Heat and bath agitation are used to increase the acid activity. Temperatures range from 140°F to 220°F. Heat is provided by heating coils or steam. Steam provides agitation when it is directly entered into the bath. Inhibitors are added to the bath to decrease the acid activity on the metallic iron. This reduces hydrogen gas formation, and, therefore, reduces acid misting. Mechanical devices such as plastic balls and chemical retardants are also used to reduce misting.

Batch Pickling

Batch pickling of hot-worked bars and rods is accomplished with sulfuric acid at Inland.

There is generally at least a series of three tanks: acid tank, water tank, and coating tank. The steel is attached to racks or hooks so that all surfaces are exposed to the acid. Different types of steel pickle at different rates which require different conditions. The temperature of the acid bath varies from 140°F to 210°F; concentration of the acid may range from 4% to 25%; the acid bath may be agitated, and pickling time may vary from a few minutes to as long as an hour.

After passing out of the acid tank, the steel is washed in a water tank and dipped into a coating tank. Coating the steel neutralizes any excess acid, provides protection from oxidation, and acts as a lubricant in further processing. Some common coatings are lime, borax, and inorganic phosphate compounds. The steel may be dried in ovens after the coating tank.

The acid tank can be made of steel, wood, brick, or concrete. The tank is generally lined with neoprene or rubber. Acid-resistant brick or terra cotta tile is used as lining in place of the rubber, or as a lining between the rubber and acid. Lead has been used as a lining, but has been discontinued due to its susceptibility to cracking.

The two batch pickling operations at Inland are designated the 12" line and the P.C. Dock. Both operate as demands arise. At the time of this survey, both batch picklers were not in operation.

Continuous Pickling

Scale from hot-rolled steel coils is removed in continuous pickling lines (5 total) using hydrochloric acid. Hydrochloric acid has replaced sulfuric acid since 1966 as it is more economical. A continuous pickling line consists of equipment to uncoil the hot-rolled steel, flex or roll the steel to crack the scale before pickling, 3 to 5 30-foot-long acid tanks, water rinsing tanks, coating tanks, and drying and recoiling equipment.

A typical continuous pickling line operates at 300 to 400 feet per minute and can reach speeds as high as 800 feet per minute. The acid is heated to between 175°F and 220°F, and ranges in concentration from 7% to 20%. The acid flows concurrently to the direction of the steel strip; acid is added to the last tank on the line and moves toward the first tank. The acid concentration increases in each tank from the beginning to the end of the line. Inhibitors are used to prevent excessive pickling in the instances of line delays or stoppages.

The acid tanks are made of steel lined with rubber. The rubber is protected by a lining of acid-proof silica-base brick. The five continuous pickling lines at Inland are designated as follows:

- #3 Cold Strip Mill - East (#5 Pickle Line)
- #3 Cold Strip Mill - West (#4 Pickle Line)
- 1 & 2 Cold Strip Mill (#1, #2, & #3 Pickle Line)

Job titles and descriptions for both batch and continuous operations are given in Appendix 2.

DESCRIPTION OF PAST EXPOSURES

Past exposures of H_2SO_4 in the continuous pickling lines (prior to 1966) were not recorded. Since 1966 the continuous pickling line switched to HCL and a fume exhaust with cascade rinse system was installed.

The batch pickling operation remains basically same type of process using H_2SO_4. H_2SO_4 mist exposures have been measured in the batch processes but a report was not made available.

DESCRIPTION OF MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

Inland has established medical, industrial hygiene and safety programs. The medical program involves corporate and plant levels. The plant has four full time M.D.'s, 16 R.N.'s and 5 paramedics. Employees are required to take pre-employment physicals, as well as periodic physicals for certain job related workers.

Medical personnel were not present and further details were not acquired.

The industrial hygiene program consists of a corporate and plant industrial hygienists. Personal sampling is done routinely. As mentioned, this plant has sampled for H_2SO_4 mist exposures but information was not given.

The safety program at the plant has a director, assistant director and 16 safety engineers. Protective equipment such as helmets, clothing, glasses, and respirators are provided by Inland. Acid workers are not required to wear respirators so information on the established respirator program was not obtained. Inland also provides separate facilities for eating and showering.

DESCRIPTION OF THE PLANT

The walk through survey was limited to inspection of the two batch pickling operations only. The continuous lines now operating with HCL were not looked at. The batch operations were not being used at the time of this walk-thru. Work practices, therefore, could not be observed. As described in the process description, Inland's batch operations appear to be similar to others in the steel industry. The operations and surrounding areas had good housekeeping.

CONCLUSIONS AND RECOMMENDATIONS

At the time of this report, NIOSH/Enviro Control, Inc. has negotiated with Inland for re-evaluation of the personnel records. NIOSH has determined that this site is suitable for this study and Enviro is preparing a study protocol.

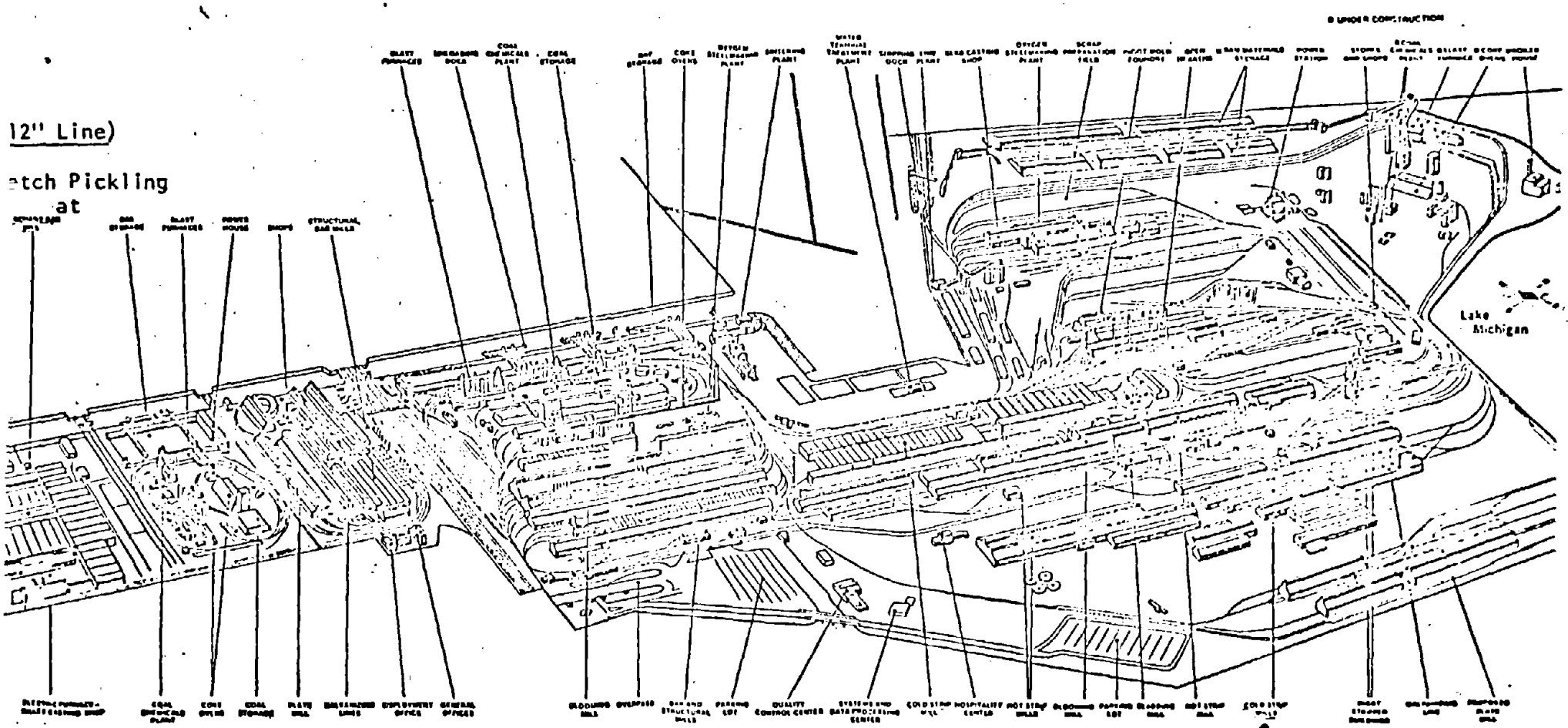
NIOSH recommends an in-depth industrial hygiene survey of the two batch pickling operations only. The continuous pickling lines at Inland which uses HCL as the pickling agent cannot be used for this study.

Appendix 1

Inland Steel Company - Indiana Harbor Works
E. Chicago, Indiana

12" Line)

tch Pickling
at



Batch Pickling (P.C. Dock)

#1,2,&3 Continuous Pickling Lines

#4 & 5 Continuous Pickling Lines

Appendix 2

Summary of Workers Involved in Pickling Operations - Inland Steel Company

Job Title	Operation	Location	Description	Number of Workers Per Shift
Operator (fork-lift)	Batch Pickling	12" Line Merchant Bar Mill	Operates forklift-stacks coils for craneman	1
Craneman (gantry)	Batch Pickling	" "	Runs crane for coil pickling - dips & removes coils from acid.	1
Hooker	Batch Pickling	P.C. Dock Bar & Structural Mill	Hooks & unhooks chains on billets for craneman.	1
Craneman (gantry)	Batch Pickling	" "	Runs crane for billet pickling- dips & rinses billets from acid	1
Operator	Continuous Pickling	Any of the 5 continuous lines (see Appendix 1)	Responsible for whole crew on pickle line, also operates automatic welder	1
Coiler	" "	" "	Responsible for exit end of line, sees coil cut to proper size & edges or trims when needed	1
Coiler Helper	" "	" "	Operates tension reel & assists coiler	1
Feeder	" "	" "	Responsible for feeding coil into the lines	1
Operator Helper	" "	" "	Responsible for cutting scrap heads off coils, before going into automatic welder	1

Appendix 2 (continued)

Job Title	Operation	Location	Description	Number of Workers Per Shift
Feeder Helper	Continuous Pickling	Any of the 5 continuous lines (see Appendix 1)	Prepares coil to feed into machine that feeds into pickle line	1
Stocker	" "	" "	Lines up coils that puts on conveyor to be run on line	1
Laborer	" "	" "	One laborer at entry end and one laborer at exit end. Entry end picks up scrap. Exit end picks up cut band	2

9 workers/shift on each continuous line - total: 45 workers/shift