U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT HE 78-105-537

BETHLEHEM STEEL CORPORATION
LACKAWANNA, NEW YORK

NOVEMBER 1978

I. TOXICITY DETERMINATION

A Health Hazard Evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) in the rolling mill, 614 Department, of Bethlehem Steel Corporation's Lackawanna, New York plant. This evaluation was conducted on July 18-20, 1978. Environmental samples were taken for total particulate, iron oxide, chromium, molybdenum, lead, manganese, copper, tin oxide, zinc oxide, and carbon monoxide.

Findings on the days of this evaluation indicate that environmental levels of the sampled contaminants were below the criteria used for this study. However, recommendations are made to provide for voluntary periodic blood lead analysis for any concerned employee in this area, and to conduct additional environmental sampling during the rolling of certain alloys.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnnati address.

Copies of this report have been sent to:

a) United Steelworkers of America, Local 2603
b) United Steelworkers of America International
c) Bethlehem Steel Corporation
d) U.S. Department of Labor, Region II
e) NIOSH, Region II

For the purpose of informing the approximately two hundred "affected employees", the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place near where exposed employees work.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6) authorizes the Secretary of Health, Education, and Welfare following a written request by an employer or authorized representative of employees to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health received such a request from Local 2603 of the United Steelworkers of America to evaluate potential health hazards in the rolling mill of Bethlehem Steel Corporation's Lackawanna, New York plant.

IV. HEALTH HAZARD EVALUATION

A. Process Description

The area of interest to this study is the rolling mill (614 department) of Bethlehem Steel Corporation's Lackawanna, New York plant. This department includes the soaking pits, rolling mill and associated cranes and service areas. The primary contaminants generated by this series of operations are metal fumes and dust from the various alloys being processed.

The initial operation in the area is the heating of metal ingots in the soaking pits. These pits are charged and emptied by two overhead cranes and heated by gas. Potential contaminants from this operation include carbon monoxide from incomplete combustion of the gas, and dust from the slag that drops off the ingots and is removed from the bottom of the pits in the cinder tunnel. The soaking pitmen and bottom-makers are the most likely employees to be exposed to toxic dust when they clean and repair the pits. The crane operators who work above the soaking pits are in air conditioned crane cabs, so their exposure is expected to be low.

The hot ingots are moved by crane from the soaking pits to a transfer table which moves them to the rolling mill. The transfer table is operated from an air conditioned enclosure or "pulpit" and little dust or other contaminant is generated at this step.

The reversing roller mill is operated from an air conditioned pulpit and the ingot is passed back and forth between the rollers until it has been reduced to a billet of desired dimensions. It is then sent to a scarfing operation, also controlled from an air conditioned pulpit, where the outer coating of impurities is removed with a combination of high pressure water and flame. The ends of the billet are then sheared off and the hot metal is removed from the area. This shearing step is also controlled from an air conditioned enclosure. While the first few passes of the ingot through the rollers creates some metal fume and dust particles, these are generally of a large diameter and the major source of toxic contaminant is the scarfing. A dense smoke was seen rising by the NIOSH investigators from the scarfer, especially during the scarfing of ingots identified as being from high sulfur heats. There is one overhead crane operator who works in this area in an open cab and his exposure could be quite high except that he does not spend his full work shift in the crane. There are also workers on the floor in the vicinity of the rolling mill and these men are potentially exposed to any contaminants.

Other employees routinely stationed in this department are the scarfer repairmen who spend much of their time in a workroom partitioned off from the general mill area. They are exposed to the fumes and dust from the mill and also to metal dust created in grinding and cleaning operations they perform in their workroom.

B. Evaluation Design and Methods

On July 18, 1978, a walk-through survey was conducted with representatives of the company and the union in the rolling mill area of this plant to become familiar with processes and to identify potential hazards. Personal and area environmental samples were collected on the 10:00 am - 6:00 pm shift on July 19, and on the 10:00 pm - 6:00 am shift on July 19-20.

Environmental samples were collected from breathing zones of employees in all parts of the 614 department by the use of battery powered personal sampling pumps worn by those employees. Similar sampling devices were also placed in crane cabs and other enclosures where employees worked. The sampling media in all cases was a preweighed 37 mm acrylonitrile - polyvinylchloride copolymer filter with a 0.8 μ pore size which was placed in a closed faced cassette in the employees breathing zone and connected by flexible tubing to a sampling pump worn on the employees belt. The sampling pumps were calibrated immediately prior to being taken into the field. The sampling rate was 1.5 lpm. The samples were subsequently analyzed for total particulate by reweighing, and for metals by atomic absorption. The choice of metal analysis was determined by the composition of the alloys being rolled at the time of the sampling, or, in the case of the scarfer repairmen, by the composition of the materials with which they were working.

Detector tube measurements were made for carbon monoxide on the top of the soaking pits, in areas where carbon monoxide was thought most likely to be found. Since minimal concentrations were measured in these areas, no further sampling for CO was done.

C. Evaluation Criteria

Table I lists various criteria used in the evaluation of the toxicity of the substances under study. Listed in this table are OSHA Standards (1), NIOSH Criteria Document Recommendations (2-4), and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists (5), along with health effects of each substance.

The evaluation criteria developed for total particulate, iron oxide and tin oxide, so called "nuisance" dusts, are based on the ability of such substances to reduce workplace visibility, create unpleasant deposits in the eyes, ears and nasal passages, or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by the rigorous cleansing procedures necessary for their removal. In addition, iron oxide exposure has been shown to create generalized discrete densities in chest x-ray films, although there has been no evidence of clinical disability. The evaluation criteria recommended for chromium, as insoluable compounds such as the oxide which is likely to be formed in this operation, is established to prevent pulmonary disease. Little information is available on the toxicity of molybdenum, although there is general agreement that it has a relatively low toxicity. Exposure to MoO_3 is irritating to the eyes and mucous membranes. Signs of molybdenum poisoning are loss of appetite, listlessness, and diarrhea. Conversely, there is extensive literature available detailing the toxic effects of lead on the kidney, the peripheral and central nervous systems, and the hematopoietic system. These effects are felt as weakness, tiredness, irratibility, digestive disturbances, high blood pressure, premature aging, nephritis, mental deficiencies, and other changes detected by testing. Manganese also affects the central nervous system. Early symptoms include langaror, sleepiness, and weakness in the legs. Health effects of copper include upper respiratory tract irritation, metalic taste, nausea, and metal fume fever. Zinc also produces metal fume fever, which is characterized by fever, chills, muscle pain, nausea and vomiting. Metal fume fever is a temporary condition of short duration, complete recovery occurs in 24 to 48 hours, and is not believed to have any chronic effects. Carbon monoxide displaces oxygen from the blood and affects the cardiovascular system since the heart has to circulate more blood to supply the oxygen required by the body. In addition, exposure to CO can result in headaches, fatigue, dizziness, and disturbance of coordination, judgement and psychomotor tasks.

D. Evaluation Results and Conclusions

Results of environmental samples for total particulates and metals are given in Tables II, III and IV. Both area and personal breathing zone samples were consistently below the evaluation criteria with the exception of the sixth and eighteenth samples in Table II and the sixth sample in Table III. These three samples are thought to be invalid since they deviate so greatly from the other NIOSH samples as well as the duplicate samples taken by the company.

Detector tube measurements for carbon monoxide, taken in the area of the soaking pits, indicated only a trace (less than 5 ppm) of CO. This is below the NIOSH recommended standard of 35 ppm.

A comparison of the results of samples taken by NIOSH with those taken by Bethlehem Steel indicated a good correlation in the metal fume samples. There was a significant difference between the two sets of samples for total particulate, however, with those taken by the company in most cases being higher than those taken by NIOSH. The companies sample results also showed a higher standard deviation. These differences are thought to be due to the collection media. The copolymer filters used by NIOSH are less hygroscopic and show more reproducability in reweighing than the cellulose acetate filters used by the company. Even though company samples for total particulate were higher, they were still below recommended maximum concentrations.

E. Summary and Conclusions

The results of samples taken by NIOSH and also samples taken by the company indicate that the levels of dust and metal fumes were below the evaluation criteria during the shifts in which those samples were taken. Carbon monoxide levels were also below the evaluation criteria. Discussions with employees indicated complaints of occasional eye, skin or upper respiratory tract irritation. Several employees said that irritation seemed to be worst when the mill was running alloys containing high concentrations of sulfur or lead. These same alloys were visually observed to produce the most emissions during the rolling and scarfing process. Sulfur dioxide from these ingots could be a contributing factor to irritation experienced by mill workers. However, since sulfur alloys were not known to be handled prior to the plant survey, no preparation was made to sample for sulfur dioxide.

V. RECOMMENDATIONS

It is suggested that voluntary periodic blood lead analyses be made available to any employee in this area who is concerned with potential lead exposure, although environmental sampling indicates that such exposure is probably minimal. Also, testing for sulfur dioxide is recommended during the rolling of a high sulfur heat, to document whether potenial exposures to that contaminant exist.

VI. REFERENCES

1. OSHA Safety and Health Standards, 25 CFR 1910.

2. Criteria for a Recommended Standard, Occupational Exposure to Inorganic Lead, Revised Criteria, NIOSH, 1978.

3. Criteria for a Recommended Standard, Occupational Exposure to Zinc Oxide, NIOSH, 1975.

4. Criteria for a Recommended Standard, Occupational Exposure to Carbon Monoxide, NIOSH, 1972.

5. Documentation of the Threshold Limit Values, American Conference of Governmental Industrial Hygienists, 1971.

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Table I

Evaluation Criteria

Bethlehem Steel Corporation
Lackawanna, N.Y.

HE 78-105

Substance	OSHA Standard	NIOSH Recommendation	Threshold Limit Value	Health Effects[a]
Total Particulate	15 mg/M^3 (b)	N.A. (C)	10 mg/M^3	Irritation of eyes and upper respiratory tract, reduced visibility, skin damage
Iron Oxide	10 mg/M^3	N.A.	10 mg/M^3	Benign lung changes
Chromium	1 mg/M^3	N.A.	1 mg/M^3	Pulmonary disease
Molybdenum	15 mg/M^3	N.A.	5 mg/M^3-Soluble compounds 10 mg/M^3-Insoluble compounds	Eye and mucous membrane irritation
Lead	0.2 mg/M^3	0.1 mg/M^3(d)	0.15 mg/M^3	Kidney, blood and nervous system effects
Manganese	5 mg/M^3 ceiling	N.A.	5 mg/M^3 ceiling	Affects central nervous system
Copper Fume	0.1 mg/M^3	N.A.	0.1 mg/M^3	Nausea, metal fume fever, upper respiratory tract irritation
Tin Oxide	15 mg/M^3	N.A.	10 mg/M^3	Same as Total Particulate
Zinc Oxide	5 mg/M^3	5 mg/M^3; 10 hr TWA; 15 mg/M^3 ceiling	5 mg/M^3	Metal fume fever
Carbon Monoxide	50 ppm	35 ppm; 10 hr TWA; 200 ppm ceiling	50 ppm	Heart effects

(a) Primary effects considered in establishing NIOSH criteria document when available, otherwise effects described by ACGIH.
(b) Criteria are 8 hour time weighted averages except as noted.
(c) Evaluation criteria not available for these substances.
(d) Lead levels in air should be maintained so that a workers blood lead concentration remains at or below 0.60 mg per 100 g.

Table II

Iron Oxide and Total Particulate Concentrations

Bethlehem Steel Corporation
Lackawanna, New York

July 19 & 20, 1978

HE 78-105

Description	Type *	Duration	Concentration, mg/M^3 Iron Oxide	Total Particulate
Soaking Pitman	P	10:40am-1:20pm	0.1	1.0
Soaking Pitman	P	2:02pm-5:22pm	0.4	3.5
Recorder Pulpit-On Desk Top	A	11:05am-2:35pm	0.1	1.0
Recorder Pulpit-On Desk Top	A	2:35pm-5:31pm	0.02	0.9
Bottom Maker	P	11:05am-1:17pm	0.2	1.0
Bottom Maker	P	2:08pm-5:44pm	4.9	93.1
Soaking Pitman	P	10:35am-1:23pm	0.1	1.6
Soaking Pitman	P	1:55pm-5:40pm	sample	lost
Pit Patcher	P	10:35am-1:18pm	0.1	2.0
Pit Patcher Helper	P	10:40am-1:20pm	0.3	6.5
Scarfing Pulpit-on top of TV	A	11:28am-3:10pm	0.1	0.7
Scarfing Pulpit on top of TV	A	3:10pm-5:33pm	0.1	0.9
Shear Pulpit-Near Breathing Zone of Operator	A	11:32am-3:15pm	N.D.	0.4
Shear Pulpit-Near Breathing Zone of Operator	A	3:15pm-5:30pm	N.D.	0.5
Mill Laborer	P	10:28am-3:32pm	0.5	1.8
Mill Laborer	P	3:32pm-5:22pm	0.2	1.8
Mill Laborer	P	10:25am-3:31pm	0.5	2.1
Mill Laborer	P	3:31pm-5:22pm	41.6	25.7
Doorman	P	10:30am-3:35pm	0.03	0.4
Doorman	P	3:40pm-5:44pm	sample	lost
Heater(south)	P	11:10am-1:19pm	0.04	0.8
Heater(south)	P	1:44pm-5:28pm	0.04	0.8
Heater(north)	P	10:12am-1:15pm	0.04	0.7
Heater(north)	P	1:40pm-5:31pm	0.04	0.8
Rolling Pulpit-2 ft. from Operator	A	11:20am-3:05pm	0.06	1.0
Rolling Pulpit-2 ft. from Operator	A	3:05pm-5:35pm	N.D.	1.4
Mill Crane Operator	P	10:20am-3:27pm	0.4	1.1
Mill Crane Operator	P	3:27pm-5:38pm	0.3	1.1
Scarfer Pulpit	A	10:40pm-4:52am	0.02	0.6
Shear Pulpit	A	10:45pm-1:43am	0.06	0.04
Shear Pulpit	A	1:43am-5:08am	0.02	0.1
Heater(south)	P	10:00pm-1:48am	0.04	0.7
Heater(south)	P	1:48am-5:20am	0.04	1.0
Pit Crane Operator	P	10:10pm-2:03am	0.05	0.7
Pit Crane Operator	P	2:03am-5:37am	0.1	1.0
Heater(north)	P	10:15pm-1:57am	0.05	1.0
Heater(north)	P	1:57am-5:23am	0.03	0.1
Pit Crane	A	11:43pm-5:25am	0.1	1.2
Soaking Pitman	P	11:32pm-1:52am	0.1	1.4
Soaking Pitman	P	1:52am-5:18am	0.1	0.9
Doorman	P	10:15pm-1:55am	0.02	0.5
Doorman	P	1:55am-5:30am	0.03	0.6
Bottom Maker	P	10:18pm-1:50am	0.2	1.1
Bottom Maker	P	1:50am-5:17am	0.1	1.2
Soaking Pitman	P	10:20pm-1:55am	0.1	1.3
Soaking Pitman	P	1:55am-5:21am	0.1	1.1
Mill Laborer	P	10:47pm-2:20am	0.1	0.9
Mill Laborer	P	2:20am-4:51am	0.1	1.1
Mill Laborer	P	10:50pm-2:00am	0.2	1.1
Mill Laborer	P	2:00am-4:50am	0.1	1.0
Mill Crane Operator	P	10:53pm-5:10am	0.9	1.9
Rolling Pulpit-2 ft. from Operator	A	10:32pm-5:02am	0.04	0.8
Recorder Pulpit-On Desk	A	10:23pm-5:25am	0.03	0.6
Utility Man	P	10:34pm-5:04am	0.06	1.3

* "P" indicates personal breathing zone samples.
"A" indicates samples taken in area where worker spends most of the shift.

Table III

Lead, Manganese, Chromium and Molybdenum Concentrations

Bethlehem Steel Corporation
Lackawanna, New York

July 19 & 20, 1978

HE 78-105

Description	Type*	Duration	Concentration, mg/M^3			
			Lead	Manganese	Chromium	Molybdenum
Doorman	P	1:55am-5:30pm	<0.01	<0.01	<0.01	<0.03
Heater(north)	P	1:57am-5:23am	< 0.01	< 0.01	< 0.01	< 0.03
Soaking Pitman	P	1:52am-5:18am	0.02	<0.01	<0.01	<0.03
Heater(south)	P	1:48am-5:20am	<0.01	<0.01	<0.01	<0.03
Pit Crane Operator	P	2:03am-5:37am	0.01	<0.01	<0.01	<0.03
Mill Laborer	P	2:20am-4:51am	0.19	<0.01	<0.02	<0.04
Bottom Maker	P	1:50am-5:17am	<0.01	<0.01	<0.01	<0.03
Mill Laborer	P	2:00am-4:50am	<0.01	<0.01	<0.02	<0.04
Shear Pulpit	A	1:43am-5:08am	0.02	<0.01	<0.01	<0.03
Soaking Pitman	P	1:55am-5:21am	<0.01	<0.01	<0.01	<0.03
Shear Pulpit	A	10:45pm-1:43am	-	-	<0.01	<0.04
Mill Laborer	P	10:47pm-2:20am	-	-	<0.01	<0.04
Mill Laborer	P	10:50pm-2:00am	-	-	0.01	<0.04
Mill Crane Operator	P	10:53pm-5:10am	-	-	<0.01	<0.04
Scarfer Pulpit	A	10:40pm-4:52am	-	-	<0.01	<0.04
Bottom Maker	P	10:18pm-1:50am	-	-	<0.01	<0.04
Roller Pulpit	A	10:32pm-5:02am	-	-	<0.01	<0.04
Recorder Pulpit	A	10:23pm-5:25am	-	-	<0.01	<0.04
Doorman	P	10:15pm-1:55am	-	-	<0.01	<0.04
Soaking Pitman	P	11:32pm-1:52am	-	-	<0.02	<0.05
Soaking Pitman	P	10:20pm-1:55am	-	-	<0.01	<0.04
Heater(south)	P	10:08pm-1:48am	-	-	<0.01	<0.04
Utility Man	P	10:34pm-5:04am	-	-	<0.01	<0.04
Pit Crane	A	11:43pm-5:25am	-	-	<0.01	<0.04
Heater(north)	P	10:15pm-1:57am	-	-	<0.01	<0.04
Soaking Pitman/ Pit Crane Operator	P	10:10pm-2:03am	-	-	<0.01	<0.04

*"P" indicates personal breathing zone samples.
"A" indicates samples taken in area where worker spends most of the shift.

Table IV

Samples Taken on Scarfer Repairmen

Bethlehem Steel Corporation
Lackawanna, New York

July 19 & 20, 1978
HE 78-105

Duration	Concentration, mg/M^3 Copper	Zinc	Total Particulate
10:10am-1:57 pm	0.02	0.01	3.1
10:18am-1:57pm	0.05	0.02	0.9
2:15pm-5:25pm	<0.01	0.01	0.8
10:41pm-4:50am	<0.01	<0.01	0.7