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 NO. 78-15-524

C F & I STEEL
PUEBLO, COLORADO

SEPTEMBER 1978

I. TOXICITY DETERMINATION

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at the C F & I Steel Company in the Ore Handling Department, Pueblo, Colorado, on June 6-8, 1978. At the time of this evaluation, breathing zone air samples were taken on workers for crystalline silica, total particulate, iron ore dust, and lead. Concentrations of crystalline silica, total particulate, iron ore dust, and lead exceeded the most recent evaluation criteria. Overexposure to crystalline silica was found in one out of five samples. Total particulate overexposures were found in 12 out of 30 samples (40%). Iron ore dust overexposures were found in 9 out of 30 samples (30%). Only one sample out of 30 showed an overexposure to lead (.03%). Overexposures to total particulate and iron ore dust were the most significant findings during this evaluation. All workers are provided respirators. However, the respirator program at C F & I Steel is inadequate due to the following: (1) foremen and other workers wear moustaches and sideburns that interfere with the proper fit of the respirators; (2) employees do not always wear the respirators; (3) C F & I does not have an adequate respirator-fitting program in this department; and (4) employees are not given physical examinations before they are told to wear the respirators.

A large percentage (approximately 60%) of the workers were interviewed. Workers had complaints such as headaches, coughing up of iron ore dust, shortness of breath, nasal congestion, bronchitis, persistent coughing--all of which could be attributed to the high dust exposures found during this survey. A health hazard existed during this survey from both high exposures to dust and the improper use of respiratory protective equipment.

II. DISTRIBUTION AND AVAILABILITY

Copies of this determination report are currently available upon request from NIOSH, Division of Technical Services, Information 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 Cincinnati address.

Copies of this report have been sent to:

1. C F & I Steel
2. United Steelworkers of America - Pittsburgh
3. United Steelworkers of America - Denver
4. United Steelworkers of America - Pueblo
5. U.S. Department of Labor/OSHA - Region VIII
6. NIOSH - Region VIII

For the purpose of informing approximately 200 affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

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 any 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.

NIOSH received such a request from the United Steelworkers of America in Pueblo, Colorado, to evaluate potential exposures associated with the preparation and handling of iron ore to be used in the production of iron and steel.

IV. HEALTH HAZARD EVALUATION

A. Process Evaluated

The Ore Handling Department at C F & I Steel receives raw iron ore from various parts of the country. The ore is crushed and milled into a fine powder. Workers in this area were monitored for exposures to iron ore dust, crystalline silica, lead, and total particulate.

B. Evaluation Design

There were approximately 50 workers on each shift in the specific area of this request. Workers who were likely encountering the highest exposures (as described by plant management and union officials) were monitored. These included pug mill operators, burner helpers, tertiary crusher operators, conveyor tenders, and screen tenders. A large number of the workers were interviewed, with questions directed at their work history and respiratory problems.

C. Evaluation Methods

All iron ore dust and lead samples were collected on 37 mm filters using vacuum pumps operated at 1.5 liters per minute. These samples were analyzed by atomic absorption spectroscopy according to NIOSH analytical procedure No. 173. Total particulate samples were taken on 37 mm pre-weighed filters

using vacuum pumps operated at 1.5 liters per minute. These were weighed to an accuracy of 0.01 milligrams per sample. Crystalline silica samples were taken using cyclones with 37 mm filters using vacuum pumps operated at 1.7 liters per minute. These samples were analyzed by x-ray diffraction.

D. Criteria for Assessing Workroom Concentrations of Air Contaminants

Three sources of criteria are generally used to assess workroom concentrations of air contaminants: (1) NIOSH criteria for recommended standards; (2) recommended Threshold Limit Values (TLVs) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), 1977; and (3) Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.1000), January 1976. NIOSH criteria and ACGIH TLVs represent the most recent and relevant recommendations and are given prominence in this evaluation.

	Permissible Exposures 8-Hour Time-Weighted Exposure Basis (mg/M^3)		
Substances	NIOSH Criteria for Recommended Standard	TLV	Current OSHA Standard
Crystalline Silica (respirable)	0.05	10 mg/m / % Respirable Quartz + 2	
Total Particulate	---	10.0	10.0
Iron Ore Dust (Iron Oxide Dust)	---	10.0	10.0
Lead	0.1*	0.15	0.2

* OSHA has proposed, and NIOSH supported, lowering the lead standard to 0.1 mg/M^3

mg/M^3 = milligrams of substance per cubic meter of air

Occupational health standards are established at levels designed to protect individuals occupationally exposed to toxic substances on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

E. Toxicology

Crystalline Silica--exposures at levels above the recommended criteria can produce a fibrotic condition of the lungs (silicosis). This is a disabling disease that can lead to permanent disability and death. Maintaining a worker's exposure below 0.05 mg/M^3 should prevent any occupational disease.

Total Particulate--exposures should be controlled so that workers are not exposed to over 10 mg/M^3. Respirators should be worn when levels exceed this concentration.

Iron Ore Dust--maintaining exposures below 10 mg/M^3 should prevent any occupational disease which could be attributed to iron ore dust. Chronic exposures to high concentrations of this dust may produce a disease called siderosis. The main complication of this disease is that it prevents getting a good x-ray of the lungs should another lung disease occur. Siderosis does not decrease pulmonary function or cause any other metabolic disturbances.

Lead--prolonged exposures to lead or its inorganic compounds from inhalation or ingestion of vapor, fume, or dust results in gastrointestinal disturbances such as anorexia, weight loss, malnutrition, colic, constipation, and abdominal discomfort and tenderness. Neurologic symptoms can include weakness, lassitude, tremor, insomnia, and motor weakness that may include paralysis of the extensor muscles of the wrists and ankles. Encephalopathy can result with the most severe lead exposures.

F. Environmental Results and Discussion

Results of environmental samples showed that workers were grossly overexposed to iron ore dust and total particulate. Iron ore dust reached as high as 592 mg/M^3. The most recent evaluation criteria of 10 mg/M^3 was exceeded in 40% of the samples taken for iron ore dust. Total particulate samples also exceeded the most recent evaluation criteria of 10 mg/M^3 in 30% of the samples. One out of five samples taken for crystalline silica exceeded the evaluation criteria of .05 mg/M^3. For a detailed description, please refer to Tables I, II, and III. About two-thirds of the workers were interviewed. Examination of these interviews showed that worker complaints were compatible with overexposures to iron ore dust. Very few of the workers had complaints such as extreme shortness of breath, wheezing, and chest tightness which could be attributed to silicosis or other chronic lung diseases.

G. Conclusions

Results of environmental data and worker interviews illustrate that a health hazard existed during this evaluation. Until adequate ventilation can be installed, a good respirator program should be instituted and enforced.

V. RECOMMENDATIONS

1. NIOSH-approved respirators which meet OSHA regulations should be used.

2. Workers should be provided with a clean place to eat, and eating should be prohibited in the work area.

3. All workers should be clean shaven, since it is inevitable that it will become a problem where respirators are required. It is impossible to get an adequate fit over facial hair. Therefore, every worker should be clean shaven just prior to his tour of duty.

4. There is no local exhaust ventilation or general ventilation in this facility. Each area would have to be evaluated for its specific ventilation needs and requirements.

VII. AUTHORSHIP AND ACKNOWLEDGMENTS

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Table I

Breathing Zone Air Concentrations of
Respirable Crystalline Silica (Quartz and Cristobalite) and Total Particulate

C F & I Steel
Pueblo, Colorado

June 6-8,1978

Sample Number	Location	Job Classification	Time of Sample	Crystalline Silica		Total Particulate (mg/M^3)
				Quartz (mg/M^3)	Cristobalite (mg/M^3)	
2859	Ore Handling	Wind Boxes	2:41 PM-10:30 PM	0.04	*	0.24
2865	Ore Handling	Pug Mill	2:40 PM-10:38 PM	0.71	*	16.0
2845	Ore Handling	Wind Boxes	10:40 PM- 6:30 AM	0.007	*	2.7
2851	Ore Handling	Coke Screen Cleaner	10:45 PM- 6:10 AM	*	*	0.57
2862	Ore Handling	Tripper Tender	2:35 PM- 7:35 PM	*	*	0.29
		EVALUATION CRITERIA		0.05	0.05	10.0
		LABORATORY LIMIT OF DETECTION		0.03 mg/sample	0.03 mg/sample	0.01 mg/sample

* = below laboratory limit of detection

Table II

Breathing Zone Air Concentrations of
Iron Dust, Lead, and Total Particulate

C F & I Steel
Pueblo, Colorado

June 6-8, 1978

Sample Number	Location	Job Classification	Time of Sample	Iron Dust (mg/M^3)	Lead (mg/M^3)	Total Particulate (mg/M^3)
412	Pug Mill	Pug Mill Operator	6:20 AM- 1:10 PM	260.0	0.06	1/
383	Ore Handling	Burner Helper	6:25 AM- 1:48 PM	27.0	0.01	69.0
424	Ore Handling	Wind Boxes	6:30 AM- 1:40 PM	12.0	*	34.0
410	Ore Handling	Tertiary Crushers	6:42 AM- 1:08 PM	3.0	*	8.0
419	Ore Handling	Secondary Crushers	6:47 AM- 1:10 PM	7.0	*	23.0
431	Ore Handling	Bobcat Operator	6:52 AM- 2:35 PM	0.06	*	2.0
432	Ore Handling	Feeder Plow Operator	6:55 AM-12:05 PM	1.4	*	5.0
413	Ore Handling	Tripper	6:58 AM-10:20 AM	0.6	*	3.0
382	Ore Handling	3-Conveyor Tender	7:00 AM-11:30 AM	592.0	0.19	1/
377	Ore Handling	Primary Crushers	7:00 AM-11:30 AM	4.0	*	13.0
411	Ore Handling	Screen Tender	7:02 AM- 2:00 PM	59.0	0.04	1/
415	Ore Handling	Millwright	7:05 AM- 2:25 PM	0.23	*	1.36
368	Ore Handling	Screen Tender	2:40 PM-10:40 PM	9.3	0.01	55.0
361	Ore Department	Primary Crusher Opr.	10:30 PM- 6:30 AM	5.4	*	19.0
370	Ore Department	Pay Loader Operator	10:40 PM- 6:10 AM	0.04	*	0.39
380	Ore Handling	Feeder Plow Operator	2:50 PM-10:00 PM	11:0	*	42.0
367	Ore Department	Pay Loader Operator	2:44 PM-10:00 PM	0.13	*	17.0
374	Ore Prep.	Switchman	2:58 PM-10:35 PM	1.6	*	6.23
373	Ore Handling	Foreman (car dumper)	2:30 PM- 9:30 PM	1.3	*	5.2
379	Ore Prep.	Primary Crusher Opr.	3:00 PM-10:35 PM	1.1	*	3.9
363	Ore Department	#3 Conveyor Tender	10:30 PM- 6:30 AM	2.6	*	8.4
376	Ore Department	Switchman (loader)	10:40 PM- 6:30 AM	1.3	*	6.6
381	Ore Department	Tertiary Crusher Opr.	2:28 PM-10:20 PM	17.0	0.03	59.0

Table II (continued)

Breathing Zone Air Concentrations of
Iron Dust, Lead, and Total Particulate

C F & I Steel - Pueblo, Colorado
June 6-8, 1978

369	Ore Prep.	#3 Conveyor Tender	3:10 PM-10:35 PM	3.4	0.01	14.6
362	Ore Department	Secondary Crushers	10:28 PM- 6:32 AM	0.62	*	2.8
558	Ore Handling	Feeder Plow Operator	10:45 PM- 5:00 AM	0.2	*	1.5
366	Ore Department	Burner Man Helper	10:35 PM- 6:30 AM	1.2	*	9.5
371	Ore Handling	Burner Man Helper	2:45 PM-10:12 PM	1.4	*	4.2
372	Ore Department	Secondary Crusher Opr.	2:30 PM-10:35 PM	3.9	*	12.0
364	Ore Department	Screen Tender	10:30 PM- 6:30 AM	14.0	*	55.0
375	Ore Department	Foreman (car dumper)	10:35 PM- 5:30 AM	193.0	*	1/
		EVALUATION CRITERIA		10.0	0.1	10.0
		LABORATORY LIMIT OF DETECTION		0.002 mg/sample	0.003 mg/sample	0.01 mg/sample

1/ = overloaded filter

Table III

Bulk Iron Ore Samples Analyzed for Iron and Lead

C F & I Steel
Pueblo, Colorado

June 6-8, 1978

Sample Number	% Iron	% Lead
1	44	---
2	42	---
3	42	---
LABORATORY LIMIT OF DETECTION	0.002 mg/sample	0.003 mg/sample