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 78-94-538
MARK STEEL CORPORATION
SALT LAKE CITY, UTAH

NOVEMBER 1978

I. TOXICITY DETERMINATION

It has been determined that employees working at the abrasive blasting operation are potentially exposed to toxic airborne concentrations of inorganic lead and inorganic arsenic. This determination was based on the high levels of these substances found in air samples collected on June 20-21, 1978. Workers are required to wear National Institute for Occupational Safety and Health (NIOSH) certified respirators at all times which may obviate the health hazard. It has also been determined that employees working in the abrasive blasting operation are not exposed to toxic levels of cadmium. This determination is based on the absence of detectable levels of cadmium in the samples collected on June 20, 1978. It was also determined that employees in this work area may be exposed to excess levels of crystalline silica, but the results were not conclusive. This determination is based on the fact that one out of four samples for crystalline silica taken on June 20-21, 1978, showed a small amount of crystalline silica which nevertheless exceeded NIOSH criteria.

The above determinations and conclusions were made concerning the constituents of the abrasive blasting grit used at the Mark Steel Corporation. More detailed information is contained in the body of the report. Recommendations are included in Section V of the report.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from the National Institute for Occupational Safety and Health, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety days, the report will

be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained by the NIOSH Publications Office at the Cincinnati address.

Copies of the report have been sent to:

(a) Mark Steel Corporation

(b) U.S. Department of Labor - Region VIII

(c) Utah State Designated Agency

(d) NIOSH - Region VIII

For the purpose of informing the two affected employees, the employer will post the report in a prominent place(s) accessible to the employees for a period of thirty 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 from 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.

The National Institute for Occupational Safety and Health received such a request from a representative of the Mark Steel Corporation, Salt Lake City, Utah, concerning the health hazards of an abrasive (made from lead smelter slag) used in their abrasive blasting operation.

IV. HEALTH HAZARD EVALUATION

A. Description of Plant Process

On June 20, 1978, an initial visit to the Mark Steel Corporation was made by NIOSH. The Mark Steel Corporation is involved in the custom fabrication of steel into such products as pressure vessels, tanks, containers, etc. Steel is cut, shaped, and welded into the various forms and sizes specified in the final product. Some of the products are painted outdoors. Prior to painting, the pieces are cleaned in an abrasive blasting operation. One worker is responsible for the blasting operation.

Occasionally, another worker will substitute. The blasting is done outdoors and the grit is a product made with the slag from lead smelting operations. The grit contains a small amount of crystalline silica (approximately 1% or less) and residuals of lead, arsenic, and cadmium. The abrasive blasting operator wears a NIOSH certified half-mask air purifying respirator in addition to eye and face protection.

B. Evaluation Methods

1. Environmental

Environmental samples for respirable crystalline silica were collected with MSA Model G personal sampling pumps in conjunction with 10 millimeter cyclones and polyvinyl chloride (FWS-B) filters. The sampling rate was 1.7 liters per minute (lpm). The samples were analyzed for silica by X-ray diffraction.

Environmental samples for lead, arsenic, and cadmium were collected with membrane filters (0.8 micrometers pore size) and MSA Model G personal sampling pumps. The sampling rate was 2.0 liters per minute. Lead and cadmium samples were analyzed by atomic absorption spectrophotometry. Arsenic samples were analyzed by the automated arsine generation method.

C. Evaluation Criteria

1. Environmental Criteria

The evaluation criteria were either the U.S. Department of Labor's (OSHA) Federal Standards for the particular substance or the limits recommended in NIOSH Criteria Documents. The following table lists the substances with the respective OSHA standards and NIOSH recommended time-weighted average limits:

	OSHA STANDARD	NIOSH CRITERIA DOCUMENT RECOMMENDED LIMIT
Inorganic Lead	0.2 mg/m^3**	0.10 mg/m^3
Inorganic Arsenic	0.01 mg/m^3 (10 ug/m^3***)	0.002 mg/m^3 (2.0 ug/m^3)
Cadmium Dust	0.2 mg/m^3	0.04 mg/m^3 (40 ug/m^3)
Crystalline Silica (Respirable)	$\frac{10\ mg/m^3}{\%SiO_2+2}$	0.05 mg/m^3* (50 ug/m^3)

* NIOSH recommends a limit of 0.05 mg/m^3 for all forms of crystalline silica (SiO_2) in respirable samples.

** mg/m^3 - milligrams per cubic meter

*** ug/m^3 - micrograms per cubic meter

2. Medical Criteria

The adverse effects from exposures to substances evaluated on the abrasive blaster vary with the agent. No medical investigation was made by NIOSH at the Mark Steel Corporation, but the effects of exposure to the substances evaluated are described below:

Crystalline Silica - Finely divided silica in the free state can cause silicosis, a fibrotic lung disease. This form of pneumonoconiosis usually occurs after a number of years of exposure, although it can occur in a short time with severe exposures. The acute form may be recognized after 8 to 18 months of exposure. Patients may note severe shortness of breath and rapid breathing. Chest X-rays may show fibrosis. However, an uncomplicated case may progress to an advanced stage without showing much functional impairment in the individual. Chronic silicosis is the type often observed in industry and usually occurs after years of exposure to silica dust.[1]

Inorganic Lead - The adverse effects of lead poisoning in man are well known. Some of these adverse effects are loss of appetite, metallic taste in the mouth, constipation, anemia, weakness, muscle and joint pains, fine tremors, encephalopathy, irreversible kidney function, and colic. With lead colic there may be severe abdominal pain, such peripheral and central nervous system effects as loss of motor function and extensor muscle weakness occur in severe lead poisoning.[2]

Inorganic Arsenic - Inhalation of inorganic arsenic compounds is the most common cause of chronic arsenic poisoning in the industrial setting. There are three phases of arsenic poisoning: first, the worker may complain of weakness, loss of appetite, nausea, and vomiting; second, there may be conjunctivitis, upper respiratory tract irritation, and perforation of the nasal septum; and third, the worker may complain of symptoms of peripheral neuritis in hands and feet. In more severe cases, motor paralysis may occur.[3] Additionally, evidence is now available which suggests that arsenic compounds may cause lung and skin cancer.

Cadmium - Acute effects from cadmium occur when the fumes or dust are inhaled in sufficient amounts after the cadmium is heated. Acute effects are after a latent period of a few hours, irritation of the upper respiratory tract, cough, chest pain, sweating, and chills. Eight to 24 hours after acute exposure, severe pulmonary effects such as dyspnea, chest pain, and pulmonary edema may develop. Chronic cadmium poisoning manifests itself in a characteristic form of emphysema. Systemic changes due to cadmium absorption include damage to the kidneys and anemia.[4]

D. Evaluation Results and Discussion

Samples for cyrstalline silica (SiO_2), lead, arsenic, and cadmium were collected on the abrasive blasting operator over a two-day period. Table I contains the results of respirable dust samples for SiO_2. Although the bulk abrasive grit sample showed less than 1% SiO_2, samples for SiO_2 were still collected. If SiO_2 percentages are less than 1% in a sample, the respirable OSHA dust limit standard calculates out to 5.0 milligrams per cubic meter of air (mg/m^3). Three out of four samples showed no silica. The respirable dust concentrations in these samples were 3.4, 4.4, and 4.7 mg/m^3 (which were all below 5.0 mg/m^3). One sample showed 5% silica, but the total milligrams of silica in the sample (0.04 mg) was barely over the lower detectable limit of 0.03 mg of SiO_2. The respirable dust level in this sample (2.68 mg/m^3) exceeded the calculated OSHA standard of 1.43 mg/m^3. Additionally, the SiO_2 air concentration is 0.13 mg/m^3 which exceeds the NIOSH criteria of 0.05 mg/m^3 for respirable SiO_2. However, with such small amounts of SiO_2, the detection of any SiO_2 in the sample would probably mean the limits would be exceeded even though a silica hazard may not necessarily exist.

Table II contains the results of samples collected for lead and cadmium at the abrasive blasting operation on June 20, 1978. No cadmium was detected in any of the six samples taken on the operator over about five and one-half hours. The time-weighted average lead concentration over 314 minutes was 1.03 mg/m^3. One sample (AA 22) showed a lead concentration of 2.34 mg/m^3. This sample (the first one collected) had loose dust, indicating that the sample was taken for too long a period. Subsequent filters were changed at much shorter intervals. If the last five samples were averaged, the time-weighted average was 0.45 mg/m^3. The Federal standard for lead is 0.20 mg/m^3 and NIOSH recommended a limit of 0.10 mg/m^3. Even the lower time-weighted average exceeded both criteria.

Table III contains the results of samples collected for arsenic at the abrasive blasting operation on June 21, 1978. Arsenic was found in all four samples taken; the time-weighted average concentration over a 262 minute period was 45.1 ug/m^3. The Federal standard for inorganic arsenic is 10 ug/m^3 (micrograms per cubic meter). NIOSH recommends a limit of 2 ug/m^3 for inorganic arsenic. The arsenic levels exceed both of these limits.

E. Conclusions

It was determined that airborne concentrations of inorganic lead and inorganic arsenic are potentially hazardous at the abrasive blasting operation based on air samples collected on June 20-21, 1978. It was also determined that cadmium was not a health hazard. There may be a crystalline silica hazard at the abrasive blasting operation, but this cannot be conclusively stated since only one of four samples detected SiO_2 at levels greater than the NIOSH recommended limit. The abrasive blasting operator wore a NIOSH certified half-mask air purifying respirator at all times for personal protection, which may obviate potential health hazards from these substances.

V. RECOMMENDATIONS

1. It is recommended that a substitute grit which does not contain these substances be considered as an alternative.

2. It is recommended that if a substitute grit is not feasible, the abrasive blasting operator be monitored medically for lead, arsenic, and crystalline silica as outlined in the NIOSH Criteria Documents for these substances.

3. The abrasive blasting operator should be provided with all the elements of a sound respirator program which must include the use of a half-mask air purifying respirator with a high-efficiency filter (as mandated in the OSHA Standard for Inorganic Arsenic).

VI. REFERENCES

1. NIOSH: "Criteria for a Recommended Standard...Occupational Exposure to Crystalline Silica", Department of Health, Education, and Welfare Publication No. (NIOSH) 75-120, 1974.

2. NIOSH: "Criteria for a Recommended Standard...Occupational Exposure to Inorganic Lead (Revised Criteria - 1978)", Department of Health, Education, and Welfare Publication No. (NIOSH) 78-158, 1978.

3. NIOSH: "Occupational Diseases - A Guide to Their Recognition", Department of Health, Education, and Welfare Publication No. (NIOSH) 77-181, pp 326-328, 1977.

4. NIOSH: "Occupational Diseases: A Guide to Their Recognition", Department of Health, Education, and Welfare Publication No. (NIOSH) 77-181, pp 345-348, 1977.

VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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TABLE I. CRYSTALLINE SILICA (SiO_2) LEVELS IN RESPIRABLE DUST SAMPLES COLLECTED AT THE ABRASIVE BLASTING OPERATION AT THE MARK STEEL CORPORATION PLANT, JUNE 20-21, 1978.

Filter#	Date	Area	Samp. Period	Tot. Time	Mg SiO_2*	Mg SiO_2/m^3**	Mg Dust	%SiO_2	Resp. Dust Conc (mg/m^3)	Calc. OSHA Standard
FWS 2994	6/20	Abrasive Blasting	8:20 am - 11:42 am	202 min.	ND***	<.1	1.18	0%	3.44	5.0 mg/m^3
FWS 2991	"	Abrasive Blasting	12:47 pm - 3:47 pm	180 min.	0.04	0.13****	0.82	5%	2.68****	1.43 mg/m^3
FWS 2992	6/21	Abrasive Blasting	7:38 am - 11:19 am	221 min.	ND	<.1	1.77	0%	4.70	5.0 mg/m^3
FWS 2996	"	Abrasive Blasting	12:52 pm - 3:15 pm	143 min.	ND	<.1	1.06	0%	4.40	5.0 mg/m^3

* Mg SiO_2 - milligrams of crystalline silica in sample

** Mg SiO_2/m^3 - concentration of crystalline silica in sample in milligrams per cubic meter of air

*** ND - not detected; limit of detection is 0.03 milligrams per sample

**** respirable dust concentration exceeded both the NIOSH criteria and the calculated OSHA standard

TABLE II. CONCENTRATIONS OF LEAD AND CADMIUM IN MILLIGRAMS PER CUBIC METER (Mg/m^3) IN BREATHING ZONE SAMPLES COLLECTED AT THE ABRASIVE BLASTING OPERATION AT THE MARK STEEL CORPORATION PLANT, JUNE 20, 1978/

Sample#	Operation	Sample Period	Total Time	Mg Lead	Conc. Lead	Mg Cadmium
AA 22	Abrasive Blasting	8:20 am - 9:57 am	97 min.	0.450	2.34 mg/m^3	ND*
AA 23	Abrasive Blasting	9:58 am -10:50 am	52 min.	0.070	0.66 mg/m^3	ND
AA 4	Abrasive Blasting	10:53 am -11:42 am	49 min.	0.043	0.44 mg/m^3	ND
AA 3	Abrasive Blasting	12:47 pm - 1:40 pm	53 min.	0.027	0.25 mg/m^3	ND
AA 15	Abrasive Blasting	1:41 pm - 2:06 pm	25 min.	0.022	0.44 mg/m^3	ND
AA 5	Abrasive Blasting	2:48 pm - 3:25 pm	37 min.	0.032	0.43 mg/m^3	ND

* ND = none detected; limit of detection 2 micrograms of cadmium per sample.

TABLE III CONCENTRATIONS OF ARSENIC IN MICROGRAMS PER CUBIC METER (Ug/m^3) IN BREATHING ZONE SAMPLES COLLECTED AT THE ABRASIVE BLASTING OPERATION AT THE MARK STEEL CORPORATION PLANT, JUNE 21, 1978.

Sample #	Operation	Sample Period	Total Time	Micrograms Arsenic	Conc.of Arsenic
AA 20	Abrasive Blasting	7:38 am - 8:23 am	45 min.	3 ug*	33.3 ug/m^3
AA 27	Abrasive Blasting	8:25 am - 9:08 am	43 min.	3 ug	34.9 ug/m^3
AA 25	Abrasive Blasting	9:45 am -11:19 am	94 min.	13 ug	69.1 ug/m^3
AA 13	Abrasive Blasting	1:55 pm - 3:15 pm	80 min.	4 ug	29.0 ug/m^3

*Limit of detection for arsenic - .03 ug per sample.