U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 77-40-424

KEYSTONE RESOURCES
CUSTOM RECOVERY DIVISION
MARS, PENNSYLVANIA 16046

SEPTEMBER, 1977

I. TOXICITY DETERMINATION

A health hazard evaluation was conducted at the Keystone Resources, Custom Recovery Division Plant during April 19-20, 1977. The purpose of the evaluation was to determine whether exposures to lead were posing a health hazard to the employees. The medical evaluation of the individual workers consisted of a medical history; a physical examination; blood sampling for BUN, creatinine, free erythrocyte protoporphyrin (FEP), hematocrit, hemoglobin, and lead determinations; and urine sampling for lead and creatinine determination. In addition, the company's medical program for monitoring the workers was reviewed and blood lead level data was obtained from company officials. The environmental evaluation consisted of a walk-thru survey, observation of work practices, and obtaining air sample data from the company and the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA). On the basis of the survey findings it is obvious that a significant health hazard did exist in the past at this plant but is now apparently being controlled to acceptable proportions. The company has achieved this hazard control through a combination of medical monitoring, environmental controls, and good work practices. It is important that the company continue these hazard control programs paying close and continual attention to all facets thereof.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this report are available 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 22152. Information regarding its availability can be obtained from the NIOSH Publications Office at the Cincinnati address. Copies have been sent to:

1. Keystone Resources, Custom Recovery Division, Mars, Pennsylvania
2. President, Local #14277, United Steel Workers of America
3. National Office, United Steel Workers of America
4. OSHA, Region III
5. NIOSH, Region III

To inform the approximately 53 affected employees, copies of the report shall be posted in a place prominent to these employees for a period of 30 days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 699(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.

On January 24, 1977, the National Institute for Occupational Safety and Health (NIOSH) received such a request, from an authorized employee representative, requesting a health hazard evaluation at the Keystone Resources, Custom Recovery Division, Mars, Pennsylvania. The requesting party was concerned about the health status of workers at the plant who were exposed to lead. Although fully aware of the company program for monitoring the workers, the requesting party felt that an independent evaluation by NIOSH would be of value.

IV. HEALTH HAZARD EVALUATION

A. Facility and Process Description

The Custom Recovery Division processes scrap metals from the Western Electric Company on a sub-contract basis. These scrap materials may take the form of anything from telephone booths to lead sheathed telecommunications cable. Although the safety hazards are varied, the principal environmental health hazard results from the company's role as a secondary lead smelter.

The company currently employs about 53 production employees on a 3-shift per day basis (24 on day, 21 on evening, and 8 on midnight). The eight employees on the midnight shift started employment at the plant the day prior to the NIOSH survey and were not included in the NIOSH medical evaluations.

Since exposure to lead appears to be the only significant environmental health hazard at this plant, only the process for handling the lead is described. The lead sheathed cable arrives at the plant on large reels. The first processing step is to cut the cable to 4' or 5' lengths at either of 4 shears. After shearing, if the pieces of cable are strippable (1 1/2 in. diameter or greater), they are run through a stripping machine, the lead sheathing is removed by hand, and the resulting portions are classified and stored for shipment. If not strippable (less than 1 1/2 in. diameter) the cable lengths are placed in racks and moved to the furnaces where the lead sheathing is "sweated" off. The resultant lead pigs are stored for shipment. The major exposures to lead are at the shears, stripping machine, and furnace building. Altogether about 4 million pounds of metals (20-25% lead) are processed at this facility per month.

B. Evaluation Methods

1. Medical

The medical evaluations (37 employees) included interviews, physical examinations, and biological sampling/testing. The interviews consisted of having the employees sign a consent form, after which a brief questionnaire was administered to obtain data on occupational as well as past and present medical histories. The physical examinations consisted of noting skin and conjunctiva color changes, gum lead lines, tremors, biceps tendon reflexes, wrist strength, and ankle strength. The biological testing included blood sampling for BUN, creatinine, FEP, hematocrit, hemoglobin, and lead determinations, and urine sampling for lead, creatinine, and specific gravity determinations.

The blood lead levels were determined by a Delves cup atomic absorption method; the urine lead levels by a chelation/extraction method with atomic absorption analysis; and the FEP's by an ethyl acetate/HCl extraction method using zinc protoporphyrin as a primary standard.[1] All urine results were corrected to a specific gravity of 1.024.

2. Environmental

Since OSHA has inspected the company on several occasions, and on the basis of the latest study, declared the company to be in compliance with the current lead standard, NIOSH did not conduct air sampling.

Both the company and OSHA use the same method for evaluating the work room atmosphere for lead exposures. The samples are collected using 37 mm diameter cellulose membrane filters (closed-face plastic cassettes) with an 0.8 u pore size and personal sampling pumps to provide air flows of 1.6 liters per minute (company) or 1.5 lpm (OSHA). The samples are analyzed by conventional atomic absorption spectroscopy.

A Sierra Model 441 air velocity meter was used to estimate capture velocities and the volumes of air exhausted at the shears.

C. Evaluation Criteria

1. Physiological Effects

Prolonged absorption of lead or its inorganic compounds from inhalation of vapor, fume or dust, as well as from oral ingestion can result in severe gastro-intestinal disturbances and anemia. With serious intoxication, neuromuscular dysfunction may occur, and with severe exposure, encephalopathy may result. Presenting symptoms are often weakness, weight loss, lassitude, insomnia, and hypertension. Usually associated with these symptoms is a disturbance of the gastro-intestinal tract, which includes constipation, anorexia, and abdominal pain described as colicky. The physical findings, although occurring later, usually consist of facial pallor, malnutrition, abdominal tenderness, and pallor of the eye grounds. The anemia associated with lead poisoning is of the hypochromic, microcytic type with basophilic stippling of the red cells. A lead line may appear on gingival tissues, and in severe cases of poisoning, paralysis of the extensor muscles of the wrist, and less often of the ankles, can occur. Encephalopathy, while common in children, is unusual in adults.

Nephropathy can result from prolonged exposure to lead or its inorganic compounds. This may be a progressive and irreversible loss of kidney function, with progressive azotemia, and occasionally hyperuricemia, with or withoug gout. Lead is teratogenic in mammalian animals so it is advised that exposure of women in the child bearing age to lead be carefully monitored. It should be noted that persons with anemia or sickle cell trait may be at increased risk from exposure to lead.[1-3]

Health information related to lead suggests that blood lead levels in individuals should be kept at values less than 60 micrograms of lead per deciliter of whole blood (ug/dl). NIOSH currently considers blood lead levels of 0 to 40 ug/dl to be in the normal range; levels of 40 to 60 ug/dl to be in the increased absorption range; and levels above 60 ug/dl to be unacceptable. NIOSH considers urine lead levels of less than 100 ug of lead per deciliter of urine (ug/dl) to be in the normal range.

2. Environmental Standard

In October of 1976, the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor, proposed that the federal standard for lead be lowered from 0.20 mg/M^3 to 0.10 mg/M^3. In March of 1977, NIOSH supported the proposed standard of 0.10 mg/M^3.[5] There is, therefore, a possibility that the federal standard will be lowered.

D. Results - Discussion

1. Medical

The plant's medical facilities include a first aid station manned by workers who have completed the Red Cross First Aid Program. The company physician has his office in Pittsburgh and visits the plant on a periodic basis.

Before they are hired, all employees are given a pre-employment physical and required to sign a consent form, stating that "they will participate in the company lead program". The company draws blood leads on all its employees exposed to lead every 30 days. The blood is sent to Refer Lab in California by air for analysis. The results are teletyped back to the company doctor's office within 48 hours.

It is the policy of the company that if any employee's blood lead is between 60 and 80 ug/dl, the employee is removed from exposure to lead until his blood lead is < 60 ug/dl, any employee who's blood lead is > 80 ug/dl is sent home and remains home until his blood lead is < 60 ug/dl.

Several employees related that they had been treated in the past for lead poisoning. A review of company records revealed that no employee in 1976 or as of the date of the NIOSH visit in 1977 had been hospitalized for lead poisoning; four (4) employees in 1976 and one (1) employee as of the date of the NIOSH visit in 1977 had been laid off for high blood lead levels.

None of the 37 employees interviewed and examined had definite signs or symptoms of classical plumbism at the time of the NIOSH visit. Of the 37 blood lead analyses, 19 were less than 40 ug/dl and 18 were in the 40-60 ug/dl range. None of the blood lead levels exceeded 60 ug/dl. Of the 34 urine specimens analyzed, 15 showed evidence of increased lead excretion, that is, were above 100 ug/liter.

The FEP determinations are shown in Table 2 as micrograms of FEP per 100 milliliters of erythrocytes (ug FEP/dl RBC). A plot of log FEP versus blood lead levels is shown as Figure 1. A regression analysis yields the following:

$$\log FEP = \text{blood lead} \times (0.0173) + 1.747$$
$$r = 0.612$$

A blood lead level of 40 ug/dl (for this data) corresponds to a FEP value of 275 ug/dl RBC. Sixteen of the 37 blood samples had an FEP value greater than 300 ug/dl RBC (NIOSH recommended cutoff). The FEP values do not always correlate with blood lead levels because the FEP's represent the effects of chronic lead exposures upon the red blood cells while the blood lead levels represent the effects of more acute lead exposures.

It should also be noted that there are several cases of elevated BUN and creatinine; however, it is not felt that these are clinically significant. Also, most of the interviewed employees had poor dental hygiene with a high incidence of dental caries and gum disease.

2. Environmental

The results of the air sampling for lead (Tables 3-5), especially the OSHA data (Table 3), generally show decreasing lead levels with time. The ventilation system for the lead shears and stripper was installed in September 1975 and the water sprays for the reels were made operational in January 1977. The beneficial effects which these control devices had on the environmental lead levels is obvious from the OSHA data. On the basis of the February 23, 1977, air samples, OSHA declared the company to be in compliance with the current OSHA standard.

The air velocity measurements made at the shear down draft ventilation hoods (Table 6) show that more than an adequate amount of air is being exhausted. Also, smoke tube tests at the stripper cabinet showed that, as necessary, the stripper is under a moderate negative pressure. It is judged that these ventilation systems provide sufficient control of potential lead emissions from the lead shears and stripper.

E. Conclusions

The survey data and findings indicate that a lead intoxication problem does not currently exist at the Keystone Resources plant, although one did exist in the past. The company has a comprehensive employee hygiene program as regards the lead exposure issue. It is felt that this program is satisfactory to meet at least the current needs of the company, but there is always the problem that many safety and health procedures have a tendency to deteriorate with time.

F. Recommendations

1. It is recommended that the company follow closely, without letup, their own "lead" program for employee health. This program includes medical surveillance, good work practices, environmental monitoring, maintenance of ventilation systems, etc.

2. A worthwhile project for the plant safety/health committee would be the promotion of good dental hygiene on the part of the individual workers.

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VII. REFERENCES

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2. Criteria for a Recommended Standard-Occupational Exposure to Inorganic Lead, Dept. HEW (NIOSH) HSM 73-11010, Second Printing, 1972.

3. Hamilton and Hardy, Industrial Toxicology, Third Edition (1974).

4. Zenz, Carl, Occupational Medicine, Principles and Practical Applications, (1975).

5. Statement of Edward J. Baier, Deputy Director, NIOSH, before the U.S. Department of Labor, Occupational Safety and Health Administration, Public Hearing on Occupational Lead Standard, March 1977.

TABLE 1
Demographic Data
Keystone Resources
Mars, Pennsylvania
April 19-20, 1977

Number of Employees Interviewed	Age (Years)			Length of Employment (Years)		
	Average	Median	Range	Average	Median	Range
1st shift						
21	36.5	33	25-63	6.8	6	4-14
2nd shift						
16	35.6	32	25-57	4.3	4	2-11

TABLE 2
Results of Biological Analyses
Keystone Resources
Mars, Pennsylvania
April 19-20, 1977

SUBJECT	BLOOD LEAD LEVEL (ug/100ml)	URINE LEAD (ug/l cor)*	HEMOGLOBIN LEVEL (gm/100ml)	HEMATOCRIT (vol. %)	ERTHROCYTE PROTOPORPHYRIN (ug/100ml rbc)	BUN LEVEL (mg/100ml)	CREATININE LEVEL (mg/100ml)	SPECIFIC GRAVITY
101	28	77	14.8	45.7	153	11	1.0	1.022
102	58	108	13.4	41.5	602	17	1.3	1.033
103	45	128	14.8	45.2	241	11	1.3	1.024
104	37	62	15.1	45.3	216	12	1.2	1.014
105	18	3	14.8	44.2	238	12	0.9	1.003
106	42	127	16.4	44.9	120	15	1.2	1.031
107	27	56	14.4	44.6	244	17	1.0	1.005
108	55	75	14.3	43.8	187	22	1.3	1.030
109	34	125	16.3	48.8	215	21	1.3	1.021
110	25	143	15.0	45.5	171	17	1.2	1.022
111	21	23	14.5	44.1	93	21	1.4	1.021
112	22	77	16.8	50.8	96	17	1.3	1.029
113	30	104	15.0	45.1	333	19	1.4	1.024
114	22	79	15.0	46.0	261	16	1.3	1.017
115	39	107	15.9	45.5	528	19	1.4	1.028
116	16	45	16.0	48.9	35	18	1.4	1.019
117	22	97	14.9	44.8	313	22	1.1	1.025
118	35	67	14.7	44.7	235	14	1.2	1.013
119	50	--	16.4	49.1	468	16	1.1	----
120	34	197	15.6	46.8	684	17	0.8	1.024
121	53	131	14.3	43.4	783	17	1.1	1.020
122	17	52	15.6	47.5	42	19	1.2	1.013
123	40	122	14.8	44.2	222	18	1.2	1.031
124	35	112	14.4	44.8	804	27	1.2	1.018
125	25	82	15.5	46.2	390	29	1.2	1.025
126	45	50	14.9	44.4	149	27	1.0	1.023
127	46	119	13.2	41.2	1068	36	1.2	1.028
128	44	127	14.8	44.8	714	22	1.2	1.022
129	50	100	14.7	45.0	489	19	1.6	1.020
130	52	86	15.3	46.8	194	20	1.3	1.024
131	56	44	15.0	45.4	176	26	1.1	1.027
132	51	122	14.7	44.6	807	35	1.8	1.026
133	48	--	14.8	44.6	291	22	1.0	1.032
134	54	193	14.1	43.1	928	22	0.8	1.023
135	30	33	15.1	44.3	117	21	0.8	1.026
136	59	60	13.7	42.3	402	16	0.8	1.015
137	46	--	14.2	43.9	310	21	0.8	1.036
NORMALS	<40	<100	14-18	42-52	<300	5-26	0.5-1.3	

* Specific gravity corrected to 1.024

Table 3
Results of OSHA Air Sampling for Lead
Keystone Resources
Mars, Pennsylvania

Date	Sample Duration (hrs)	Description	Lead (mg/M^3)*
2-25-75	3.0	# 2 Shear	2.02
2-25-75	3.4	Lead Stripper	0.98
2-25-75	2.5	Lead Stripper	0.83
2-25-75	1.4	Lead Stripper	0.84
2-25-75	1.9	Lead Stripper	0.38
2-25-75	2.5	Lead Stripper	5.94
2-25-75	5.3	Cleanup	0.06
2-25-75	4.1	Banding scrap lead	0.27
7-9-76	5.8	Box car unloading	0.08
7-9-76	5.7	Yard - pallet loading	0.05
7-9-76	7.1	Fork lift - new bldg.	0.03
7-9-76	?	# 2 Shear	0.32
6-9-76	6.0	# 3 Shear	0.32
7-9-76	7.4	# 3 Shear	0.26
7-9-76	7.4	# 4 Shear	0.51
7-9-76	7.4	Lead stripper	0.12
7-9-76	5.6	No lead shear	0.02
7-9-76	5.8	No lead stripper	0.03
6-9-76	5.5	Forklift - furnance bldg.	0.55
2-23-77	7.1	# 2 Shear	0.03
2-23-77	7.0	# 3 Shear	0.05
2-23-77	6.9	Furnace laborer	0.15
2-23-77	6.8	Forklift	0.17
OSHA Proposed Standard			0.10
OSHA Legal Standard			0.20

* Milligrams of lead per cubic meter of air

Table 4
Results of Company Air Sampling for Lead
Keystone Resources
Mars, Pennsylvania

Date	Location	Lead (mg/M^3)*
12-22-76	# 3 Shear Operator	0.46
1-4-77	# 3 Shear Operator	0.18
1-4-77	# 3 Shear Operator	0.39
1-4-77	# 3 Shear Operator	0.96
1-4-77	# 3 Shear Operator	0.20
1-4-77	# 3 Shear Operator	0.31
1-4-77	# 3 Shear Operator	0.43
1-4-77	# 3 Shear Operator	0.99
1-4-77	# 3 Shear Operator	0.33
1-20-77	# 3 Shear Operator	0.18
2-16-77	# 3 Shear Operator	0.16
2-16-77	# 3 Shear Operator	0.00
2-17-77	# 3 Shear Operator	0.07
2-17-77	# 3 Shear Operator	0.07
12-17-76	# 4 Shear Operator	0.21
12-20-76	# 4 Shear Operator	0.05
12-21-76	# 4 Shear Operator	0.15
12-23-76	# 4 Shear Operator	0.29
2-16-77	# 4 Shear Operator	0.18
2-16-76	# 4 Stripper	0.26
12-17-76	Furnace forklift Driver	0.06
12-20-76	Furnace forklift Driver	0.06
12-21-76	Furnace forklift Driver	0.24
12-22-76	Furnace forklift Driver	0.23
1-26-77	Furnace forklift Driver	0.02
1-26-77	Furnace forklift Driver	0.03
1-26-77	Furnace forklift Driver	0.05
1-26-77	Furnace forklift Driver	0.10
12-23-76	Cu. Washer - Furnace	0.15
1-26-77	Cu. Washer - Furnace	0.03
1-26-77	Cu. Washer - Furnace	0.08
1-26-77	Cu. Washer - Furnace	0.10
1-26-77	Cu. Washer - Furnace	0.12
OSHA Proposed Standard		0.10
OSHA Legal Standard		0.20

*Notes
1. All samples were of 2 hours duration
2. mg/M^3 = milligrams of lead per cubic meter of air

Table 5
Summary of Company Air Lead Level Data
Keystone Resources
Mars, Pennsylvania

Month-Year	No. of Samples	Location	Mean Air Lead Concentration (mg/M^3)*
Dec 1976	1	# 3 Shear Operator	0.46
Jan 1977	9	# 3 Shear Operator	0.44
Feb 1977	4	# 3 Shear Operator	0.08
Dec 1976	4	# 4 Shear Operator	0.18
Feb 1977	1	# 4 Shear Operator	0.18
Feb 1977	1	# 4 Stripper Operator	0.26
Dec 1976	4	Furnace Forklift Driver	0.15
Jan 1977	4	Furnace Forklift Driver	0.05
Dec 1976	1	Copper Washer - Furnace	0.15
Jan 1977	4	Copper Washer - Furnace	0.08

*Milligrams of lead per cubic meter of air

Table 6
Summary of Air Velocity Measurements
Keystone Resources
Mars, Pennsylvania
April 20, 1977

Hood	Est. Air Flow	Capture Velocity @ Nip Point
Shear # 2	2200 cfm*	1000 fpm*
Shear # 3	2900 cfm	700 fpm
Shear # 4	2500 cfm	700 fpm

*Notes:

1. Each of the estimated air flows was based on 8 air velocity measurements
2. cfm = cubic feet of air per minute
3. fpm = linear feet per minute

FIGURE 1
Log FEP vs Blood Lead Levels
Keystone Resources
Mars, Pennsylvania
April 19-20, 1977