U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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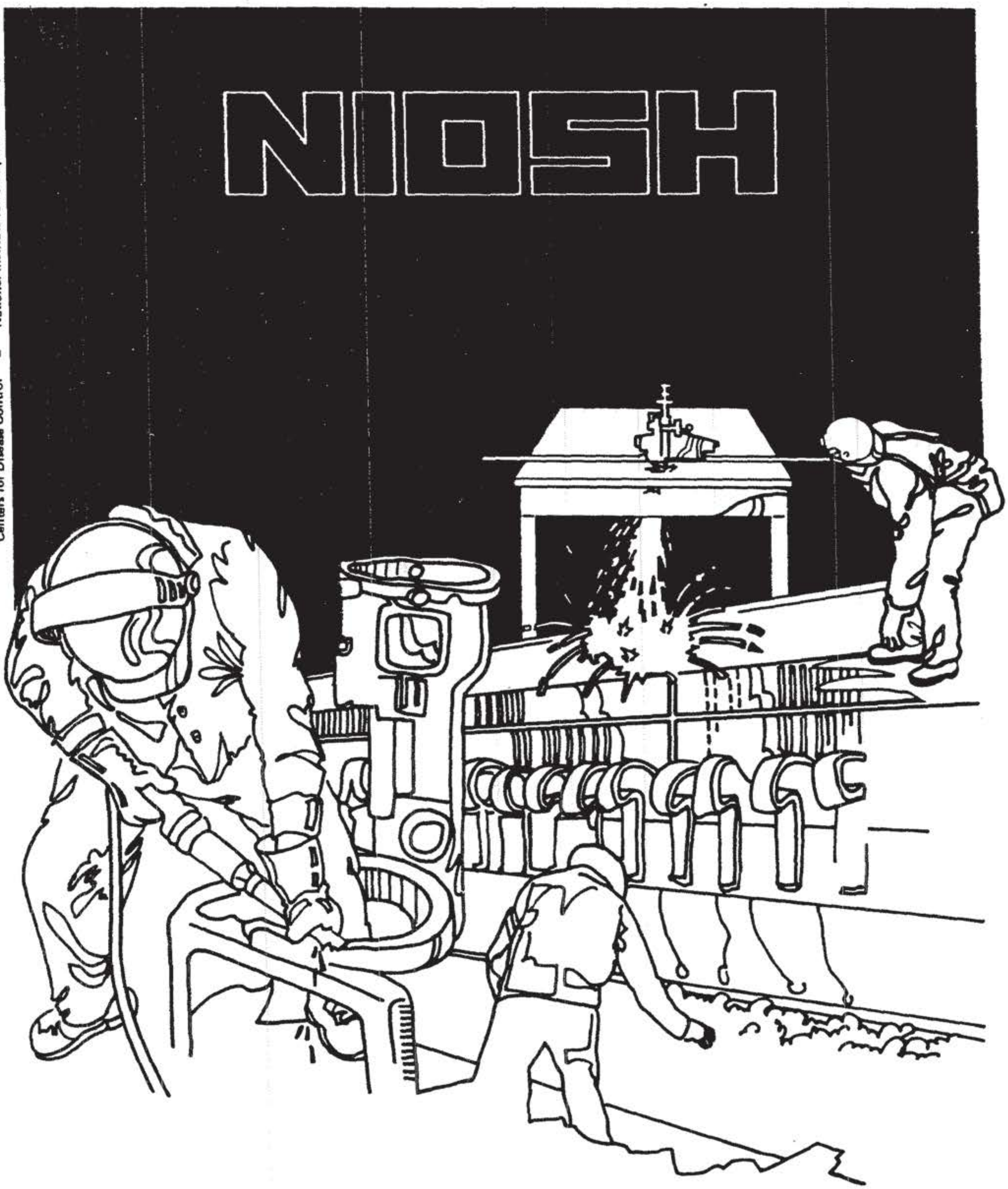

Health Hazard Evaluation Report

HETA 81-036-1023
ALASKA SMELTING & REFINING COMPANY
WISILLA, ALASKA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, 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 Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 81-036-1023
December 1981
ALASKA SMELTING & REFINING Company
Wisilla, Alaska

NIOSH INVESTIGATOR:
Arvin G. Apol

I SUMMARY

In November 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Alaska Smelting and Refining Company, Wisilla, Alaska, to determine if a health hazard existed as a result of the three workers' exposures to lead and silver fumes, dust, and chemicals found in the silver smelting and refining process.

NIOSH conducted an environmental and medical evaluation on April 28-May 1, 1981. Breathing zone and area samples were collected for lead, silver, iron oxide, nitric acid, nitrogen dioxide, sulfur dioxide and sulfuric acid. Blood samples were drawn from the exposed workers for lead and for erythrocyte protoporphyrin analysis.

Four of six full shift breathing zone air lead concentrations exceeded the lead criteria of 50 ug/cu m. They occurred during the following operations: smelting - 229 and 295 ug/cu m; cupeling - 79 ug/cu m; general maintenance and clean up - 114 ug/cu m. Five of seven full shift breathing zone airborne silver concentrations and one 2-hr. sample exceeded the silver criteria of 10 ug/cu m. They occurred during the following operations: film burning and welding - 80 ug/cu m; cleaning ash from the incinerator - 1330 ug/cu m; smelting - 526 and 1214 ug/cu m; cupeling 22 ug/cu m; general maintenance and clean up - 92 ug/cu m. All workers' exposure to iron oxide fumes, nitric acid, nitrogen dioxide, sulfur dioxide and sulfuric acid were much less than the applicable evaluation criteria.

Blood lead and free erythrocyte protoporphyrin results were all within acceptable limits. This is probably due to the fact that the above operations had been shut down for over 3 months prior to the collection of the samples and respirators are worn by the workers while conducting several operations.

NIOSH has determined that a health hazard due to lead and silver existed at Alaska Smelting and Refining Company. This is based on breathing zone samples that showed excessive airborne lead concentrations that ranged from 1.5 to 6 times the lead criteria when workers were conducting the smelting, cupeling, clean up and maintenance operations; and excessive airborne silver concentrations that ranged from 2 to 130 times the silver criteria when workers were shoveling silver ash from the incinerator, and during the smelting, cupeling, clean-up and maintenance operations.

Recommendations to reduce the workers' exposures to lead and silver are included in section VII of this report.

KEYWORDS: SIC 3339 (Primary Smelting & Refining of Nonferrous Metal) 3341 (Secondary Smelting & Refining of Nonferrous Metal) Lead, nitric acid, nitrogen dioxide, silver, sulfur dioxide, sulfuric acid.

II INTRODUCTION

In November 1980, NIOSH received a request from Alaska Smelting and Refining Company, Wisilla, Alaska to determine if a health hazard existed as a result of the workers' exposure to lead, silver fumes dust, and chemicals used in the silver smelting and refining process. An initial-environmental survey was conducted from April 28 to May 1, 1981. An interim report including the environmental results, blood lead results and recommendations was submitted to the requestor on August 19, 1981.

III BACKGROUND

Alaska Smelting and Refining Company is a secondary silver smelter and refiner. Most of the silver processed is recovered from photographic and x-ray film. The firm occupies a 30' by 50' building which houses the smelter, cupel, electrolytic refiner and offices/lab. The incinerator is located under a covered area next to the building.

The film is burned in the incinerator where the combustible material is burned off and the silver concentrated in the ash.

The film is hand-fed in small batches into the incinerator by opening the door, throwing in a batch of film and immediately closing the door. When the door is open, some smoke is emitted through the opening. The incinerator is kept under slight negative pressure with all the effluents passing through a bag house where the precious metals are recovered. The burning may take 24 hours or more depending on the amount of film to be burned. After the burning is completed and the incinerator cooled, the top is removed. The worker climbs into the incinerator and hand shovels the ash into 5 gallon buckets. During this time he wears a half-face air purifying cartridge respirator for use with dust and fumes.

The silver concentrate is mixed in an open trough with measured amounts of soda ash, galena (a high lead ore), silica sand, sodium nitrate and borax. This charge is placed in the smelter, a tilting crucible furnace, and heated to 2000 to 2150^{0} F. The lead alloys with the silver, gold and two other metals present in the mix. When the smelting is completed, the furnace is tilted and the ore poured into a vee-shaped mold. The metal solidifies on the bottom and the slag on the top. After cooling, the metal and the slag are separated. Lead and silver fumes are released from the furnace during the smelting. There is a gravity flow hood over the furnace; however, it is inadequate. During the pour, much fume is generated which rises past the operator.

The silver lead alloy is placed in a "cupel" where it is heated with air blowing over it. The lead is oxidized, separates from the silver, floats on the surface and is periodically removed . All the metals except silver and gold are removed along with the lead. This process continues until the silver is pure. The silver is then cast into square blocks that will be used in electrolytic refining. There is local exhaust ventilation on the cupel that is connected to the bag house.

Electrolytic refining consists of passing a DC current through the silver block and a nitric acid electrolyte solution. The silver goes into solution and is redeposited as 99.999% pure silver. The silver is then cast into ingots which are sold on the silver market.

The current cleanup procedure involves dry sweeping. Maintenance work is an on-going operation that may involve welding, building new equipment and other jobs.

The plant is operated by the two business partners. When a batch is started, the plant is run continuously 24 hours a day until the batch is completed. When in operation, each person works a 12 hour shift. One day a week a person will do cleanup and maintenance work.

IV EVALUATION DESIGN AND METHODS

A. Environmental

Breathing zone samples were collected to evaluate the workers' exposure to the substances listed below. Area samples were collected to evaluate the emissions from each process.

1. Iron oxide, lead and silver samples were collected on cellulose membrane filters at a flow rate of 1.5 lpm with subsequent analysis using atomic absorption spectrophotometry according to NIOSH P&CAM method #173.

2. Nitric acid samples were collected on silica gel at a flow rate of 25 to 50 cc/min. with subsequent analysis by ion chromatography.

3. Nitrogen dioxide samples were collected in passive samplers and analyzed by a modification of NIOSH method P&CAM 231.

4. Sulfur dioxide samples were collected on potassium hydroxide treated filters at a flow rate of 1.5 lpm with subsequent analysis by ion chromatography according to NIOSH method P&CAM 268.

5. Sulfuric acid samples were collected on cellulose membrane filters at a flow rate of 1.5 lpm with subsequent analysis using ion chromatography according to NIOSH P&CAM 268.

B. Medical

Blood samples were drawn from the workers by an Alaska Public Health Nurse. These samples were analyzed for lead and free erythrocyte protoporphyrin (FEP) concentrations.

V EVALUATION CRITERIA

A. Environmental

The criteria used in evaluating the exposures are as follows:

SUBSTANCE	NIOSH RECOMMENDED LEVEL 10 HR. TWA[1]	STATE OF ALASKA STANDARD 8 HR. TWA
Iron oxide	(5 mg/cu m)[3] (ACGIH[2]TLV)	10 mg/cu m
Lead	50 ug/cu m[4]	50 mg/cu m
Noise	85 dBA 8 hr.	90 dBA 8 hr.
Nitric Acid	2 ppm	2 ppm[5]
Nitrogen Dioxide	1 ppm (ceiling)	5 ppm
Silver	---	10 ug/cu m
Sulfur Dioxide	0.5 ppm	5 ppm
Sulfuric Acid	1 mg/cu m	1 mg/cu m

1. TWA - Time Weighted Average
2. ACGIH - American Conference of Governmental Hygienists
3. mg/cu m - milligrams/cubic meter
4. ug/cu m - micrograms/cubic meter
5. ppm - parts of vapor or gas per million parts of air

B. Medical

Blood lead results less than 40 ug/100 ml blood are acceptable. There is no well defined limit for FEP. A normal acceptable range for FEP is 16-100 ug/dl of whole blood.

C. Toxicology

LEAD -- Lead accumulates in the body and is excreted slowly. The general public is exposed to small amounts of lead in food, water, and air. Occupational lead exposure occurs primarily by inhalation, and to a lesser degree by ingestion (contamination of hands, food, and smoking). Inorganic lead poisoning is a chronic process, although symptoms may develop suddenly after sufficient chronic exposure. Manifestations of inorganic lead poisoning in adults include decreased appetite, abdominal pain, nausea, constipation (or diarrhea), fatigue, irritability, insomnia, headache, anemia, muscle pain, sore joints, tremor, weakness of the extensor muscles of the wrists and ankles, and impaired kidney function. There is some evidence that occupational lead toxicity can impair fertility.[4]

The blood lead analysis is one measure of the amount of lead in the body. People who are not exposed to lead at work usually have a blood lead level of less than 40 ug/dl. People exposed to lead at work often have higher levels. Any blood lead level below 80 was formerly considered acceptable for people occupationally exposed to lead, but many authorities, including NIOSH, consider lesser blood lead levels to be potentially harmful to health.[1] OSHA regulations may eventually require blood lead levels to average less than 50 (29 CFR 1910.1025). Since blood lead levels even lower than 40 may have harmful effects on the mental development of infants and young children[5], it is possible that if a pregnant woman has a blood lead level above 30 her unborn child might be adversely affected. For purposes of evaluating the occupational environment, a blood lead level of 40 or more represents excessive lead exposure.

The FEP level measures one of the biologic effects of lead in the body (interference with heme synthesis). With the analytical method used in this study, the FEP level is ordinarily no more than 87 ug/dl RBC. The two most common causes of increased FEP are iron deficiency and lead exposure.[6]

SILVER [7]-- "Argyria, a cosmetic defect, which consists of an unsightly permanent blue-gray discoloration of the skin, mucous membranes and eyes, appears to be the main pathologic effect from the accumulation of silver in the body. It may be of two types, a generalized form or localized in the conjunctiva of the eye, nasal septum or posterior pharynx. Its occurrence has been principally through its use in medicine by ingestion, injection or topical application; development from inhalation through occupational exposure appears to be very slow and may require years. Local argyria of the skin is rare. Barrie and Harding called attention to the fact that silver polishers exposed over long periods exhibit some increased densities in their lung x-rays due to a silver impregnation of the elastic membranes of the pulmonary vessels."

"According to Hunter, generalized argyria may result from inhalation or ingestion of silver salts, such as the nitrate, fulminate, or cyanide, while localized argyria may be caused by penetration of the skin by fine particles of metallic silver."

"Fassett after careful observation of a group of workers for many years failed to note any systemic pathology directly attributable to silver and reached the conclusion that generalized argyria is unlikely to develop when silver concentrations in the air are in the neighborhood of 0.01 mg/cu m. The nature of the exposure, however, was not the weighted average of a repeated, daily eight-hour contact."

"Jindrichova described 12 cases of argyrosis in subjects working in the manufacture of silver varnish and in silvering radio-technical parts. In 11 cases there was argyrosis of the upper respiratory passages; in 9 cases conjunctival or corneal argyrosis was observed. Concentrations of 1 to 2 mg/cu m of silver were found in the air during varnish spraying."

"The exact air concentration of silver that will result in generalized argyria is not known with certainty, but it can be estimated approximately in the following way. Hill and Pillsbury stated that the gradually accumulated intake of from 1 to 5 grams Ag will lead to generalized argyria. If one assumes a 20-year exposure, a 10 cu m/day respiratory volume and a 50% body retention, a level of Ag five-fold the recommended TLV (0.05 mg/cu m will result in an accumulation of 1.2 gram or a probable borderline amount for the production of argyria. In this connection, it is important to note the observation of Aub and Fairhall that silver, once deposited in the body, is not liberated in the urine in amounts detectable by spectrochemical methods, despite intensive and prolonged "deleading" procedures."

"In view of these facts, a TLV of 0.01 mg/cu m (10 ug/cu m) is suggested for this element by the ACGIH."

VI RESULTS AND DISCUSSION

The environmental results are listed in Tables 1-4 and the blood test results in Table 5.

The breathing zone sample results for lead, silver and iron oxide are shown in Table 1. Iron oxide concentrations were 0.16, 0.23 and 1.11 mg/cu m. Iron oxide fumes occurred during the intermittent welding that was done during several work shifts. These exposures are all less than the criteria of 5 mg/cu m.

Nine breathing zone samples, collected for lead, resulted in 6 full shift samples. The lead exposures of 5 and 18 ug/cu m during film burning were less than the lead criteria. The 18 ug/cu m lead exposure on 4-28-81 was probably due to welding on contaminated metal. The smelting process produced lead exposures of 229 and 295 ug/cu m, which is 4-6 times the lead criteria of 50 ug/cu m. The highest exposure occurs during the pour and mixing of the charge for the next batch. The potential lead exposure during the cupeling process was 79 ug/cu m. This is 1.5 times the lead criteria. A respirator was worn during the time that the slag was removed from the cupel. The worker doing the general maintenance and clean-up had a TWA exposure of 114 ug/cu m which is over 2 times the lead criteria. The clean-up portion air lead level which involved sweeping the floor, was 224 ug/cu m. The worker wears a respirator when sweeping the floor.

The silver criteria of 10 ug/cu m was exceeded on 5 of the 6 full shift samples. During the film burning one sample was low and the other was high. The high sample could have resulted from the operator welding on contaminated metal during this sample period. Cleaning the ash from the incinerator resulted in a 2-hour potential exposure of 1330 ug/cu m. This is 130 times the criteria. A cartridge type dust respirator was worn. The smelting operation produced extremely high exposures of 526 and 1214 ug/cu m. These were 52 and 121 times the silver criteria. The silver exposure during the cupeling operation was 22 ug/cu m which is twice the criteria. The maintenance and clean-up work resulted in a silver exposure of 92 ug/cu m which is 9 times the silver criteria.

Lead and silver were below detectable limits in the well water.

General area samples were also collected for lead and silver to determine the airborne concentrations in various locations when the different operations were conducted. These results are shown in Table 2. The bag house effluent was low (14 ug/cu m) which shows the unit is working as designed. As expected there is silver escaping the incinerator when the door is opened for charging. When smelting is conducted the lead and silver concentrations are the highest near the ceiling, and they decrease as distance from the smelter increases. When the cupel is in operation the concentrations are approximately 20 times higher near the ceiling as compared to the breathing zone height. During electrolytic refining the silver concentration was 3 ug/cu m which is less than the silver criteria.

Samples collected for sulfur dioxide near the incinerator and the smelter ranged from less than 0.01 to 0.05 ppm (Table 3) which is 10% or less of the sulfur dioxide criteria. Sulfuric acid was not detected near the incinerator.

Nitric acid is used in the silver electrolytic refining process. Both breathing zone and area samples collected for nitric acid ranged from 0.14 to 0.16 ppm, which is 8% of the nitric acid criteria of 2 ppm and the nitrogen dioxide concentrations ranged from 0.06 to 0.14 ppm. This is 6 to 14% of the nitrogen dioxide criteria of 1 ppm. These results are shown in Table 4.

Blood samples were taken from 3 workers and one worker's wife for analysis of lead and Free Erythrocyte Protoporphyrin (FEP). The results are shown in Table 5. The workers' blood leads were 26, 32 & 37 ug/100 ml of blood. Levels below 40 are acceptable. These levels are indicative of some increased lead exposure. Based on the lead air concentrations these blood levels would be expected to rise when the work load increases. The minimal smelting activity the 4 previous months is probably the reason the blood levels are less than 40. The FEP's all were in the normal range of 16-50 ug/dl of whole blood.

Noise level measurements were taken in various locations during the smelting and cupeling operations. The results are shown in Figure 1. During the smelting the levels were from 90-96 dBA and during the cupeling the noise levels ranged from 85 to 90 dBA. The permissible noise exposure is a function of the length of exposure per day and the noise levels. Above 85 dBA a potential noise exposure exists.

VII <u>SUMMARY AND RECOMMENDATIONS</u>

Film burning - Lead is not a problem during film burning as the lead exposures were less than the criteria. The potential silver exposure during film burning was up to 8 times the criteria. However, the high silver concentration which occurred only on the second shift of burning, is probably due to welding and not the film burning. There is an extremely high potential silver exposure when the silver bearing ash is removed from the incinerator. During this 2 hour period the silver exposure was 130 times the criteria. When the concentrations exceed 10 times the allowable levels, supplied air respirators must be worn.

Smelting - The smelting operation produces a high potential lead and silver exposure for the operator. The hood above the furnace uses gravity flow. Local exhaust ventilation should be used here. A new hood that encloses the furnace and is tied into the bag house exhaust system would greatly reduce this exposure. There should also be provision to capture the fumes when the furnace is tilted for pouring.

The mixing of the charge should be accomplished using local exhaust ventilation. A ventilation system coming off the side of the mixing box and tied into the bag house system, would be effective. The ventilation rates needed for the smelter and mixing box is dependent on the hood design and the distance the hoods are from the point of generation of the dust and fumes. This should reduce the lead and silver concentrations near the criteria levels. Again when the silver and/or lead concentrations are greater than 10 times the criteria a supplied air respirator must be worn.

Cupel - The worker's potential lead and silver exposure, when the cupel is in operation, exceeds the criteria for both lead and silver by 1.5 to 2 times. Improving the hood design by placing the hood closer to the cupel and designing a means to do slag removal with the hood in position should reduce the exposure to within the lead and silver criteria. The high lead and silver concentration above the cupel shows much lead escapes during this operation. Cartridge type respirators for use with lead and silver fumes should be worn when the cupel is in operation.

Clean-up - Clean-up and maintenance work produced airborne concentrations that were 2 times the lead criteria and 9 times the silver criteria. Use of a vacuum system to clean the area, in place of sweeping, will probably reduce the concentration to within acceptable levels. Vacuuming should be done once or twice a day. This will keep the lead and silver dust that is tracked inside from becoming airborne.

Electrolytic refining - All the sample results for silver, nitric acid and nitrogen dioxide were less than the respective criteris, so there are no recommendations for this process.

Blood leads - Based on the high airborne lead concentration, blood samples should be drawn on at least a 6 month basis, or more frequently if the work load increases.

Noise levels - Based on the noise levels of 90-96 dBA during the smelting operation, anyone working in the area for 5-6 hours or more, should wear hearing protection. (Ear plugs or ear muffs).

VII CONCLUSIONS

NIOSH has determined that a health hazard due to lead and silver existed at Alaska Smelting and Refining Company. This is based on breathing zone samples that showed excessive airborne lead concentrations that ranged from 1.5 to 6 times the lead criteria when workers were conducting the smelting, cupeling, clean up and maintenance operations; and excessive airborne silver concentrations that ranged from 2 to 130 times the silver criteria when workers were shoveling silver ash from the incinerator, and during the smelting, cupeling, clean-up and maintenance operations.

Blood leads and free erythrocyte protoporphyrin results were within acceptable limits. This is probably due to the fact that the above operations had not been conducted for over 3 months prior to the collection of the samples, and respirators are worn by the workers while conducting several operations.

IX REFERENCES

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6. Center for Disease Control: Preventing lead poisoning in young children. J Pediatr 93: 709-720, 1978.

7. Documentation of the Threshold Limit Values. American Conference of Governmental Industrial Hygienists 3rd Edition 1971.

X DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this complete Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio, 45226. After ninety (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. Alaska Smelting and Refining Company Wisilla, Alaska

2. Alaska State Department of Labor, Anchorage, Alaska

3. U. S. Department of Labor, Occupational Safety and Health Administration Region X Seattle, Washington

4. National Institute for Occupational Safety and Health, Region X, Seattle, Washington

For the purpose of informing the affected workers, the employer shall promptly post this Determination Report in a prominent place(s) near the work area of the affected employees for a period of thirty (30) calendar days.

XI ACKNOWLEDGMENTS

Report prepared and survey conducted by:

Arvin G. Apol
Industrial Hygienist
Region X/NIOSH
Seattle, Washington

Originating Office:

Hazard Evaluation and Technical
Assistance Branch
DSHEFS/NIOSH

TABLE 1

IRON OXIDE, LEAD AND SILVER
BREATHING ZONE AIR CONCENTRATIONS

ALASKA SMELTING & REFINING COMPANY
WISILLA, ALASKA
HHE 81-036

JOB	DATE	SAMPLE NUMBER	SAMPLE TIME MIN.	SAMPLE VOL. LITERS	LEAD ug/cu m SAMPLE	LEAD ug/cu m FULL SHIFT TWA	SILVER ug/cu m SAMPLE	SILVER ug/cu m FULL SHIFT TWA	IRON OXIDE mg/cu m
Burning film	4-27-81	2	380	570	5	5	4	4	0.23
Burning film - also did some welding	4-28-81	5	440	660	18	18	80	80	1.11
Cleaning ash from incinerator	4-28-81	9	115	173	--	--	1330	1330	--
Charging and working in area during smelting	4-28-81	10	362	543	129	229 (samples 10 and 11)	239	526 (samples 10 and 11)	0.16
Only during pour from smelter and mixing of charge	4-28,29	11	132	198	505	295 (samples 11 and 14)	1313	1214 (samples 11 and 14)	--
Charging and working in area during smelting	4-29-81	14	615	922	250		1193		--
General work during time cupel is used	4-29-81	15	640	960	74	79 (samples 15 and 16)	21	22 (samples 15 and 16)	--
Only during slag removal from cupel	4-29-81	16	55	83	133		36		--
General maintenance and chipping slag from furnace	5-1-81	26	393	590	100	114 (samples 26 and 20)	75	92 (samples 26 and 20)	--
Clean up only	5-1-81	20	51	76	224		224		--

TABLE 2

LEAD & SILVER
GENERAL AREA AIR CONCENTRATIONS

ALASKA SMELTING & REFINING COMPANY
WISILLA, ALASKA
HHE 81-036

LOCATION	DATE	SAMPLE NUMBER	SAMPLE TIME MIN.	SAMPLE VOL. LITERS	LEAD ug/cu m	SILVER ug/cu m
Bag house effluent	4-27-81	4	810	1215	---	14
On incinerator, just above the door	4-27-81	3	390	585	---	171
On incinerator, just above the door	4-28-81	7	440	660	---	288
Next to crucible tilting furnace (smelter) 6 ft above floor	4-21-81	8	885	1327	278	203
15 ft from smelter, near middle of room 3 1/2 ft above floor	4-28-81	12	400	600	20	53
15 ft from smelter, near middle of room 10 ft above floor	4-28-81	13	395	592	1334	321
13 ft above cupel	4-29-81	17	762	1143	1225	96
4 ft from cupel, 5 ft above floor	4-29-81	18	762	1143	67	4
2 ft above silver cell	4-30-81	19	525	787	---	3

NOTE: Well water collected on the premises contained less than 0.02 mg lead/liter and less than 0.004 mg silver/liter.

TABLE 3

SULFUR DIOXIDE & SULFURIC ACID AIR CONCENTRATIONS

ALASKA SMELTING & REFINING COMPANY
WISILLA, ALASKA
HHE 81-036

JOB OR LOCATION	DATE	SAMPLE NUMBER	SAMPLE TIME MIN.	SULFUR DIOXIDE ppm	SULFURIC ACID mg/cu m
On incinerator, just above the door (GA)	4-27-81	1	390	0.02	0.01
On incinerator, just above the door (GA)	4-28-81	6	440	0.02	0.01
BZ - Burning film	4-27-81	2	380	0.01	--
BZ - Burning film	4-28-81	5	440	0.01	--
GA - 6 ft. above floor - next to the crucible tilting furnace	4-28-81	8	885	0.05	--

TABLE 4

NITROGEN DIOXIDE & NITRIC ACID
AIR CONCENTRATIONS

ALASKA SMELTING & REFINING COMPANY
WISILLA, ALASKA
HHE 81-036

JOB OR LOCATION	DATE	SAMPLE NUMBER	SAMPLE TIME MIN.	NITROGEN DIOXIDE ppm	NITRIC ACID ppm
Refining operator (BZ)	4-30-81	23	585	--	0.16
Refining operator (BZ)	4-30-81	3	585	0.12	--
Refining operator (BZ)	5-01-81	25	494	--	0.16
Refining operator (BZ)	5-01-81	5	494	0.06	--
2 ft above silver cell (GA)	4-30-81	22	525	--	0.14
2 ft above silver cell (GA)	4-30-81	2	525	0.11	--
2 ft above silver cell (GA)	5-01-81	24	581	--	0.16
2 ft above silver cell (GA)	5-01-81	4	581	0.08	--
In office (GA)	4-30-81	1	585	0.14	--

TABLE 5

BLOOD LEAD AND FREE ERYTHROCYTE PROTOPORPHYRIN (FEP) CONCENTRATIONS

ALASKA SMELTING & REFINING COMPANY
WISILLA, ALASKA
HHE 81-036

WORKER	ug lead/100 ml blood	FEP ug/dl whole blood
1	32	35
2	26	46
3	37	--
Wife	8	29

Blood leads less than 40 ug/100 ml blood are acceptable.
There is no well defined limit for FEP. A normal acceptable range for FEP is 16-50 ug/dl of whole blood with values less than 100 still acceptable.

FIGURE 1

NOISE LEVELS (dBA)
ALASKA SMELTING & REFINING CO.
WISILLA, ALASKA
HHE 81-036