Mining HHE

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
DIVISION OF RESPIRATORY DISEASE STUDIES
MORGANTOWN, WEST VIRGINIA 26505

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 79-102-106

HOMESTAKE MINING COMPANY (ID 39-00055)
LEAD, SOUTH DAKOTA 57754

JUNE 1980

I. TOXICITY DETERMINATION

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at the Homestake Mining Company, Lead, South Dakota on December 18, 1978. At the time of this evaluation, personal, breathing zone and area air samples were taken on workers at the 2,150-foot level of the Ross shaft for diesel emission particulates. These particulates included: sulfates, formaldehyde, hydrocarbons, nitrogen dioxide, particulate polycyclic aromatic hydrocarbons, and trace metals.

Results of analysis of air samples collected showed airborne concentrations of the above materials to be below current Federal and consensus standards as well as NIOSH recommended criteria.

II. DISTRIBUTION AND AVAILABILITY

Copies of this determination report are currently available upon request from NIOSH, Division of Respiratory Disease Studies, Environmental Investigations Branch, 944 Chestnut Ridge Road, Morgantown, West Virginia 26505. 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 Morgantown address.

Copies of this report have been sent to:

1) Homestake Mining Company
2) U.S. Department of Labor/MSHA, Arlington, Virginia
3) NIOSH - Region VIII

For the purpose of informing the approximately 20 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

Under the provisions of Section 501(a)(11), Federal Mine Safety and Health Act of 1977 (FMSH Act), the Secretary of Health, Education and Welfare is responsible "to determine upon the written request by any operator or authorized representatives of miners, specifying with reasonable particularity the grounds upon which such request is made, whether any substance normally found in a coal or other mine has potentially toxic effects in the concentrations normally found or used and shall submit such determinations to both the operators and miners as soon as possible".

IV. HEALTH HAZARD EVALUATION

A. Process Evaluated

Homestake Mining Company is located in the Black Hills of South Dakota in the town of Lead.

Its function is mining and refining ore bearing gold and other metals. It is the oldest continously operated gold mine in the world.

At the Homestake mine, there are two operating shafts, the Ross and Yates. These are used to move men and materials up and down the vertical shafts to the 5,000-foot levels. In the rock pick area of the 2,150-foot level of the Ross, two dieselized front end loaders are used.

Their function is to haul blasted ore from the face to the rock pick where a pneumatic bit breaks up the ore. This ore then falls below to a collection point where a rail system brings the ore outside for crushing and then to the mill bins where its held until processed.

The diesel equipment that was present at the 2,150-foot level was utilizing catalytic converters to control diesel emissions from their exhausts. The effectiveness of these converters appeared to be a result of the daily maintenance schedule performed on the equipment.

B. Evaluation Design

Of the approximately 10-20 employees who work the 2,150-foot level, five were working the area of the survey. Two of the five were

drivers of the front end loaders. These drivers were personally monitored for particulate polycyclic aromatic hydrocarbons and nitrogen dioxide.

Breathing zone samples were monitored for trace metals and sulfates. The remaining workers were not personally monitored because they went to the 49 raise, another level above the requested 2,150-foot level to work. "General area" samples were placed at the 49 raise as well as the haulageways of the 2,150-foot levels.

C. Evaluation Methods

Data in Table I and VII was collected on 37 mm MCE 0.8 um pore size filters using personal MSA vacuum pumps operating at 1.7 liters per minute (lpm). These samples were than prepared by wet ashing with nitric acid and analyzed by atomic absorption.

Data in Table II was collected on 37 mm MCE 0.8 um filters using MSA vacuum pumps operating at 1.7 liters per minute. These samples were analyzed for the sulfate ion by ion chromatography.

Data in Table III was collected on charcoal tubes using MSA pumps operating at 1.0 lpm. The samples were then analyzed by ion chromatrography.

Table IV data was collected on charcoal tubes utilizing low flow pumps (200 ml/minute) and subsequently analyzed by gas chromatography.

Data in Table V was collected on a three section passive dosimeter impregnated with triethanolamine and then desorbed and analyzed by a colorimetric spectrophotometer. Data in Table VI was collected on 37 mm silver membrane filters with a pore size of 0.8 um using a MSA pump operating at 1.7 lpm. Analysis was by reverse phase high pressure liquid chromatography.

D. Criteria for Assessing Workroom Concentrations of Air Contaminants

Four sources of criteria are generally used in NIOSH evaluations to assess worker exposure to concentrations of air contaminants in the mining industry: (1) NIOSH criteria for recommended standards; (2) Mine Safety and Health Administration's adoption of the Threshold Limit Values (TLVs) for Coal and for Metal and Nonmetal Mining; (3) other Federal standards and (4) national consensus health standards.

E. Environmental Results and Discussion

Results of analysis of 75 environmental air samples collected, revealed their concentrations to be below current NIOSH recommended exposure levels. NIOSH criteria is used in assessing worker exposure to potentially hazardous agents except in cases where

more current and stringent Federal or consensus standards exist or where sufficient state of the art health research information is available and can be applied.

Personal and breathing zone samples were taken only on the front end loader operators with the remaining samples being general area. Mine dilution ventilation as well as water sprays were employed to control dust throughout the mine at this working level. The front end loaders which were the only dieselized pieces of equipment used, had mechanical scrubbers on their exhaust.

According to maintenance personnel, these front end loaders were set up on a maintenance schedule. All the data analyzed was found to be below current recognized occupational health evaluation criteria.

F. Conclusions

Results of air samples collected at the rock pick area, maintenance barn, 49 raise and haulageways of the 2,150-foot level showed ambient airborne concentrations of the contaminants measured to be below current Federal and consensus standards as well as NIOSH recommended criteria.

However, insufficient information is present at this time to evaluate the long term health effects of diesel emissions to underground miners.

A high priority on research has been given to and is under way on the long term effects of worker exposure to diesel emissions by NIOSH.

V. RECOMMENDATIONS

The maintenance schedule recommended by the manufacturer on schedule 24 equipment should be followed as close as possible. The catalytic converters should be changed as is necessary.

VI. REFERENCES

1. NIOSH Certified Equipment List, DHEW (NIOSH) Pub. No. 79-107, July 1, 1978.

2. Summary of NIOSH Recommendations for Occupational Health Standards, October 1978.

3. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment, TLV, American Conference of Governmental Industrial Hygienists (ACGIH), 1973.

4. Code of Federal Regulations, Title 30, Chapter I, Subchapter N, Part 57.5-1, November 1978.

5. NIOSH Criteria for a Recommended Standard--Occupational Exposure to Inorganic Arsenic. DHEW (NIOSH) Pub. No. 75-149, 1975.

6. Personal Sampler for Nitrogen Dioxide, Palmes, E.D., American Industrial Hygiene Association Journal, No. 37, 1976.

7. NIOSH Manual of Analytical Methods, Volumes 1, 2, and 3. DHEW (NIOSH) Pub. No. 77-157A, 77-157B, 77-157C, April 1977.

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TABLE I

Results of Trace Metal Analysis

Location	Sample No.	Date Sampled	Sample Volume (liters)	Contaminant Selenium mg/m^3	Contaminant Arsenic mg/m^3
Tram #2 (P)	79-00114	12/18/78	654.5	<0.080	0.0013
Tram #3 (A)	79-00115	12/18/78	637.5	<0.080	0.0007
Control	79-00112	12/18/78	N/A	ND	ND
Control	79-00113	12/18/78	N/A	ND	ND
*TLV ACGIH (mg/m^3)				0.2	0.5
NIOSH (mg/m^3) 15-minute ceiling				NRC	0.002

NRC = No NIOSH criteria for a recommended standard for the subject material

ND = none detected

A = area sample

P = personal sample

* = "Threshold Limit Values for Chemical Substances in Workroom Air adopted by ACGIH for 1973," pages 1-54 is approved and accepted by MSHA's metal and non-metal mine division of safety and health.

TABLE II

Results of Analysis for Sulfates

Location	Sample No.	Date Sampled	Sample Volume (liters)	Sulfates (mg/m^3)
TRAM #3 (A)	7900068	12/18/78	200	0.80
TRAM #3 (A)	79-00069	12/18/78	308	0.65
TRAM #2 (A)	79-00070	12/18/78	190	0.79
TRAM #3 (A)	79-00071	12/18/78	176	0.44
TRAM #2 (A)	79-00072	12/18/78	180	0.94
TRAM #2 (A)	79-00073	12/18/78	300	0.40
Haulage Way "D" 20' from Dump Point (A) +	79-00074	12/18/78	180	0.34
Haulage Way "D" 40' from Dump Point (A) +	79-00075	12/18/78	180	0.34
Maintenance Barn Entrance (A) +	79-0076	12/18/78	186	0.03
Maintenance Barn Back (A) +	79-00077	12/18/78	188	0.03
Haulage Way "B" 10' from Haulage Way "C" (A) +	79-00078	12/18/78	180	0.33
Haulage Way "D" 200' from Rock Pick Dump Point (A) +	79-00079	12/18/78	180	0.29

TABLE II

(continued)

Location	Sample No.	Date Sampled	Sample Volume (liters)	Sulfates (mg/m^3)
20' Away from 49 Raise Area (A) +	79-00080	12/18/78	180	0.24
20' Away From 49 Raise Area (A) +	79-00081	12/18/78	180	0.24
30' Left of 49 Raise Area (A) +	79-00082	12/18/78	180	0.20
20' Right of 49 Raise Area (A) +	79-00083	12/18/78	180	0.44
30' Left of 49 Raise Area (A) +	79-00084	12/18/78	180	0.24
30' Left of 49 Raise Area (A) +	79-00085	12/18/78	180	0.19
Control	79-00086	12/18/78	N/A	ND
Control	7900087	12/18/78	N/A	ND
NIOSH Recommendation mg/m^3				1.0

+ = Locations were identified based on schematic of the 2,150-foot level given to the NIOSH Team by Ernie Boyt
A = Area sample
P = Personal sample
ND = None Detected

TABLE III

Results of Formaldehyde Analysis

Location (+)	Sample No.	Date Sampled	Sample Volume (liters)	Formaldehyde* (mg/m^3)
Control	FC-1	12/18/78	N/A	<0.002
Control	FC2	12/18/78	N/A	<0.002
3rd Crosscut Left of 49 Raise (A) +	J-1	12/18/78	139	<0.002
Haulage Way at 49 Raise (A) +	J-2	12/18/78	176	<0.002
2nd Crosscut Left of 49 Raise (A) +	J-3	12/18/78	134	<0.002
Haulage Way D 210' From Rock Pick Dump Pt. (A) +	W-1	12/18/78	249	<0.002
Haulage Way B at 49 Crosscut (A) +	W-2	12/18/78	265	<0.002
Rear of Maintenance Barn (A) +	W-3	12/18/78	245	<0.002
Right Side 4' From Rock Pick Dump Pt. (A) +	RF-1	12/18/78	315	<0.002
Left Side of Rock Pick 50' From Dump Pt. (A) +	RF-4	12/18/78	302	<0.002

TABLE III

(continued)

Location (+)	Sample No.	Date Sampled	Sample Volume (liters)	Formaldehyde (mg/m^3)
Right Side of Rock Pick 70' From Dump Pt. (A) +	RF-5	12/18/78	274	<0.002
NIOSH Recommendation C-ceiling (30 minutes) (mg/m^3)				C-1.2

A = Area sample

P = Personal sample

(+) = locations based on schematic of the 2,150-foot level

* = results of all the formaldehyde analysis given above are the minimum detectable levels measured per the analytical procedures used.

TABLE IV

Results of Hydrocarbon Analysis

Location (+)	Sample No.	Date Sampled	Sample Volume (liters)	Benzene* (mg/m^3)	Toluene* (mg/m^3)	Xylene* (mg/m^3)
10' Away From Portion Haulage Way G (A) +	J-1	12/18/78	8.95	1.11	1.11	1.11
3rd Crosscut at Haulage Way F (A) +	J-2	12/18/78	6.95	1.43	1.43	1.43
Left Side of Rock Pick 20' From Dump Pt. (A) +	RF-2	12/18/78	15.5	0.63	0.63	0.63
TRAM #2 in Rock Pit Area (A)	RF-6	12/18/78	16.0	0.63	0.63	0.63
Right Side of Rock Pick 80' From Dump Pt. (A) +	RF-16	12/18/78	13.5	0.71	0.71	0.71
Right Side of Rock Pick 65' From Dump Pt. (A) +	W-1	12/18/78	13.5	0.71	0.71	0.71
Haulage Way B, 30' on Right From Haulage Way C (A) +	W-2	12/18/78	14.1	0.71	0.71	0.71
Rear of Maintenance Barn (A) +	W-3	12/18/78	13.0	0.77	0.77	0.77
NIOSH Recommendation (mg/m^3) # TWA for 60 minutes C-ceiling				C-3.2 #	375	434

* Results of analysis of benzene, toluene, and xylene given above are the minimum detectable levels measured per the analytical procedures used.

TABLE V

Results of Nitrogen Dioxide Analysis

Location (+)	Sample No.	Date Sampled	NO_2 (PPM)
TRAM # 3 Operator (P)	163	12/18/78	0.30
TRAM # 3 (A)	231	12/18/78	0.34
TRAM # 3 (A)	77	12/18/78	0.24
TRAM # 2 Operator (P)	230	12/18/78	0.26
TRAM # 2 (A)	33	12/18/78	0.39
TRAM # 2 (A)	221	12/18/78	0.40
TRAM # 2 Operator (P)	87	12/18/78	ND
Rock Pick Operator (P)	214	12/18/78	0.33
3' From Rock Pick (A) +	148	12/18/78	0.48
50' From Rock Pick on Left (A) +	32	12/18/78	0.41
60' From Rock Pick on Right (A) +	174	12/18/78	0.18
90' From Rock Pick on Left (A) +	164	12/18/78	0.27
Rear of Maintenance Barn (A) +	102	12/18/78	0.06
Front of Maintenance Barn (A) +	276	12/18/78	0.06
Haulage Way B (A) +	152	12/18/78	0.10

TABLE V

(continued)

Location (+)	Sample No.	Date Sampled	NO_2 (PPM)
30' on Right Outside Maintenance Barn (A) +	22	12/18/78	0.20
Haulage Way D (A) +	2	12/18/78	0.20
Haulage Way B (A) +	30	12/18/78	0.18
10' on Right Outside Maintenance Barn (A) +	146	12/18/78	0.26
30' on Right Towards 48 Crosscut (A) +	99	12/18/78	0.15
80-90' From Haulage Way on Right (A) +	267	12/18/78	0.33
20' North of 49 Raise (A) +	222	12/18/78	0.14
40' Left of 49 Raise (A) +	250	12/18/78	0.21
Across From Haulage Way C (A) +	243	12/18/78	0.43
Across From Haulage Way C and Into a Dead End (A) +	35	12/18/78	0.06
Haulage Way G (A) +	136	12/18/78	0.24
At 3rd Crosscut in Haulage Way F (A) +	10	12/18/78	0.56

TABLE V

(continued)

Location (+)	Sample No.	Date Sampled	NO_2 (PPM)
At 2nd Crosscut in Haulage Way F (A) +	52	12/18/78	0.49
Control	7	12/18/78	ND
Control	93	12/18/78	ND
Control	173	12/18/78	ND
Control	239	12/18/78	ND
NIOSH Recommendation C-ceiling (15 minutes)			C-1

+ = Locations based on schematic from Ernie Boyt of the 2,150-foot level.

ND = None Detected

TABLE VI

Results of Particulate Polycyclic Aromatic Hydrocarbons

Samples were taken for the following particulate polycyclic aromatic hydrocarbons and were found to be below or at the NIOSH limit of detection: Fluoranthene, Benz(a)Anthracene, Benz(a)Pyrene, Benz(e)Pyrene, Perylene, Chrysene, Pyrene, and Benzene solubles. The limit of detection is below and expressed in mg/m^3.

	LOD (mg/m^3)	TLV ACGIH (mg/m^3)	MSHA (mg/m^3)	NIOSH Recommendation* (mg/m^3)
Fluoranthene	<0.00012	NS	NS	NS
BaA	<0.00008	NS	NS	NS
BaP	<0.00008	NS	NS	NS
BeP	<0.00008	NS	NS	NS
Perylene	<0.00048	NS	NS	NS
Chrysene	<0.00020	NS	NS	NS
Pyrene	<0.00036	NS	NS	NS
Benzene solubles	<0.00002	NS	NS	NS

NS = no standard; no NIOSH criteria for a recommended standard

LOD = Limit of Detection

TABLE VII

Results of Trace Metal Analysis

	NIOSH Analytical Limit of Detection (mg/m^3)	NIOSH Evaluation Criteria mg/m^3	TLV* mg/m^3
Vanadium	<0.025	C-0.05	N/A
Berylium	<0.0005	0.0005	N/A
Cadmium	<0.002	<0.04	N/A
Total Chromium	<0.003	NRC	0.50
Lead	<0.005	0.10	
Cobalt	<0.0025	NRC	0.10
Nickel	<0.005	0.015	
Copper	<0.002	NRC	1.0

* Current metal/non-metal health and safety standards are based on the ACGIH 1973 TLV, pages 1-54, CFR Title 30, 57.5-1.

NRC = No NIOSH criteria for a recommended standard on the subject material.

C = ceiling (15 minutes)

Appendix A

Permissable Exposures 8-Hour
Time Weighted Exposure Criteria
(mg/m^3)

Substance	NIOSH Criteria for Recommended Standards	(ACGIH) TLV* 1973	Current ACGIH TLV 1979
Selenium	none	0.2	0.2
Arsenic	0.002 (15 mins.)	0.5	0.5
Vanadium	0.05 (15 mins.)	0.5	0.5
Berylium	0.0005 (130 mins.)	0.002	0.002
Cadmium	0.040	0.2	0.05
Total Chromium	none	0.5	0.5
Lead	<0.1	0.15	0.15
Cobalt	none	0.1	0.1
Nickel	0.015	1.0	0.1
Copper	none	1.0	1.0
Sulfuric Acid (SO_4)	1.0	1.0	1.0
Formaldehyde	C-1.2 (30 mins.)	C-3.0	C-3.0
Benzene	C-3.2 (60 mins.)	none	30.0
Toluene	375.0	375.0	375.0
Xylene	434.0	435.0	435.0
Nitrogen Dioxide	C-1.8 (15 mins.) (1 ppm)	C-9.0	C-9.0
Particulate polycyclic aromatic hydrocarbons	none	none	0.2

*Current metal/non-metal health and safety standards are based on the ACGIH 1973 TLV, pgs. 1-54, CFR Title 30, 57.5-1.

C = ceiling

NIOSH criteria is used in assessing worker exposure to potentially hazardous agents except in cases where more current and stringent Federal or consensus standards exist or where sufficient state of the art health research information is available and can be applied.