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Results from the National Occupational Health Survey of Mining

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The National Institute for Occupational Safety and Health (NIOSH)* conducted field surveys for the National Occupational Health Survey of Mining (NOHSM) from May 1984 through August 1989. The main objective of NOHSM was to identify the health-related agents found in the U.S. mining industry, per the U.S. Federal Mine Safety and Health Amendments Act of 1977. NOHSM included a total of 491 mines (60 coal mines and 431 metal and nonmetal mines) which employed 59,734 miners, representing 66 mineral commodities. The mines were selected from a total of 2131 mines that employed 297,322 miners. Although NIOSH surveyed only a representative sample of mines in each mineral commodity, the data were projected over all of the mines in each of those mineral commodities. Each mine's survey included three phases: questionnaire, chemical inventory, and worksite visit. The data obtained during the questionnaire described medical services, industrial hygiene practices, and general facility information. The inventory data identified all chemical substances and trade name products found on the mine property. NIOSH inventoried 2570 chemical substances and 84,939 trade name products. During the worksite visit, the NOHSM surveyors observed and interviewed workers to determine their potential exposures at the worksite. The term "potential exposure" means the health-related agent was in sufficient proximity to a worker that the agent could have entered or contacted the worker's body. The potential exposures recorded during the worksite visits included chemical substances, trade name products, physical agents, musculoskeletal overload conditions, welding-related products, abrasive grinding materials, and bulk dust. Since workers were often potentially exposed to more than one agent, the projected numbers of potential exposures are often greater than the number of workers involved. The projected numbers of potential exposures across the entire mining industry were: physical agents—365,332; musculoskeletal overload conditions—710,340; and welding-related agents—188,852. More than 1.1 million potential exposures to chemicals and trade name substances were found in surface shops alone. The bulk dust samples suggested that approximately 214,000 miners were potentially exposed to dust that contained greater than 5 percent quartz. GRESKEVITCH, M.F.; BAJPAYEE, S.S.; HALE, J.M.; GROCE, D.W.: RESULTS FROM THE NATIONAL OCCUPATIONAL HEALTH SURVEY OF MINING. APPL. OCCUP. ENVIRON. HYG. 12(12):924-931; 1997. © 1997 AIH.

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The National Occupational Health Survey of Mining (NOHSM) was designed by the National Institute for Occupational Safety and Health (NIOSH) to characterize health-related agents found at U.S. mines. A sample of mines representing 66 different mineral commodities was surveyed during the period of May 1984 through August 1989. These 66 mineral commodities are listed in Table 1. A total of 491 mines were surveyed during that period, including 431 metal and nonmetal mines and 60 coal mines. The 491 surveyed mines employed 59,734 miners.

NOHSM Purpose

NOHSM was developed to characterize all of the health-related agents found at U.S. mines, pursuant to the U.S. Federal Mine Safety and Health Amendments Act of 1977. The Act required that the Secretary of Health, Education, and Welfare (now the Department of Health and Human Services) "shall, for each toxic material or harmful physical agent which is used or found in a mine, determine whether such material or agent is potentially toxic at the concentrations in which it is used or found in a mine."[1] To partially fulfill these requirements of the Act, NIOSH identified the following through NOHSM: occupational health hazards in the mining industry; mining commodities where these occupational health hazards occurred; and occupations and number of workers, by sex, potentially exposed to these occupational health hazards.

NOHSM Sample Selection, Data Projection, and Variance Calculation

NOHSM was designed to provide the capability to project the survey data to national statistics and calculate variances for the projections. The NOHSM sample selection, data projection, and variance calculation were all based on systematic sampling with replacement, which is described in a document entitled *Final Report on the Sampling Design for the Occupational Health Survey of the Mining Industry*. This document provides a thorough description of the NOHSM sample selection.[2]

Survey Description

Each NOHSM survey consisted of a questionnaire, an inventory, and worksite observations.

Questionnaire

The NOHSM questionnaire was administered at each of the 491 facilities in the NOHSM sample, representing 66 mineral commodities. The questionnaire was designed to document certain management practices and policies towards workers' health. The questions were subdivided into four major subject

TABLE 1. NOHSM Mineral Commodities and Associated MSHA SIC Codes

Mineral Commodity	MSHA SIC Code	Mineral Commodity	MSHA SIC Code
Aluminum	10510	Mica	14994
Anthracite coal[A]	11110	Molybdenum	10615
Aplite	14591	Nonmetallic minerals, NEC[B]	14990
Asbestos	14991	Oil shale	13111
Barite	14720	Perlite	14996
Beryl	10992	Phosphate rock	14750
Bituminous coal[A]	12110	Pigment minerals[A]	14792
Boron minerals	14741	Platinum group	10993
Cement	32410	Potash	14742
Clay	14530	Pumice	14997
Copper[A]	10210	Pyrites	14793
Feldspar	14593	Rare earths	10994
Fluorspar	14730	Salt (evaporated)	28991
Gemstones	14992	Salt (rock)	14760
Gilsonite	14993	Sand and gravel[A]	14410
Gold[A]	10410	Sandstone (crushed and broken)	14292
Granite (crushed and broken)	14230	Sandstone (dimension)	14114
Granite (dimension)	14111	Shale (common)	14596
Gypsum	14920	Silver	10440
Iron ore	10110	Slate (crushed and broken)	14293
Kyanite	14594	Slate (dimension)	14115
Lead/zinc[A]	10310	Sodium compounds	14744
Leonardite	29900	Stone, crushed and broken, NEC[B]	14290
Lime	32740	Stone, dimension, NEC[B]	14110
Limestone (crushed and broken)	14220	Talc, soapstone and pyrophyllite	14960
Limestone (dimension)	14112	Titanium	10996
Lithium	14791	Traprock (crushed and broken)	14294
Magnesite	14595	Trona	14743
Manganese	10614	Uranium	10941
Marble (crushed and broken)	14291	Uranium–vanadium ores	10940
Marble (dimension)	14112	Vanadium	10942
Mercury	10920	Vermiculite	14998
Metal ores, NEC[B]	10990	Zircon	10997

[A]NOTE: Abbreviated or slight change to name: Coal, Anthracite to Anthracite Coal; Coal, Bituminous to Bituminuous Coal; Copper Ore to Copper; Gold (Lode and Placer) to Gold; Lead and/or Zinc Ore to Lead/Zinc; Pigment Mineral to Pigment Minerals; Sand & Gravel to Sand and Gravel; Silver Ores to Silver; and Stone, Dimension NEC[B] to Stone, Dimension, NEC[B].
[B]NOTE: NEC represents Not Elsewhere Classified.

areas. The first of these subject areas consisted of general facility information that characterized sampled facilities by industrial classification, commodities mined or processed, age, and workforce size.

The second subject area contained profile information on the provision of medical services to employees as a result of management policy. These medical services included information regarding the following: a formal agreement between labor and management concerning occupational health, an established health unit at the facility, a physician or nurse on the facility payroll, the number of physician or nursing hours spent per week for medical care of the employees, the type of medical tests provided regularly to the employees (detailed in Figure 1), medical exam requirements for new, sick, and terminated employees, and whether the facility maintains medical records, and if so, how long these records are maintained.

The third subject area contained profile information on the provision of industrial hygiene services to employees as a result of management policy. These industrial hygiene services included information regarding the following: facility industrial hygiene services with a consultant during the past 12 months before the time the survey was conducted; whether the facility employed an industrial hygienist, and if the industrial hygienist was certified or noncertified; the number of industrial hygienists and their major duties; facility monitoring programs for fumes, gases, mists, dusts, vapors, or physical agents (detailed in Figure 2); methods and equipment used for the monitoring programs at the facility; areas requiring personal protective equipment, personnel responsible for servicing and maintaining the personal protective equipment; and corrective measures taken if personal protective equipment is not worn when required; and whether economic penalties are issued if corrective measures are necessary.

The final portion of the questionnaire addressed the employee health-related record-keeping practices, and the geology of the sampled facility. These record-keeping practices and geology questions included information regarding the follow-

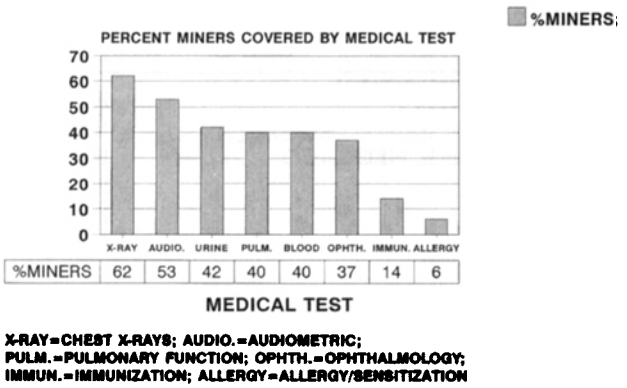

FIGURE 1. Provision of medical tests on a periodic basis across all mineral industries.

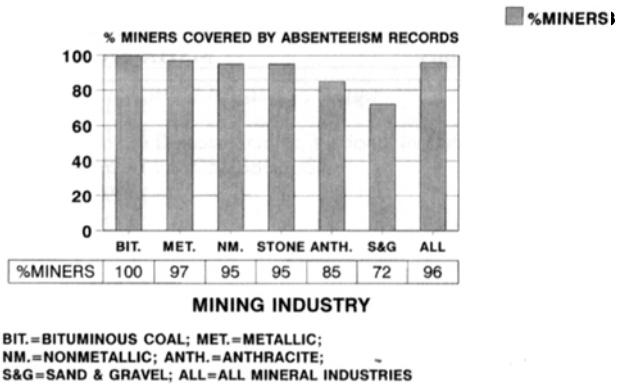

FIGURE 3. Program to keep absenteeism records by mineral industry.

ing: year the facility commenced a personnel system and the items contained in that system, such as social security number, birth date, job history, sex, or race; turnover and absenteeism rate; shift rotation; labor/management health committee; facility underground diesel equipment or equipment with PCB-containing fluids; percentage of each mineral mined in the ore body; facility assay reports; and absenteeism records (detailed in Figure 3).

Questions in the NOHSM questionnaire are listed and defined in the NIOSH technical report entitled *Results from the National Occupational Health Survey of Mining.*[3]

Inventory

The NOHSM inventory included all chemical substances and trade name products present at the mine site. The NOHSM definition of a chemical substance is any substance that can be unambiguously characterized by a specific chemical name or formula. If a substance could not be identified by a specific chemical name or formula by the surveyor, it was coded as a trade name product. Trade name products include substances such as Windex Glass Cleaner, WD-40, WD-40 (aerosol), Chevron Sri-Grease No. 2, and Certanium 705 Welding Rod.

This inventory was quite diverse as shown in the following product categories: paints; lubricants, oils, and greases; janitorial cleaning chemicals; welding rods and wires; solders; abrasives such as grinding wheels and grinding discs; lab chemicals; mill reagents; sealants and adhesives; explosives; fuels; and aerosol products. The inventory excluded cosmetics, medical supplies, and food items.

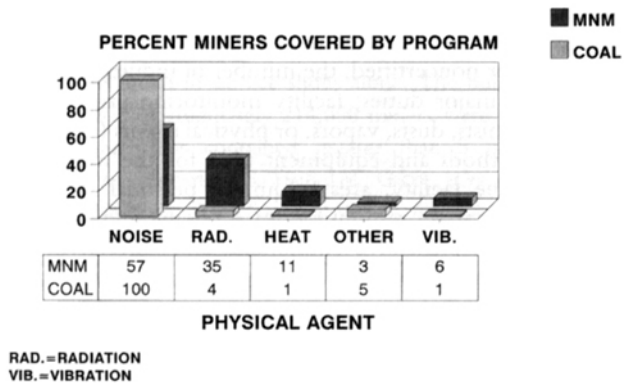

FIGURE 2. Program to monitor physical agents: coal versus metal/nonmetal (MNM).

Worksite Observations

Potential Exposure Criteria

During the worksite visit, the surveyors observed and interviewed workers to determine their potential exposures at the worksite. The term "potential exposure" had two criteria. First, the NOHSM surveyor must have determined that the health-related agent was in sufficient proximity to a worker such that the agent could have entered or contacted the worker's body, although the level of exposure was not measured by NIOSH. Second, the duration of the potential exposure must have met the minimum duration guidelines [i.e., a part-time duration was defined as the potential exposure time greater than 30 minutes per week (on an annual average) or at least once per week 90 percent of the weeks of the work year]. The potential exposure duration could have been either full-time or part-time. A full-time duration was defined as the potential exposure time greater than 4 hours per day, and on a daily basis of at least 90 percent of the company's work year or a standard work year.

Physical Agent Potential Exposures

The physical agents that were recorded during the worksite observations were: (1) noise, (2) heat (whether caused by work processes or generated by underground rock strata), (3) radiation (ionizing radiation from ore bodies were recorded as potential exposures when the surveyor was notified of such conditions, but the environmental levels were not assessed), and (4) vibration (whole-body or segmental). These recorded physical agent potential exposures did not necessarily exceed NIOSH's recommended exposure limits (RELs) or any Mine Safety and Health Administration (MSHA) or Occupational Safety and Health Administration (OSHA) standards for physical agents. For example, the NOHSM surveyor coded a potential exposure to noise (NL) whenever the surveyor had to raise his or her voice above a normal conversational level to be heard by the person standing next to him or her. The written

definitions, guidelines, and procedures to code physical agents that NIOSH established for NOHSM are listed and defined in the NIOSH technical report.[3]

Musculoskeletal Overload Potential Exposures

The musculoskeletal overload potential exposures consisted of twelve different types of awkward bending, posture, and lifting. These recorded musculoskeletal overload potential exposures did not necessarily exceed any NIOSH, MSHA, or OSHA guidelines for musculoskeletal overloads. For example, the NOHSM definition for the heavy lifting musculoskeletal overload was lifting greater than 50 pounds unaided. The definitions, guidelines, and procedures for coding potential exposures to musculoskeletal overloads that NIOSH established for NOHSM are listed and defined in the NIOSH technical report.[3]

Welding, Brazing, Soldering, and Grinding Potential Exposures

NOHSM had 34 different types of welding, brazing, and soldering processes that are listed and defined in the NIOSH technical report.[3] Processes with abrasive grinding wheels or discs were also recorded during the NOHSM worksite visit. The three elements coded in welding, brazing, and soldering processes or abrasive grinding operations were: the name of the metals being welded or ground, the trade names of the welding rods or grinding wheels or discs used, and any chemical substances or trade name products attached to the metals that were welded on or ground, such as solvents used to clean the metals or lubricants used to lubricate metals prior to welding or grinding.

Chemical Substance Potential Exposures

Only the chemical substances and trade name products recorded during the inventory phase of the NOHSM survey, and observed during the worksite observations to meet potential exposure guidelines, were recorded as chemical substance and trade name product potential exposures.

Bulk Dust Potential Exposures

At each worksite, approximately 10 cc of fine settled dust was collected in a plastic vial. If no fine settled dust was available, coarser bulk dust was collected. Of all the bulk dust samples gathered at each mine, five were selected and analyzed for crystalline silica (quartz, cristobalite, and tridymite), 31 different metals, and asbestos. When fewer than five bulk dust samples were collected, all were submitted for analysis.

Any potential exposures that occurred as a result of nonwork activities were not coded. Thus, the surveyor did not code the potential exposures that resulted from the personal use of alcohol, tobacco, prescribed, over-the-counter, or recreational drugs, or perfume.

Limitations of the NOHSM Data

The following limitations of the NOHSM data must be recognized.

Annual Usage Data

The annual usage data for each inventoried item were only a guide to the projected magnitude of usage for those items, since they were based on estimates provided by mine management. Further, all the estimates from mine management were rounded to the nearest whole number, with all quantities between 0 and 1 being reported as 1. Thus, extremely small usage rates may actually be lower than estimated. With this possible exception, NIOSH believes the projected magnitude of the usage rate to be appropriately represented.

Large Variances in Projections

The projections of attributes have variances and standard deviations that are quite large.

Trade Secret Data Exclusions

Mine management had the right to designate any data from all phases of the NOHSM survey as trade secret. Any NOHSM data reported to the public must exclude data that were designated as trade secret by mine management. Seventy-nine of the 491 mines (16 percent) surveyed under NOHSM designated some data from at least one phase of the NOHSM as trade secret.

Time Dependency of Data

Since the NOHSM surveys were conducted at one point in time, the data will become outdated due to subsequent changes occurring at surveyed mine sites, or in the mining industry as a whole. The data in the NOHSM database may be slightly changed in the future to make the information more applicable to that point in time. For example, the number of employees in each mine at the time the NOHSM sample was selected was used to calculate the commodity projections and variances, but the current number of employees in these mines could be substituted to calculate the commodity projections and variances.

Lack of Trade Name Product Resolution

NOHSM has not determined the chemical ingredients for trade name products. When questioning the NOHSM query system for the presence of a chemical, only the single chemical data will appear in the results. Because of the lack of trade name product chemical ingredients, the trade name products cannot be queried for the presence of a chemical.

Bulk Dust

The limitation of bulk dust samples as an indicator of airborne dust must be recognized; bulk dust samples can only be used to estimate the percentage of crystalline silica, trace metals, or asbestos in the worksite dust, but not the concentration of airborne quartz, trace metals, or asbestos. Bulk dust samples may represent an accumulation of dust over many months or dust that was recently deposited. It is possible that a bulk dust sample was never airborne.

Results

Questionnaire

The questionnaire results section of this report describes questionnaire data for the following groups of mining (Table 2): (1) the entire mining industry, (2) the six mineral industries that MSHA uses in their annual injury experience information reports, with the exception of anthracite and bituminous coal mining, which MSHA combines under the single heading of

TABLE 2. Questionnaire Data Results Displayed by 6 MSHA Mineral Industries

- All mineral industries
- Stone
- Nonmetallic
- Metallic
- Sand and gravel
- Anthracite coal
- Bituminous coal
- Coal versus metal/nonmetal

MSHA uses one heading: "coal mining."

"coal mining," and (3) coal versus metal and nonmetal mining. Results for all of the 66 mineral commodities surveyed under NOHSM could not be conveniently displayed in this article.

Figure 1 shows one example from the NOHSM questionnaire, question 18, which asks "Do you provide the following medical tests to all or selected groups of employees on a periodic basis?" As can be seen from this figure, a higher percentage of workers across all mineral industries were employed by facilities that provided chest x-rays to all or selected groups of employees on a periodic basis than any of the other examinations or tests. This is followed by audiometric (53%), urine (42%), pulmonary function (40%), blood (40%), ophthalmology (37%), immunizations (14%), and allergy/sensitizations (6%).

Figure 2 shows another example from the NOHSM questionnaire, question 27, which asks "Do you have a program under which you monitor the presence of physical agents such as heat, vibration, radiation, noise, or other types of physical agents?" This figure shows a higher percentage of coal and metal/nonmetal miners were covered by a noise monitoring program than for any other physical agent. The coal-mining industry provided noise monitoring for 100 percent of its workers, since noise monitoring is required by law at all coal mines. A higher percentage of metal/nonmetal miners worked at facilities that provided monitoring for radiation, heat, and vibration when compared with coal miners.

Figure 3 shows a final example from the questionnaire, question 39, which asks "Do you keep absenteeism records?" Ninety six percent of the workers across all mineral industries worked at a facility that kept absenteeism records, while sand and gravel industries had the least at 72 percent.

Inventory

The inventory contains 84,939 trade name products and 2570 chemical substances. Approximately 31 percent of all inventoried items were recorded as having zero usage (not having been used in the 12 months before the mine was surveyed, as estimated by mine management). Two hundred fifty-seven MSHA-regulated chemicals were found during the surveys, in addition to approximately 2197 chemicals that have no NIOSH recommended exposure limit (REL) or MSHA permissible exposure limit (PEL).

For each inventoried item, the NOHSM surveyor recorded mine management's estimated annual usage rate in gallons or pounds. Table 3 shows the ten chemical substances with the highest annual usage rate (amount used in the previous 12 months before the NOHSM survey was conducted at the mine) in gallons. Seven of the ten chemicals with the highest usage rate (by gallons) are fuels: natural gas, methane, acetylene, diesel fuel no. 2, gasoline-unleaded, diesel fuel no. 1, and gasoline-leaded.

TABLE 3. Ten Chemicals with Highest Annual Usage Rate (Gallons)

1. Natural Gas*
2. Methane*
3. Acetylene*
4. Diesel fuel no. 2*
5. Nitrogen
6. 95% Argon, 5% oxygen
7. Phosphorous yellow
8. Gasoline, unleaded*
9. Diesel fuel no. 1*
10. Gasoline, leaded*

*Fuels.

Worksite Observations

All of the potential exposure results from the worksite observation phase of the NOHSM survey include both full and part-time potential exposures, which were previously defined in the survey description section of this report.

1. Physical Agent Potential Exposures
   Figure 4 indicates the projected number and percent of workers who were potentially exposed to the different types of physical agents recorded under NOHSM. The percentage of workers potentially exposed to noise (73%) was much higher than found for the other physical agents. "Other" in Figure 4 includes temperature (underground strata) and ionizing, ultraviolet, microwave, laser, and miscellaneous radiation.
2. Musculoskeletal Overload Condition Potential Exposures
   Figure 5 shows the projected number and percent of workers potentially exposed to the different types of musculoskeletal overloads. The musculoskeletal overload condition "neck and/or back" had the highest projected number and percent of workers potentially exposed to any musculoskel-

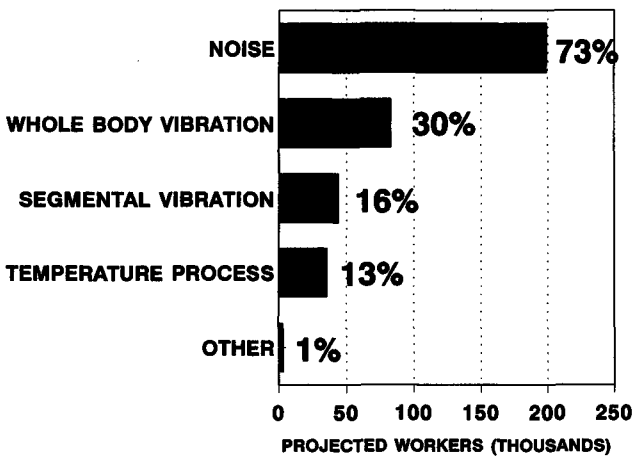

FIGURE 4. Projected number and percent of workers potentially exposed to Physical Agents.

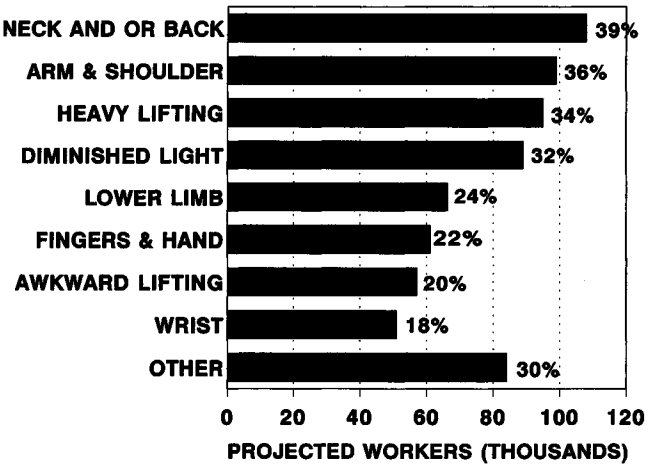

FIGURE 5. Projected number and percent of workers potentially exposed to musculoskeletal overloads.

etal overload condition potential exposure. "Other" in Figure 5 includes sitting, frequent lifting, prone or supine lying, and standing. Although diminished light is not a musculoskeletal overload, it was included in the NOHSM survey because it could make work more fatiguing and hazardous.

3. Welding, Brazing, and Soldering Process Potential Exposures
   NIOSH surveyors identified and coded 24 of the 34 different types of welding, brazing, and soldering processes listed in the NOHSM field manual. Figure 6 shows that these processes included 18 types of welding, 3 types of cutting, 1 type of brazing, and 2 types of soldering. Approximately 32 percent of the projected number of workers were potentially exposed to welding or cutting processes. Less than 3 percent of the projected number of workers were potentially exposed to brazing and soldering processes.
4. Chemical Substance Potential Exposures
   The Bureau of Mines found that chemicals in mining are an occupational health concern.[4] Table 4 lists the ten chemical substances with the highest projected number of workers potentially exposed. The number of workers potentially exposed to chemical substances contained in the ore being mined is not reported in Table 4. Table 4 only reports those chemical substances purchased and then used in the mining process. Hence, in Table 4, coal miners are not listed as being potentially exposed to coal, asbestos miners are not reported as being potentially exposed to asbestos, and so forth. This figure shows that 8 of the 10 chemical substances to which workers were most frequently potentially exposed were all fuels: diesel fuel no. 2, acetylene, unleaded gasoline, leaded gasoline, diesel fuel no. 1, propane, coal, and kerosene.
5. Product Use Term Potential Exposures
   For each potential exposure, the NOHSM surveyor recorded a product use term (PUT), which indicated how the product was used at that particular worksite. Table 5 shows the ten PUTs with the highest projected number of workers potentially exposed. This table shows that the ten PUTs most frequently associated with potential exposures were maintenance-related products.

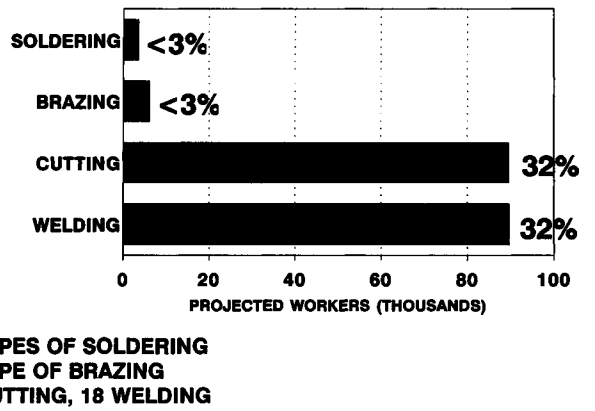

FIGURE 6. Projected number and percent of workers potentially exposed to welding-related processes.

TABLE 4. Ten Chemicals with Highest Projected No. of Miners Potentially Exposed

Chemical	Projected No. of Miners Potentially Exposed
Diesel fuel no. 2	109,000
Acetylene	67,000
Gasoline, unleaded	31,000
Gasoline, leaded	20,000
Diesel fuel no. 1	17,000
Propane	11,000
Coal	11,000
Kerosene	11,000
Calcium chloride	11,000
Limestone	9,000

TABLE 5. Ten Product Use Terms with Highest Projected No. of Miners Potentially Exposed

PUT[A]	Projected No. of Miners Potentially Exposed
Fuel	165,000
Grease	113,000
Cleaner, hand	89,000
Oil, hydraulic	87,000
Oil, motor	79,000
Welding rod	66,000
Lubricant, NEC[B]	61,000
Solvent	56,000
Penetrant	56,000
Compound, dust control	49,000

[A]PUT = Product use term.
[B]NEC = Not classified elsewhere.

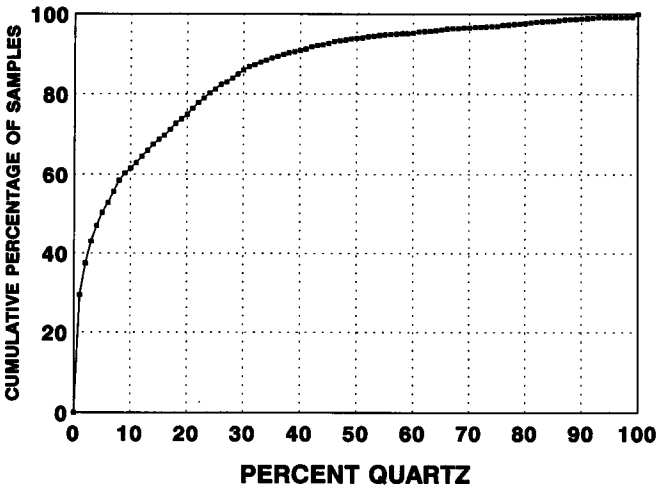

FIGURE 7. Cumulative frequency distribution of bulk dust samples containing the indicated percentage quartz or less.

6. Bulk Dust Potential Exposures

a. Quartz

Out of 7143 bulk dust samples collected from the NOHSM, 2075 were analyzed for crystalline silica (quartz, cristobalite, and tridymite). The NIOSH analytical method #7500 was used to determine the percentage of quartz in the bulk dust samples.[5] This method uses x-ray powder diffraction as a measuring technique. Figure 7 shows the cumulative frequency distribution of the percent quartz contained in bulk dust samples. Nearly 30 percent of the 2075 analyzed samples were equal to or less than 1 percent quartz. Approximately 50 percent of all samples had a quartz percentage of 5 or greater. Approximately 38 percent of the samples contained greater than 10 percent quartz. Approximately 214,000 miners were projected to be potentially exposed to bulk dust that had an average quartz percentage greater than 5 (which is where MSHA begins to reduce exposure standards based on quartz content).[6]

b. Metals

Out of 7143 bulk dust samples collected from the NOHSM, 2151 were analyzed for different metals. The NIOSH analytical method #7300 was used for the trace metal analysis of the NOHSM bulk dust samples.[7] This method uses inductively coupled argon plasma-atomic emission spectroscopy (ICP-AES) as a measuring technique. Table 6 shows that the bulk dust samples collected from the Rare Earths and Zircon commodity mines yielded averages of 0.93 and 0.17 percent of arsenic in their respective bulk dust samples. Although it may appear that these commodities were underrepresented since only one facility was surveyed for each of these commodities, only 1 active Zircon mine and 3 active Rare Earths mines existed in the United States for these commodities at the time the NOHSM survey was conducted.

c. Asbestos

Out of 7143 bulk dust samples collected from the NOHSM, 2152 were analyzed for asbestos. The NIOSH analytical method #9002 was used to analyze the bulk dust samples for seven forms of asbestos: actinolite asbestos, amosite (cummingtonite-grunerite), anthophyllite asbestos, chrysotile, crocidolite (riebeckite), tremolite asbestos, and amphibole asbestos. This method uses polarized light microscopy and dispersion staining as a measuring technique.[5] Five forms of asbestos were found: actinolite asbestos, amosite (cummingtonite-grunerite), anthophyllite asbestos, chrysotile, and amphibole asbestos. Table 7 summarizes the number of facilities, maximum percentage, and nonasbestos commodity associated with the maximum percentage for the five forms of asbestos found during NOHSM.

d. CD-ROM Disc with NOHSM Query System

NIOSH has developed a CD-ROM disc with the user-friendly, NOHSM query system included, which makes the data from the NOHSM survey available to any interested party. One example of a query that may be asked from the NOHSM database might be: "What are the projected number of female miners potentially exposed to sodium cyanide in the gold mining industry"?

e. NOHSM Database Users

Parties that have requested information from the NOHSM database or the CD-ROM with the NOHSM database include several academic institutions such as the Penn State University Mining Engineering Department, Brown University, the University of Massachusetts at Lowell, and the Harvard School of Public Health; federal government agencies such as MSHA, NIOSH, the United States Bureau of Mines, and the National Institutes of Health (NIH); labor unions such as the United Mine Workers of America (UMWA); private industrial associations such as the National Mining Asscian and the American Mining Con-

TABLE 6. Commodities with Highest Percentage Arsenic in Bulk Dust Samples

Commodity	No. of Mines Surveyed	No. of Samples	Maximum %	Mean %
Rare earths	1	5	4.21%	0.93%
Zircon	1	5	0.67%	0.17%
Silver	11	44	2.39%	0.11%
Gold	20	72	0.37%	0.08%
Metal ores, NEC*	2	4	0.14%	0.04%

*NEC = not classified elsewhere.

TABLE 7. Bulk Dust Asbestos Results

Asbestos Form	No. of Facilities	Maximum % Found	Commodity Associated-Max %[A]
Actinolite	9	35.0	Vermiculite
Amosite	19	1.0[B]	Several
Anthophyllite	2	1.5	Talc
Chrysotile	18	4.0	Vermiculite
Other	1	<1	Salt (rock)

[A]Asbestos mines yielded actinolite (max = 1.5%). Amosite (max = 7.5%) and chrysotile (max = 90%).
[B]14 Commodities yielded ≥ 1 sample with 1% amosite.

gress (AMC); mining companies such as Englehard Corporation and Homestake Mining Company; medical institutions such as the George Washington University medical center; and individual researchers.

Discussion

The information presented in this report provides an indication of the range of occupational health-related agents found at U.S. mining facilities. This information is only a small portion of the NOHSM information that is available. After the field data were collected and coded, the data were keyed into a facility dataset. NIOSH has constructed a database that makes the data from the NOHSM survey available to any interested party. This database is described in a report entitled *National Occupational Health Survey of Mining Query System.*[8] Any parties that are interested in special queries from the NOHSM data or a copy of the PC-based NOHSM query system should direct their requests to: Janet Hale, National Institute for Occupational Safety and Health (NIOSH) 1095 Willowdale Road, Morgantown, WV 26505-2888. NIOSH plans for using these data include:

- Encouraging MSHA to use the NOHSM data in combination with other data (exposure data) to set regulatory priorities and write improved health standards, and to identify and determine research needs and priorities;
- Assisting in setting priorities for mine-related occupational health research;
- Responding to questions from other parties regarding occupational health aspects of the mining industry; and
- Providing potential exposure data for use in NIOSH reports.

Acknowledgment

The individuals who collected data during this field survey deserve special recognition. They were asked to endure the rigors of transition assignments in a variety of geographic settings, usually without the aid of fellow workers. Their work took them into a broad spectrum of worksites where they encountered a staggering array of potential exposure agents. The National Occupational Health Survey of Mining owes much to their grace under pressure, their persistence in the face of adversity, and their commitment to the goals of the survey.

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