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COAL MINES OF THE UNITED STATES PRODUCTION, SAFETY & HEALTH, AND THE NATIONAL MINE TRAINING ACADEMY

Summary. Coal mine fatalities in surface and underground mines and processing plants in the United States dropped to an all-time historical low of 27 fatalities in 2002 with 15 occurring in underground mines. Total coal production from both surface and underground mines in 2002 again remained over one-billion short-tons for the ninth consecutive year. Two-thirds of the coal produced, 738 million short-tons, was from surface mine operations. Again in 2002, coal production was maintained with fewer mine workers and fewer underground mines. The falls-of-roof, powered-haulage equipment, and electrical hazards were the leading causes of accidents resulting in the deaths of miners. The high priority health issues continue to be the control of diesel-engine emissions, abatement of hazardous noise levels, and identification of chemicals in underground mines. A principal reason for the continued impressive safety records in coal mines has been the quality and the uniform and consistent education and training of Federal mine inspectors.

KOPALNIE WĘGLA W STANACH ZJEDNOCZONYCH AMERYKI - WYDOBYCIE, BEZPIECZEŃSTWO I ZDROWIE ORAZ NARODOWA AKADEMIA GÓRNICZA

Streszczenie. Wypadki śmiertelne w kopalniach podziemnych i odkrywkowych oraz w zakładach przeróbczych w USA spadły w znaczący sposób do poziomu 27 wypadków śmiertelnych w 2002 roku, z których 15 miało miejsce w górnictwie podziemnym (738 milionów ton). Całkowite wydobycie zarówno z kopani odkrywkowych, jak i podziemnych w 2002 roku utrzymało się na poziomie ponad jednego miliarda ton amerykańskich, z czego dwie trzecie pochodziło z wydobycia odkrywkowego. Znów w 2002 r. produkcja węgla została osiągnięta przy mniejszym zatrudnieniu i redukcji ilości kopalń. Zawały stropu, sprzęt hydrauliczny oraz porażenie prądem elektrycznym były głównymi przyczynami wypadków śmiertelnych. Priorytetem w dziedzinie ochrony zdrowia pozostała kontrola emisji spalin z silników diesla, poziomu hałasu oraz identyfikacja chemikaliów w podziemnych kopalniach. Tak dobre wyniki w dziedzinie bezpieczeństwa w kopalniach węgla zawdzięczamy wysokiej jakości kształcenia zapewnianej przez federalnych inspektorów górniczych.

1. Introduction

Increased mechanization and automation of mining equipment, design of mine systems, and the training of the work force, including mine inspectors, have been the emphasis of the coal industry in the United States since powered-haulage equipment replaced the horses and animals that once pulled coal out of the mines. Emphasis in these areas, along with favorable mining conditions of thick horizontal coal seams close to the surface have resulted in high production rates with fewer workers underground. Surface mining methods now account for two-thirds of total coal production.

Along with increased production and productivity gains, the coal mining industry in the United States has experienced a dramatic trend of declining fatalities. The year 2002 set an all-time record low number of fatalities -- 27 coal miners lost their lives mining and processing 1.09 billion short-tons of coal from underground and surface mining operations. 15 fatalities were from underground mining that accounted for 358,373,000 short-tons of the total 1.09 billion tons produced. The impressive safety record is, in large part, attributed to the experienced workforce, the initiation of Federal Rules governing coal mining in 1969, and the establishment of the National Mine Training Academy in 1976. This Academy trains all Federal Mine Inspectors in the country.

Historically, falls-of-roof have been the leading cause of fatal accidents in underground coal mines. Over the past several years, fatal accidents from the use of powered-haulage equipment have joined falls-of-roof as the two top leading causes of fatalities. With increased automation and mechanization of mining equipment, this change is not surprising. High priority health issues continue to include diesel engine emissions, hazardous noise levels, and chemical substances.

2. Coal production and number of mines & workers

Coal Mine Production. Total surface and underground coal production has remained just over one billion short-tons per year since 1994. In 2002, surface and underground mine production totaled 1,094,283,000 short-tons. Surface mines accounted for two-thirds of the coal with 735,910,000 tons, and underground mines accounted for one-third of the coal with 358,373,000 tons.

The percentage of underground coal mined from longwall operations has been steadily increasing over the past 25 years. In 2002 the production from longwall operations reached a record high of 52% of the underground coal produced with 187,766,000 short-tons mined. Continuous miner, room-and-pillar operations accounted for most of the remaining production. Conventional blasting techniques produced approximately one-percent of the underground coal.

Nearly all coal mined by surface operations is by strip mining methods. To illustrate the enormous size of these operations, the largest surface mine in the United States in the State of Wyoming produced 74.8 million short tons of coal in 2002. The pictures below show the blasting of the coal seam and removal of coal. Up to 120 feet of earth covering the horizontal coal seam is removed in 40-foot slices. The exposed coal is then blasted and removed by shovels and haul trucks that can carry 190 to 270 short-tons of coal in a single load.

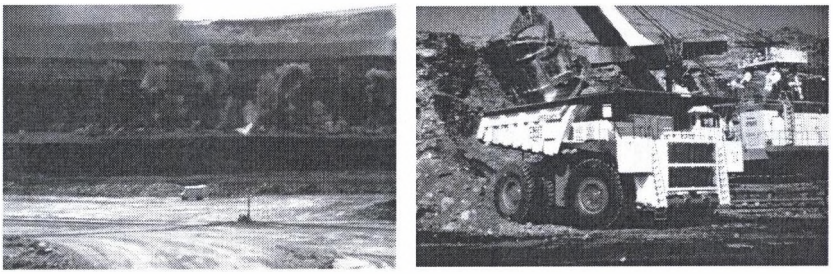


Fig. 1. Surface Strip Mining Accounts for Two-Thirds of U.S. Production Coal Seam is Blasted and Coal Removed by Shovel and Trucks

Rys. 1. Odkrywkowe kopalnie węgla zapewniają dwie trzecie wydobycia w USA. Pokład węgla jest wysadzany w powietrze, a węgiel jest usuwany przy pomocy koparek i ciężarówek

Average coal mine productivity for 2002, given in the number of short-tons extracted per-miner per-hour, was 10.38 for all surface mines, and 4.00 for all underground mines. To illustrate how dramatically productivity has increased throughout the years, surface productivity in 1990 was 5.94 and in 1980 it was 1.93. Underground productivity in 1990 was 2.54 and in 1980 it was 1.21. Increased coal production, along with a greatly reduced workforce, have both resulted in the dramatic productivity increases.

Number of Mines. The number of surface and underground coal mines has been continually decreasing since the 1960's. Economies of scale requiring mines to operate at higher production levels to pay for increasing costs have prevented many smaller operations from competing with the large operations. The increased production of large operations has kept coal prices down making it difficult for small mines to compete.

2001 was a rare year when both the number of underground and surface mines increased. However, the decreasing trends continued once again in 2002. In 2002 there were 653 active underground coal mines, a 9% decrease from 2001. The number of surface mines decreased 2% from 2001, and in 2002 there were 744 active surface mines.

Coal Mine Workers. Mining cultures in the United States have changed. In the past, many families and communities grew up in mining towns that provided for a sufficient work force. Now, many persons do not wish to remain in the rural areas of mining regions making it difficult to attract miners. This is reflected in the average age of coal miners -- 48 years in 2002. However, this age is one reason for the high experience level of workers making for a safer environment.

The mining workforce has declined dramatically over the years. In 2002 the total underground and surface mining workforce of coal companies, not including contract workers, was 75,025 employees (42,852 at underground operations and 32,466 at surface mine operations). This number includes miners and processing plant employees, but not office workers. The number of underground coal workers presently is approximately one-half of the workforce that existed in 1990.

In 2002, contract miners added an additional 40 percent to the total number of mine employees. This brings the total underground and surface workforce to 105,366 workers. Some mines have no contract workers, while others contract out a large part of the work. This percentage of contract workers hired by the mining companies has been increasing. The increase is attributed to difficulty in attracting a full-time employees with mines closing and a decreasing workforce, and the added costs to a mining company of future worker retirement benefits, which are often not paid to the workers by contractors.

3. Coal mine safety - fatalities

The long-term decreasing trends of fewer injuries and fatalities of coal mine workers are impressive. The year 2002 set an all-time record low number of miner fatalities -- 27 coal miners lost their lives mining and processing 1.09 billion short-tons of coal from underground and surface mining operations. 15 fatalities were from underground mining that accounted for 358,373,000 short-tons of the total 1.09 billion tons produced. These numbers include mine company workers, contract workers at the mines, coal processing employees, and office workers.

To illustrate the decreasing trend in fatalities over the years, 1,388 mine workers died in surface and underground mines and processing plants in 1940, 325 in 1960, 133 in 1980, and 66 in 1990.

Historically, falls-of-roof have been the leading cause of fatal accidents in underground coal mines. Currently, fatal accidents from the use of powered-haulage equipment have joined falls-of-roof as the two leading causes of fatalities over the past six years. This is not surprising when considering the production levels and high degree of mechanization in mines.

Machinery and electrical hazards are the next categories responsible for the greatest number of worker fatalities. The remaining categories are not as commonplace and result from a number of different categories such as slips and falls, hoisting, hand-tools, and exploding vessels. Fatalities from explosions of methane are not common, but when they occur multiple fatalities frequently result.

4. Coal mine health

Currently, the control of diesel-engine-exhaust emissions, abatement of hazardous noise levels, and the awareness of chemical substances continue to be the primary focuses of health issues in underground coal mines. New Federal rules in these areas are have been established in the past three years by the U.S. Department of Labor, Mine Safety and Health Administration (MSHA), the Federal agency responsible for establishing and enforcing safety and health rules. Activities now continue in implementing the rules and include four areas: revising the rules during the Public Comment Periods, establishing administrative procedures to inspect and enforce the rules, determining specific control technology suitable for the mine environment, and offering training to assist the workforce in understanding the rules.

Diesel Engine Exhaust Emissions. Concern over diesels has resulted from their increased use and the fact that engine exhaust products contain particulates that are in the smallest size of the respirable dust range, less than 1.0 micrometers. Combustion products that are adsorbed on these tiny particles have been proven to contain cancer-causing compounds. Approximately 20% of the coal mines operate diesel equipment underground. Health studies estimate that the new rules will avoid at least 1.8 cases of lung cancer per year.

Significant regulatory deliberations of diesel use in underground coal mines first took place in 1982. At that time there was not a practical method of measuring diesel particulate matter (DPM) in mines. Since that time it has been determined that about 80-85% of the DPM

mass is total carbon (elemental and organic), and the particles have a mass mean diameter of 0.2 micrometers. This allows for measurement methods that estimate the DPM by collecting the particles less than 0.8 micrometers in diameter, or by analyzing the respirable dust sample for total carbon content.

The diesel emission rule finalized in 2001 sets a specific engine exhaust limit of 2.5 grams of DPM per hour to be emitted from the engine. Both permissible equipment, the equipment that travels past the last open cross-cut into the coal-face, coal extraction area, and non-permissible equipment are included. The rule does not dictate how to comply with the DPM level, but gives coal mine operators the choice of using a combination of control technology including cleaner solid-state-controlled engines, indirect-injection engines, modified fuels, and particulate filters.

The diesel rules require training for all miners exposed to diesel emissions. Training is in four areas: (1) health risks of breathing DPM, (2) control methods used to reduce emissions, (3) proper maintenance of equipment to help ensure emission levels remain constant, and (4) the identification of mine personnel responsible for maintaining diesel engines. Currently, an emphasis of the rule making is establishing a uniform diesel inventory procedure that will inventory equipment used and monitor and track an engine's undiluted exhaust emission level, i.e. the combustion exhaust products at the exhaust pipe.

Hazardous Noise Levels. MSHA estimates that about 13% of miners will suffer significant hearing loss if something is not done. The new rules, the first modification to the noise standard in over 20 years, allow for the first time the use of hearing protectors in hazardous noise areas, and notes that there are "a few types of mining equipment where it is not technically or economically feasible to reduce miners' noise exposure to within the permissible level."

MSHA's noise rules require mine operators to monitor workplace noise exposure and provide for miners and their representatives to observe the monitoring. In addition, the rule provides for training that includes the dangers of noise exposure, the benefits of using hearing protectors (ear plugs and muffs), and how to use hearing protectors. A new lower noise level at which to take action is established at 85dBA, 5 decibels lower than the previous 90 dBA level. Mine operators must also monitor workplace noise exposures.

The new standards establish several levels requiring operators to take action:

· 85 decibels: Miners exposed to an average sound level of 85 dBA or more over an 8-hour period must be enrolled in a hearing protection program. The program will include special training, hearing tests, and voluntary use of hearing protectors.

· 90 decibels: If workplace noise levels reach 90 dBA or more over an 8-hour period, mine operators must use feasible engineering and administrative controls to reduce noise levels. Hearing protectors are required to be provided and worn if the permissible noise level cannot be achieved using available engineering and administrative controls. Administrative controls will include rotating workers out of high noise level environments.

· 105 decibels: At workplace noise level of 105 dBA or more over an 8-hour period, mine operators must ensure the use of both ear plugs and earmuff-type hearing protectors.

· 115 dBA: At no time during the work shift may workers be exposed to noise levels exceeding 115 dBA.

Toxic Substances. A new rule finalized in 2002 will require mine operators to list the hazardous chemical substances found in mines and on mine property, to evaluate the hazards of these chemicals, and to train miners on the proper handling and medical concerns of the chemicals. Miners must receive training before being assigned to a work area and also when new chemicals are used or new hazard information becomes available.

This rule is called the Hazard Communication or HazCom Standard, and has been a requirement of the industrial sector of the United States for many years. It is now being applied to mines and processing plants.

Major provisions of the HazCom rule include:

· HazCom Program. Operators must maintain a written plan that includes a list of the hazardous chemicals found onsite, the procedures used for labeling containers, and how miners are informed of the hazards of their jobs. Each chemical must have a Material Safety Data Sheet (MSDS) posted in the workplace. MSDS's provide a description of the chemical, the exposure limits that are considered harmful, and the immediate first aid actions to take if a worker is exposed to harmful levels. MSDS's have been developed and are used in other industries in the United States.

· Identification of chemicals. Mine operators must identify all chemicals used at their mines and determine if they pose a physical or health hazard.

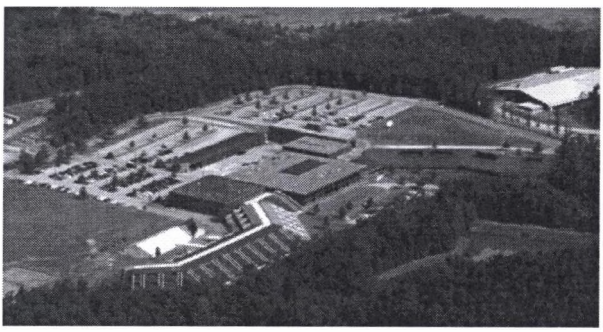
· Labeling. Containers of hazardous chemicals must be marked, tagged, labeled or otherwise identified, and must include the appropriate warning and health hazard information.

Typical chemical hazards include burns and poisonings. Among the hazardous chemicals in mines are organic nitrates in explosives that produce nitrogen oxides and ammonia; solvents and oils used in equipment maintenance that are toxic, flammable, and harmful to the skin and lungs; plastic and organic resins and reactants used in roof bolting and as sealants

that are harmful if inhaled; and processing plant reagents that can contain hydrogen sulfide, cyanide, or other dangerous chemicals.

5. Training of federal mine inspectors

Education and training in safety, health and mining operations are essential to continue to reduce accidents and injuries in mines and to provide a healthier work environment. The National Mine Health and Safety Academy was established in 1976 to develop, implement, and promote mine health and safety through education programs in cooperation with educational institutions, state government, labor, and industry. This Federally-funded education and training facility was mandated under the Federal Coal Mine Health and Safety Act of 1969 (Public Law 91-173). Its mission is to train federal mine inspectors and technical support personnel of MSHA and furnish safety and health training and materials to the mining industry.



Rys. 2. Aerial View of the National Mine Safety and Health Training Academy
Fig. 2. Widok z lotu ptaka na Narodową Akademię Bezpieczeństwa i Higieny Pracy w Górnictwie

The Academy is situated on 80 acres of land located in Beckley, West Virginia. All Federal coal and metal/nonmetal mine inspectors are trained at the Academy. These inspectors are located throughout the United States and responsible for on-site inspections of all operating mines. In 2002 there were 1,059 Mine Safety and Health employees responsible for keeping coal mines safe. Annual inspections at each coal mine averaged 220 hours per mine during 2002. The total time spent inspecting each individual mine ranged greatly depending on the size and employees at the operation. Every mine in the United States is inspected at least once a year.

The Academy complex is comprised of nine laboratories and training centers all supported by the Technical Information Center and Library. The laboratories provide hands-

on training in the following disciplines: roof control, ground control, mine emergency and mine rescue, ventilation, electrical, machinery, industrial hygiene, computer, and underground mine simulation.

Along with the laboratories, the Academy includes 15 classrooms that accommodate 600 students, dormitory space for 320 persons, a cafeteria, library, auditorium, and a modern, fully-equipped gymnasium and athletic facilities. Instructors often spend up to two-weeks at a time at the complex.

During 1996-98 members of the Coordinating Committee of the Polish-American Mine Center in Katowice, Poland, had the opportunity to stay at the Mine Academy during a visit and tour of the complex. Committee members included representatives of the Technical University of Silesia, Solidarity Trade Union, Rybnik and Gliwice Coal Companies, Central Mining Rescue Station of Bytom, and the Polish State Mining Authority.

The quality of training and the fact that all instructors throughout the Nation receive the same uniform and consistent training are, in large part, responsible for the effectiveness of the mine inspections to improve conditions. All safety and health training materials produced at the on-site video production and print shop facilities are available to everyone, some are free and others for a fee.

6. Conclusions

The first Federal Rules governing the safety and health conditions in U.S. coal mines were introduced in 1969. In 1976 the National Mine Health and Safety Academy was opened providing for quality and uniform education and training for all Federal mine inspectors. The mid-1980 saw the development of safety and health academic curriculums in university mining departments. This emphasis in safety and health along with more automated safer equipment have greatly improved worker conditions. The year 2002, set an all-time record for the lowest number of coal miner fatalities – 27 total (15 from underground mines). Coal production remained over one billion short-tons and the trend of fewer mines and mine workers continued.

With current productivity levels, it is not a surprise that fatalities from powered-haulage equipment now rank together with falls-of-roof as the two most hazardous categories. Fatalities resulting from operating machinery and from electrical hazards rank just behind

falls-of-roof and powered haulage. Explosions resulting in fatalities are not common, but always remain a threat and often result in many fatalities.

From a health perspective, Federal rules have recently been established in three areas: (1) Control of diesel-engine-exhaust particulate matter, (2) Revision of noise control rules that are being updated for the first time in 20 years, and (3) Awareness and knowledge of chemical hazards and how to control them. Efforts in these areas continue in clarifying technical requirements, designing procedures on how to inspect for the hazards, and training of the miners.

Recenzent: Dr hab. inż. Stanisław Krzemień, prof. Pol. Śl.