

Employment, Production, and Fatality Trends

IN THE U.S. COAL MINING INDUSTRY

BY GEORGE R. BOCKOSH, BARBARA FOTTA,
AND WILLIAM M. MCKEWAN

The National Institute for Occupational Safety and Health (NIOSH) defined safety and health threats that stem from emerging technologies as a priority research area. To address this priority, NIOSH's Pittsburgh Research Laboratory performed a study that focuses on emerging technology and similar issues for the coal industry.

One factor that will impact the industry's use of new technology is how coal mine production and employment will change. During the last two decades, production grew to more than 1 billion tons per year (tpy). The number of miners (direct employment by the coal mining industry), however, fell by 108,000 from 1980 to 1999.

At the same time, fatality rates (fatalities per 100,000 workers over a 5-year period) declined from 62.8 to 33.88, or 46%. Independent contractors have become an increasingly greater proportion of the workforce, they also account for an increasing

proportion of mining fatalities, contributing 16% of fatalities for the period 1995 to 1999. These trends are expected to continue into the future.

AN ERA OF CONSTANT IMPROVEMENT

The study used 1999 Mine Safety and Health Administration (MSHA) data as a benchmark. Total U.S. coal production for 1980 through 1999 increased by 40%, from 798 million tons to more than 1 billion tons.

A GROWING USE OF CONTRACTORS CONTRIBUTED TO A SUBSEQUENT RISE IN SAFETY CONCERNS FOR THOSE WORKERS, WHILE INDUSTRY-WIDE TURNOVER REPRESENTS A LONG-TERM CHALLENGE

Conversely, over the same period, employment decreased by 56%, from 192,000 to 84,000 jobs. These production increases occurred incrementally, indicating no sudden changes in the industry, but rather a moderate and constant adaptation.

Although increases in both underground and surface production have contributed to the increase in overall coal production, surface production has been steadily increasing since 1991, while underground production has not exceeded its 1990 peak production level of 419.9 million tons. From 1980 to 1999, surface mining production increased by 48%, while underground production increased by 31% from 1980 to 1997, and declined by 7% from 1997 to 1999. Consequently, the proportion of total production accounted for by surface mines increased from 60% in 1980 to 64% in 1999.

While overall production increased, the number of coal-producing operations, as well as the number of coal processing facilities or prep plants, declined. Since 1982, the number of surface coal mines has decreased by 63% (from 2,901 to 871) and underground mines by 67% (from 2,260 to 749). Although MSHA data makes no distinction between coal washing and sizing facilities, the number of plants has steadily declined from 1,223 in 1981 to 572 in 1999, a 53% drop.

Coal employment figures are based on the number of employee hours reported to MSHA by both mine operators and independent contractors. The number of employ-

ees was derived by designating 2,000 hours as being equivalent to one full-time worker. According to these numbers, during the 20-year period from 1980 to 1999, overall employment de-

clined by 55%. Similar to the trends observed for the numbers of mining operations, the largest declines in employment were observed for underground mines where employment decreased 63%, followed by surface coal mines with a 46% decline and processing plants which declined by 39%.

Although overall employment has declined, employment of independent contractors in mining has been steadily increasing at all coal mining locations (See Figure 1). Across all locations, the number of employee-hours reported by independent contractors has more than tripled since 1980 from 8.7 million to 32.1 million hours reported in 1999. Most of these hours are reported for surface production operations (52%), followed by underground operations (26%), and prep plants (22%).

Given the decline in operator employment from 1980 to 1999, the corresponding percentage of total employment accounted for by independent contractors has risen substantially, from 2% to 16.5%. These increases in the proportions of workers designated as independent contractors are even more dramatic when examined by work

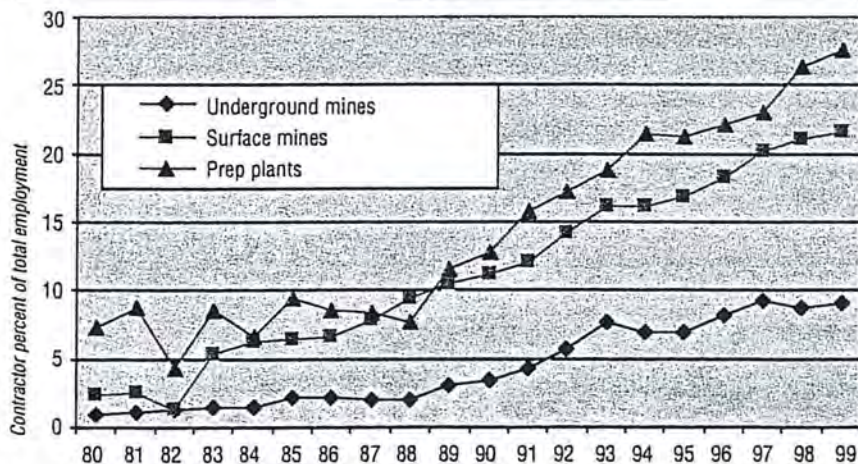


Figure 1—Annual percent of employment accounted for by independent contractor workers at underground mines, surface mines, and preparation plants from 1980-99. (Source: MSHA)

location. It should be noted that, by 1999, more than one-fourth (27.6%) of employee-hours worked at prep plants were reported by independent contractors, 21.6% at surface production operations, and 9% at underground production operations. In the case of the latter, most of the independent contractor-hours are reported for the surface areas of underground mines and in 1999 they accounted for 41% of employment hours at this location.

LABOR TRENDS

Overall labor productivity (tons of coal per production worker year) at coal operations has been steadily increasing since 1980 and more than tripled by 1999. From 1980 to 1999 labor productivity at surface operations increased by a factor of 2.8 from 6,661 to 18,436 tons per full-time, employee (miner)-year (tpmy). Underground productivity increased by a factor of 3.2 from 2,583 to 8,488 tpmy. Linear regression lines fitted to the productivity data for the years 1980 to 1999 shows that productivity grew by 598 tpmy in surface mines, 322 tpmy for underground mines resulting in a growth of 463 tpmy for surface and underground mines combined.

A linear regression line fitted to the production data for the years 1980 to 1999 shows a production increase of 17.9 million tpy. The Energy Information Agency (EIA) predicts that this rate of growth will continue through 2005 and then the rate of increase will decline to 6.8 million tpy for the next 5 years. If the productivity gains of the last two decades continue in surface and underground mining, surface mining would be expected to gain 598 tpmy over 10 years, resulting in an increase of 5,980 tpmy and a productivity of 24,416 tpmy. Similarly, underground mines would be expected to gain 322 tpmy for 10 years, resulting in an increase of 3,220 tpmy, and a productivity of 11,708 tpmy. This would result in the need for 34,071 miners in surface mines and 35,343 miners in underground mines plus support personnel, to meet the expected production of 831.9 million tons of surface coal and 413.8 million tons of underground coal in 2009. In 1999, MSHA reported that 38,000 miners were employed in surface mines and 46,000 miners were employed at underground mines.

FATALITIES & SAFETY CONCERNS

MSHA actively investigates fatalities to identify all factors contributing to the fatality and to determine the type of incident (i.e., explosion, machinery, fall of ground, etc.). The high reliability of fatality data is a key indicator of occupational safety in the min-

ing industry. Since the annual number of fatalities for a given type of incident and work location (i.e., underground, surface, or prep plant) are highly variable, fatality trends in coal mining were examined by aggregating the data over 5-year periods.

Using the number of fatalities per 20 million employee-hours (equivalent to 100,000 workers) during the four 5-year periods from 1980-99 as a benchmark, the fatality rate for the entire industry (fatalities per 100,000 workers over a 5-year period) fell from 62.7 to 33.9, a decrease of 46%. This significant decrease was not evenly realized in all locations in the industry. The underground fatality rate fell from 89.1 to 48, a decrease of 46%. The surface mining rate fell from 28.5 to 19.6, a decrease of 31%, and the prep plant rate

accidents involving powered haulage remain the second-leading cause of fatalities at underground mines. While the fatality rates for most types of incidents are at their lowest in the most recent 5-year period from 1995-99, fatality rates due to rib falls have increased and were the third-leading cause of underground fatalities during this time. The rate of fatalities resulting from falling, rolling, or sliding material were also at their highest during 1995-99 but accounted for less than 5% of the fatalities during this time.

The major causes of death in the surface mining industry include powered haulage, machinery, fall of highwall, falling material, explosives, electrical, and fall of person. From 1980-99, the surface mining fatality rate fell from 28.5 in 1980-84 to 19.6 during

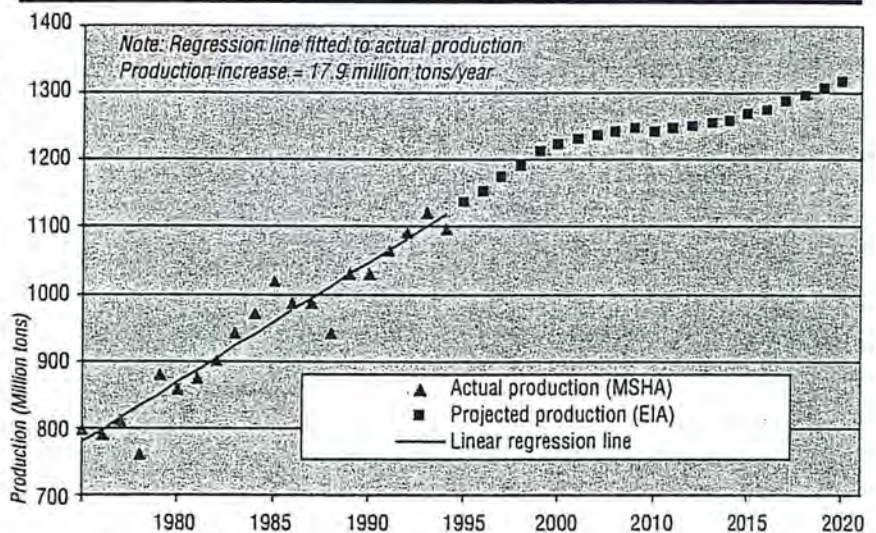


Figure 2—Historical (MSHA, 1980-99) and EIA projected U.S. coal production with trend line.

fell from 36.5 to 23.2, a decrease of 37%. Despite significant decreases in underground fatality rates, underground mining remains the most hazardous work location, followed by processing plants and surface mines.

The decline in underground fatality rates across this 20-year time period are due primarily to substantial decreases in the rates of fatal incidents involving falls of roof, the use of powered haulage, and disastrous incidents including ignitions or explosions of gas or dust, and fires. Declines in rates are also observed for fatal incidents involving machinery, electricity, and the use of explosives. Decreases in the use of explosives underground are related to a decline in the relative proportion of operations using conventional mining methods. Across all four time periods, roof falls account for a greater proportion of the fatalities at underground mines than any other single type of incident. Similarly,

1995-99, a decrease of 31%. This decline was due primarily to decreases in the rates of fatal incidents involving machinery (from 7.5 to 3.9), falling, rolling, or sliding materials (from 2.4 to 0.5), electricity (from 2.1 to 0.5), and powered haulage (from 10.2 to 8.8).

Incidents involving powered haulage and machinery continue to account for more fatalities than any other single type of incident. While most types of surface mining fatal incidents decreased across the 20-year period, fatalities due to slips or falls of persons increased in rate from 0.0 during 1980-84 to a high of 2.5 during 1990-94. Although the rate declined to 1.5 during the second half of the 1990s, it still exceeds rates observed throughout the 1980s. Alternatively, rates of fatalities resulting from falls of the highwall had declined to a low of 0.8 during 1990-94 and then tripled during the subsequent 5-year period (1995-99) to a rate of 2.5.

The major types of incidents resulting in fatalities in processing plants involve powered haulage, machinery, and slips or falls of persons, and falling, rolling, or sliding materials. Across the four 5-year periods from 1980-99, the fatality rate at prep plants declined by 37% from 36.5 to 23.2 during 1995-99. The bulk of this decline was due to substantial decreases in the rates of fatalities involving powered haulage which declined by 63%, from 23.3 (1980-84) to 8.7 (1995-99). While rates for powered haulage fatalities have been steadily declining, fatality rates for the remaining incidents appear more erratic over time, in part due to the small numbers involved (fewer than 1 fatality per year).

In surface mining, both the absolute number and percentage of the total has seen a significant increase, more than tripling from 9.5% in 1980-1984, to 39% in 1990-1994, and to 30% in 1995-1999. Prep plants saw a decrease in the absolute number of contractor fatalities but, here too, the percentage of the total fatalities has grown, increasing from 30.6% in 1980-1984 to 43.8% in 1995-1999. Clearly, contractors are a growing part of the mining workforce and a growing proportion of those that are fatally injured.

The analysis above shows that a relatively slow growth in production of coal can be expected in the future. Most of that growth is expected to be in the Western surface

mines that their best longwall produces almost 7,200 tons per shift, which would result in approximately 5.3 million tpy, assuming two shifts per day of production.

In addition, the EIA reported in 1999 that U. S. mines East of the Mississippi River were at 80% utilization and those West were at 83.5%. The total U. S. mining industry has the current capacity to mine about 1.34 billion tons. This level of consumption is not expected by the EIA in the foreseeable future. Therefore, no massive increase in the number of mines is expected in the near future.

A recent workforce analysis shows that, because of the shrinking workforce in coal mining and little hiring during the last two decades, the average age of the workforce is likely to exceed 45 years. Some mines have an average workforce age of 50 years. Research indicates that while injury rates generally decline with increasing age, injury severity and recovery time increases. Furthermore, the occupational fatality rate increases with age. Thus, with the anticipated shrinkage of the workforce and subsequent increasing age, severity and fatality rates can be expected to increase if this issue is not addressed. Furthermore, the current workforce will eventually have to be replaced with younger less-experienced workers. This may also result in higher accident rates.

Another study predicted that the new equipment and technologies for coal production will not involve any strikingly new technologies and that there will be short-term and incremental improvements, not breakthrough innovations. However, the new haul trucks and shovels will undoubtedly be larger and more complex, requiring different strategies for operation and training. The new longwalls will be larger and will also require different equipment and planning.

The number of contractor employees is significant and their numbers are expected to continue to grow as a percentage of the mining workforce. The recent past has also seen an increase in the percentage of the total of fatal mining injuries occurring in the contractor ranks.

Coal production will grow slowly, the workforce, while experiencing a high turnover due to retirements, will continue to shrink, and a larger portion will be contractors, and technology will evolve slowly. CA

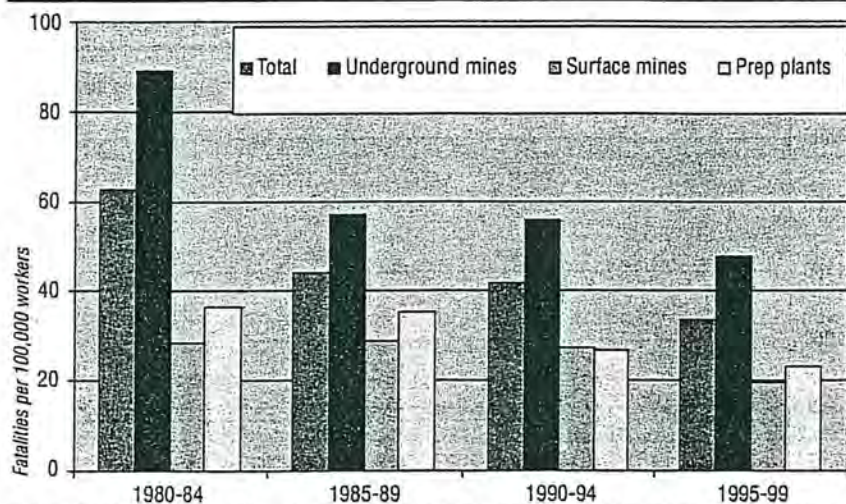


Figure 3—Annual average rate of coal fatalities (per 100,000 workers) by work location and computed within 5-year periods from 1980-99.

THE CHANGING COMPLEXION OF THE AMERICAN WORKFORCE

As independent contractors become an increasingly greater proportion of the workforce, they also contribute an increasing proportion of mining fatalities, particularly at surface mining operations. During 1980-84, contractors accounted for 5.1% of all coal mining fatalities, increasing to 16.6% in the first half of the 1990s and falling slightly to 15.6% at the end of that decade. In underground mines the absolute number of contractor fatalities has decreased but they make up a larger percentage of the total, rising from 2.3% in 1980-1984 to 6.5% in 1995-1999.

mines because of environmental issues (the Clean Air Act) and the low cost. Upon examination of coal production over the last 10 years, it would appear that only surface bituminous will be having any real production increases. The increase in surface bituminous mining will likely remain steady at about 18 million tpy for the next five years.

To put this increase into perspective, a hypothetical 10 million-tpy increase at a large Western surface mine would require five 240-ton haul trucks and a 56-cubic-yard (cu yd) shovel for overburden removal and four 240-ton trucks and a 40-cu-yd shovel for coal production. CONSOL Energy report-

REFERENCES

1. Mine Safety and Health Administration, <http://msha.gov/ACCINJ/accinj.htm>
2. High Performance Longwalling and Continuous Miner Development in Hard Coal Mining by C. Wesley McDonald and Jurgen F. Brune, CONSOL Inc., <http://www.consolenergy.com/news/0699.htm>
3. Capacity Utilization of Coal Mine by State, 1998, 1993-1997, U.S. Energy Information Administration, <http://www.eia.doe.gov/cneaf/coal/cia/html/t17p01p1.html>
4. The Aging Workforce: An Emerging Issue in the Mining Industry by Barbara Fotta and George Bockosh, Proceedings Thirty-First Annual Institute on Mining Health, Safety, and Research 2000, pp 33-45.
5. New Forces at Work in Mining: Industry Views of Critical Technologies by D.J. Peterson, Tom Latourette, and J. T. Bartis, RAND Corp. 2001

A PRIMEDIA Publication

www.coalage.com

Coal Age[®]

The Magazine for Coal Mining and Processing Professionals

OCTOBER 2002

A New NIOSH Study Examines Today's Trends

The Emission Debate: Mercury, Chlorine, and Fuel-Switching

