STONE, SAND & GRAVEL

REVIEW

Official Publication of the National Stone, Sand & Gravel Association March/April 2003

2002 Annual Report

100 Years of Improvement in Aggregate Worker Safety

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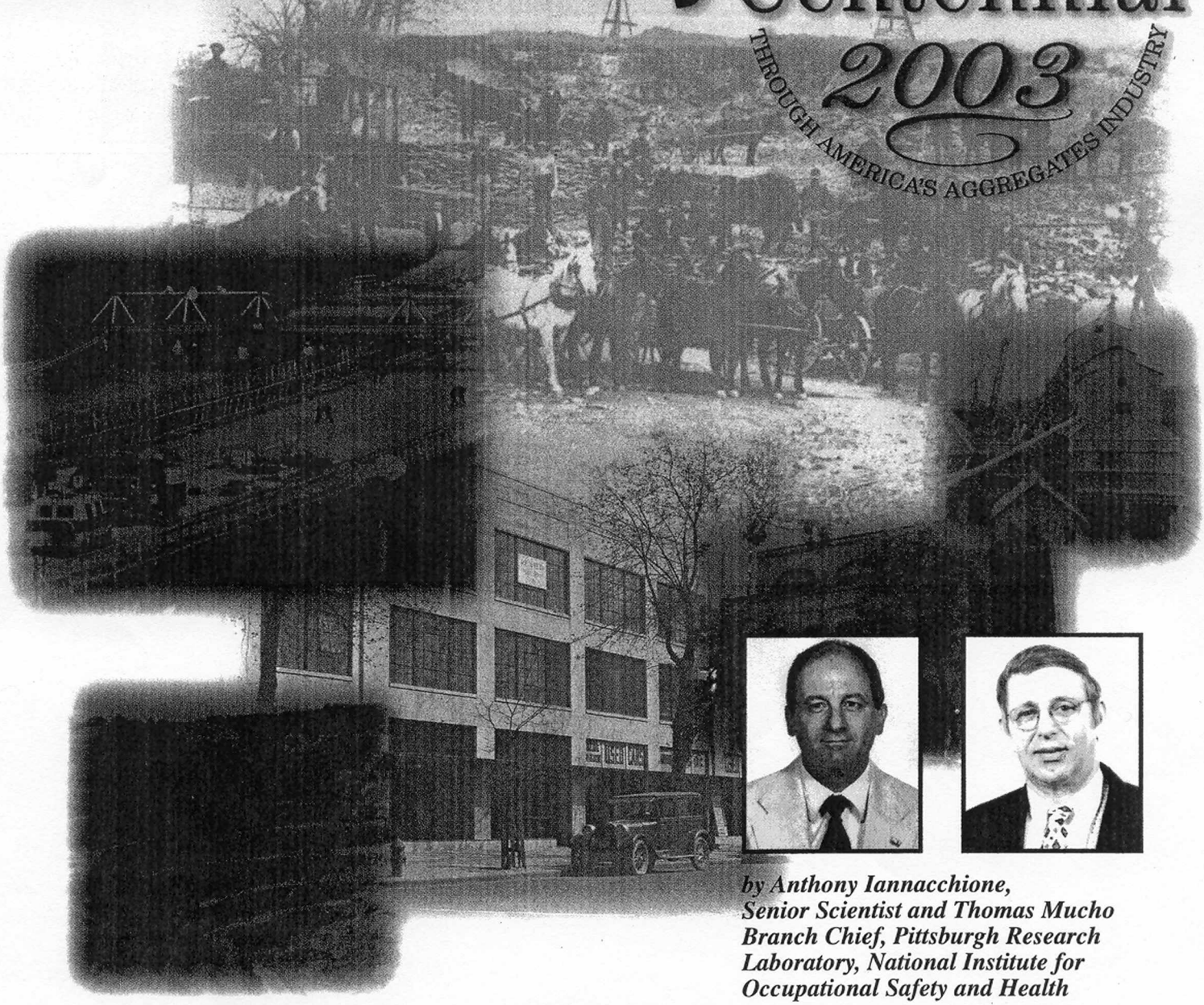
OBSERVING A CENTURY OF PROGRESS
1903 Centennial 2003
THROUGH AMERICA'S AGGREGATES INDUSTRY



by Anthony Iannacchione, Senior Scientist and Thomas Mucho Branch Chief, Pittsburgh Research Laboratory, National Institute for Occupational Safety and Health

This marks the 100th year that the aggregate industry has been served by a national association. Of all the accomplishments this longstanding relationship has achieved, there is probably none greater than the progress made in worker safety.

Perhaps the best way to measure this success is to examine injury trends in the aggregate miner population. For example, in the first half of the 20th century, 16 quarry mining disasters (a "disaster" is an incident with five or more fatalities) claimed 157 miners between 1909 and 1952.

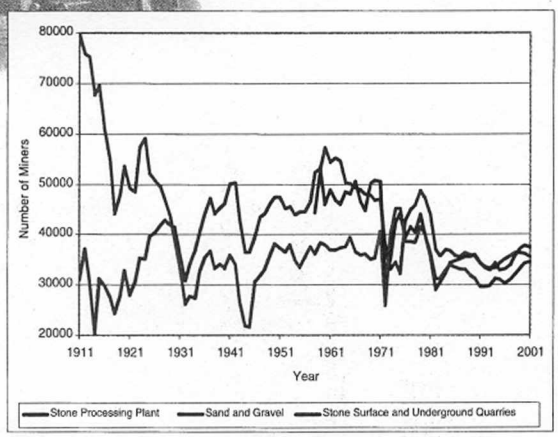


Figure 1 – Number of miners in the three segments of the aggregate industry: stone processing plants, sand and gravel quarries, and stone surface and underground quarries, 1911-2001.

The largest of these was the disaster at the Sandts Eddy Limestone Quarry near Allentown, Pa., on March 26, 1942, where 31 miners died of asphyxiation by fumes/explosion. Thankfully, no mining disasters have occurred in the aggregate industry since 1952. It is these kinds of information that help us characterize improvements in aggregate worker safety over the last 100 years.

Background

In 1911, the former U.S. Bureau of Mines (USBM) began tracking miner injuries for the aggregate industry, which then consisted of cement-rock, granite, limestone, lime, marble, sandstone, slate, traprock quarries and related mills and processing plants (USBM technical papers, bulletins and informational circulars). It wasn't until 1958 that the bureau, and later the Mine Enforcement and Safety Administration (MESA) in 1971 and the Mine Safety and Health Administration (MSHA) in 1975, began reporting injuries in the sand and gravel industry (USBM Mineral Industry Survey Series, MESA and MSHA Information Reports).

The three major subdivisions within the aggregates industry include stone processing plants, sand and gravel operations and surface and underground stone quarries. The number of miners in each of these three groups in the years between 1911 and 2001 is shown in Figure 1.

Over this 90 year reporting period, the total number of aggregate miners has ranged from a high of 144,300 in 1959 to a low of 56,900 in 1932 during the Great Depression (these numbers exclude office workers and contractors). Since 1975, the miner population has remained fairly constant, averaging 107,000. During the last 20 years, the numbers of miners in each category has ranged from 30,000 and 38,000.

Continuous Improvement

Possibly the greatest indication of continuous improvement in aggregate miner safety has been the significant reduction in fatal injuries. The highest number of fatal injuries, 213, occurred in 1912 (Figure 2). These fatalities occurred when the aggregate workforce was high, but also at a time when occupational safety was sometimes neglected.

From 1911 until 1957, prior to tracking the sand and gravel industry, the average number of fatalities was 100 per year. After 1958, and prior to the enactment of the 1977 Federal Mine Safety and Health Act, the average number of fatalities fell to 80 per year. Since the implementation of the 1977 Act, this average dropped to 31 per year. During 2001, 11 aggregate miners were fatally injured.

A more meaningful way to analyze this trend is to examine the fatalities as a rate. One way this rate is calculated is to normalize fatalities per 100,000 workers. Since 1992, the Bureau of Labor Statistics reports fatality rates in its National Census of Fatal Occupational Injuries in this manner (Table 1). The USBM, and later MESA, estimated the miner population from their employee-hours database from 1911 to 1978. These estimations did not distinguish between surface and underground until 1931.

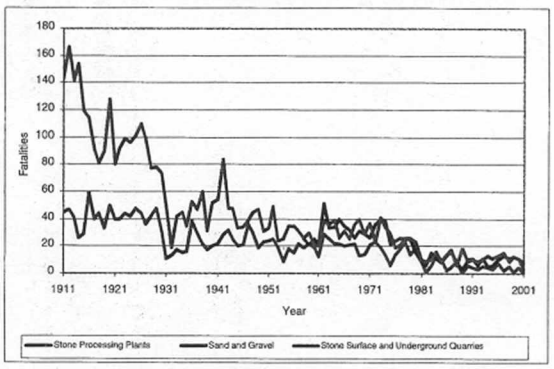


Figure 2 – Number of fatal injuries in the Aggregate Industry by segment, 1911-2001.

The 1977 Federal Mine Safety and Health Act required employers to

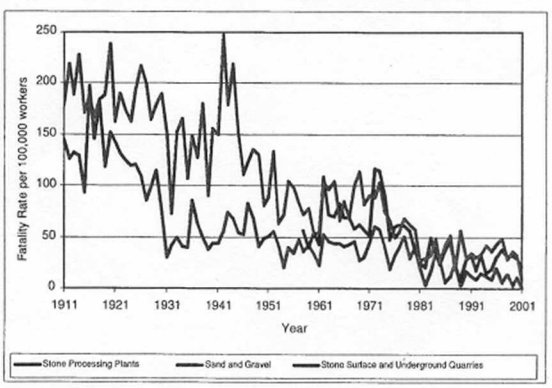


Figure 3 – Fatality rates in the Aggregate Industry by segment, 1911-2001.

Table 1 – Average fatality rates per 100,000 workers by industry or industry segment for selected time periods.

	Average from 1911 to 1957	Average from 1958 to 1977	Average from 1978 to 2001	Average from 1992 to 2001
All U.S. Industries	NA	NA	NA	4.8
Construction Industry	NA	NA	NA	14.2
Mining Industry	NA	95.6	34.8	27.7
Coal Mining	NA	140.7	41.4	33.6
Aggregates Industry	118.6	61.9	28.2	23.0
Stone Processing Plants	83.1	40.0	16.3	9.8
Sand and Gravel	NA	69.4	31.2	26.6
Stone Surface and Underground Quarries	155.3	80.2	38.3	33.7
Stone Underground Quarries Only	NA	132.6	72.8	100.5

NA - Not Available

report employment and injury statistics, so all data after 1978 represents reportable data. Figure 3 shows the fatality rate per 100,000 workers from 1911 to 2001 for the three segments of the aggregates industry.

In 1920, the fatality rate was 206 per 100,000 miners and represents the aggregates industry's darkest hour. From 1911 until 1957, the fatality rate averaged 119 per year (Table 1). After 1958 and prior to 1977, the fatality rate average fell to 62 per year. Since the implementation of the 1977 Act, the average rate dropped significantly to 28 per year. During 2001, the fatality rate was reduced to an all time low of 10.

During all of these periods, stone processing plant workers have the lowest fatality rate within the aggregates industry, followed by sand and gravel pits, surface stone quarries and underground stone quarries (Table 1). There are currently between 110 and 120 underground stone mines employing approximately 2,200 workers, or less than two percent of the total aggregates industry workforce.

The reasons for this major decline in fatal injuries are numerous, but certainly better training, safer equipment and the elimination of hazardous tasks are three important factors.

- The implementation of training programs over the years has undoubtedly had a significant impact on miner fatalities. The success of these programs at the nation's safest quarries has long been touted as one of the principal reasons for improved safety. On Oct. 1, 2000, through an agreement with the aggregates industry, MSHA began to enforce Part 46's mandatory training standards. This was another positive step toward improving worker safety and early indications, based on the 2000-01 data, are that the fatality rate is declining.
- Tremendous improvements have been made in almost every piece of equipment used in the aggregates industry. Most mobile equipment now has rollover protection, more ergonomically designed controls and better lighting and visibility. Belts and drives are more adequately guarded and walkways are designed to lessen the occurrence of slips and falls. Every piece of equipment used in the industry has been reevaluated and improved to provide safer working conditions.
- Many of the most hazardous occupations have been eliminated or tasks redesigned so as to lessen hazardous exposures. For example, the working face areas within the quarries have long been recognized as areas of considerable risk of injury. Through time, work procedures and methods have changed and, where possible, sophisticated equipment has helped to minimize miner exposure.

Opportunities for Additional Improvement

While the improvements in aggregate miner safety over the last 100 years have been continuous and considerable, there is still a need for further progress. The good news is that the aggregate average fatality rate over the last 10 years is slightly lower than the mining industry average and considerably below coal mining (Table 1).

The bad news is that the aggregates industry fatality rate of 23.0 per 100,000 workers is still considerably higher than the U.S. industrial average

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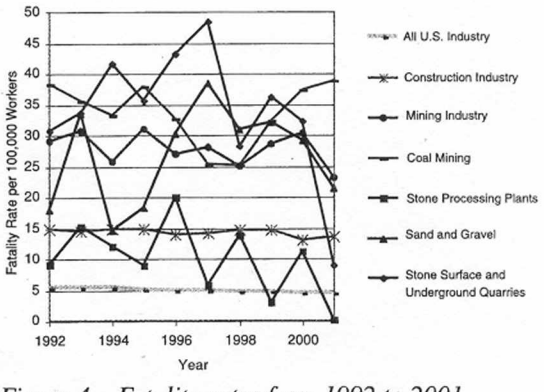

Figure 4 – Fatality rates from 1992 to 2001. (Note: Mining populations do not include office workers or contractors.)

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of 4.8 or the construction industry average of 14.2 (Table 1). Perhaps it is unfair to compare mining statistics with the general industry, since miners operate in one of the most difficult and challenging environments imaginable. But this is the challenge before us—to make the aggregate industry ever safer for our nation's miners. Fatality rate trends presented in Figure 3 show that much has been accomplished, but when compared to the other non-mining industries there exist opportunities for additional improvement (Figure 4).

The most effective way to lower fatal injuries is to concentrate on reducing the most significant causes. Major causes of the 233 fatal injuries within the aggregates industry over the last 10 years include: 1) powered haulage, 2) machinery, 3) falling, rolling, slip or fall of person, 4) sliding material, 5) falls of roof, 6) electrical, and 7) falls of face, rib, side or highwall (Figure 5).

Another way to examine significant safety problem areas is to evaluate the 38,696 nonfatal lost-time injuries reported to MSHA over this same 10-year period. Major causes of these injuries included: 1) handling materials, 2) slip or fall of person, 3) hand tools, 4) machinery, and 5) powered haulage (Figure 6).

Changes on the Horizon

To ensure future improvements in worker safety, it is necessary to continue to make safety innovations in mining procedures and equipment. Each of the injury causes identified above will need to be investigated and solutions implemented. The following represents some of the potential solutions to the aggregates industry's most significant safety concerns:

- *Powered Haulage*–New and improved collision warning systems need to be developed and implemented to reduce worker exposure to moving vehicles and equipment. Better techniques to reduce operator jolting and jarring on mobile equipment will decrease back injuries.
- *Machinery*–Improved hardware, operating conditions and machine design guidelines will reduce injuries to miners working on or near equipment.
- *Falling, Rolling, Sliding Material*–Techniques to detect, mitigate and/or eliminate material bridging in storage piles, bins, silos and hoppers need to be developed to reduce injuries from collapsing materials.
- *Slips and Falls*–Procedures and equipment are needed to eliminate injuries while mounting or dismounting from a vehicle with ladders.
- *Falls of Roof*–Existing technology to warn of ground stability hazards needs to be utilized by a larger percentage of the industry.
- *Falls of Highwalls*–New hazard recognition techniques to identify unstable highwalls and slopes are needed so that innovative hazard mitigation strategies can be utilized.
- *Handling Materials*–Changes in the way manual tasks are done or mechanization of these tasks is needed to reduce back injuries (*i.e.*, palletizations of supplies and materials). The part of the body most frequently injured is the back.
- *Electrical*–Overhead power line contact proximity alarms for mobile equipment need to be used on more mobile equipment.

Rising to the Challenges and Cause for Optimism

The aggregates industry faces a number of challenges in the near future, including loss of experienced mine workers due to retirement, an influx of new, inexperienced workers and more challenging mining conditions. More effective training is needed to reduce injuries of both experienced and inexperienced workers from ever increasing diverse backgrounds.

Some of the mining challenges include quarrying closer to cities and civil structures and under greater quarry depths with highwalls subjected to more rock stress and water pressure. In addition, many are forecasting more underground operations that are inherently more dangerous (Table 1).

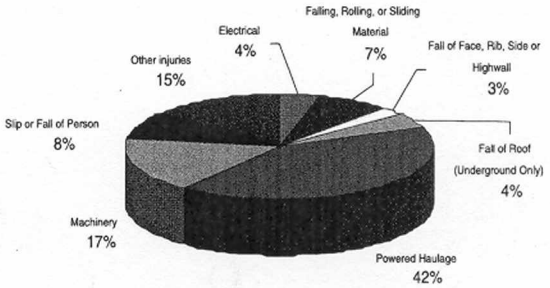

Figure 5 – Causes of fatal injuries over the 10-year period from 1992 to 2001. (Note: Only causes with greater than 3% of the total are displayed separately.)

These challenges can be met with better training, using interactive mediums or even virtual reality techniques. The awareness and involvement of the entire workforce needs to be fostered by management, labor and government jointly identifying risk factors, selecting mining practices, implementing mining plans and engineering and administrative controls.

As the aggregates community has repeatedly demonstrated in the past, it will rise to the many challenges while improving the working environments of our nation's miners. □

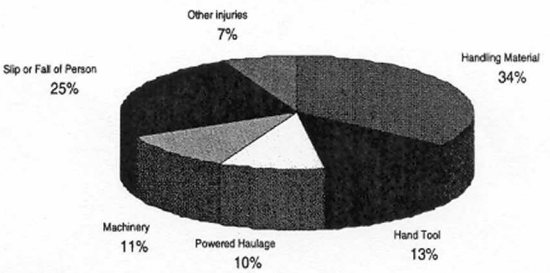

Figure 6 – Causes of nonfatal injuries over the 10-year period from 1992 to 2001. (Note: Only causes with greater than 1% of the total are displayed separately.)