Surface Haulage Accidents--Causes and Cures

by Guy A. Johnson

Introduction

The Department of Labor's Bureau of Labor Statistics recently reported that mining employs a little less than 1 percent of our country's workers, yet it accounts for over 8 percent of all industrial deaths. The social and productivity costs of mine accidents require industry and government to work toward improving this situation. The Department of the Interior's Bureau of Mines and the Department of Labor's Mine Safety and Health Administration (MSHA) have been active in this area for a number of years.

Mine safety hazards can be classified in several ways. One way is to look at accidents from a geographical point of view, and MSHA does make this breakdown in its quarterly and annual reports. Another way is to break the problem down into commodities produced, which is also done by MSHA. For the purpose of relating accident statistics to research needs, I have dissected accident information by mining activity. I have done this in order to understand what the miner was doing when he was hurt. Knowing this, one can search for improved procedures or equipment to reduce the danger of the activity. Thus, when I talk of mine safety, I will not talk of geographical (i.e., State-by-State) problems, or commodity (i.e., coal versus noncoal) problems, but I will discuss problems--amd possible solutions--that cut across the entire mining industry. Also, the discussion will concentrate on overall accident information rather than just fatality figures. This is because a larger sample size is obtained when analyzing an accident classification rather than individual fatalities which are often site specific.

Problem Definition

In 1978, the mining industry suffered 240 fatalities and over 40,000 reported injuries. Twenty-four pct of the injuries involved underground coal mining, which was the largest single category. Reflecting this situation, the majority of the Bureau's research funds are directed at underground coal. Continuing the overall analysis, about 16 percent of mining accidents occurred in underground metal and nonmetal mines. Subtracting the preparation plant and mill accidents (17 percent), the remaining 43 percent of mining accidents relate to surface mining and the surface area of underground mines. This fraction of the mine safety area is where I will focus my attention. That is because the majority of these mine safety problems have cost-effective solutions in state-of-the-art technology, and thus many of these accidents can be prevented. Too often, however, the relatively modest research needed to adapt this technology of the specialized needs of the mining industry has not been conducted because the industry is isolated, technologically speaking. By blending short-and long-term research efforts, we do not have to "rediscover the wheel," but can utilize America's intelligence and apply it to mine safety needs.

With the recent growth in western coal mining, as part of our country's energy program, surface mining accidents are increasing. Records show about a one-third increase from 1973 to 1978. This is one of the few areas where safety problems are increasing. Surface miners thus have a growing need for improved safety technology.

MSHA's Health and Safety Analysis Center (HSAC) is a tremendous resource of statistical data. Old data (1972-78) point out that haulage and machinery account for over two-thirds of metal and nonmetal mine surface fatalities. Haulage trucks accounted for 77 of 241 deaths, or about one-third. Front-end loaders were almost as dangerous. These two key pieces of surface mining equipment are constantly growing larger, thus more dangerous. More recent data (1979) show that 358 (of 3,280) surface coal injuries involved haulage trucks. Thus, the problem is spread throughout the industry.

More recent statistics show that in 1980 there were 74 fatalities and about 9,000 reported accidents in our country's surface mines. Of these, powered haulage (haulage trucks, front-end loaders) accounted for 27 deaths (36 percent) and about 900 reported accidents (10 percent). Machinery (dozers, drills, etc.) accounted for 11 deaths (15 percent) and over 1,100 reported accidents. Thus, research to improve mobile mine equipment safety will have a great impact on improving mine safety.

Some additional information concerning haulage safety is presented below. It must be reemphasized that MSHA collects statistical accident information for its own purposes, which many times do not match our needs. But these data are the best available and are much better than statistical information from other organizations.

Because one must know the limitations of one's data, some difficulties with HSAC statistical data in an engineering analysis are presented. One such problem can first be seen in how MSHA categorizes accidents. Examples are given below:

1. In the "Fire" accident category, accidents related to uncontrolled burning of material or minerals in the mine environment are included. Not included are fires initiated by

electricity or by ignition or explosion of gas or dust. Because electrical problems cause many surface vehicle (and underground) fires, these accidents are combined with "electrical" accidents rather than fire accidents, where they should be.

2. Another example is the "Machinery" category. These accidents are defined as "Accidents related to motion of the machinery." Dozers, draglines, and power shovels are included, but front-end loaders are not. Loaders are included in the "Powered Haulage" category.
3. A final example is the "Slips and Falls of Person" category. This category is defined as "Accidents including slips or falls while getting on or off machinery and haulage equipment which is not moving, and slips or falls while servicing or repairing equipment or machinery."

Thus, haulage equipment-related accidents appear in at least three categories.

Noting the above, and analyzing the best available current data (table 1), the impact of surface mine haulage accidents is seen. These incidents account for between 10 and 20 percent of all mine accidents. Thus Bureau research in this area will have a positive payback.

Short-Term Projects

The Bureau of Mines has many components in its research and development work. We are involved with both long-term efforts, such as improving technology to monitor and correct a haulage truck driver's alertness, and shorter term projects, such as improved truck visibility aids and improved fire protection systems. Because the shorter term work has a "hardware orientation," one of the philosophies behind this work becomes evident. That is that in many cases there is a lot of technology in this world that has not yet been applied to solve mining problems. The ability to take this state-of-the-art technology and make it work in the rugged environment of a mine (at a reasonable price) will give the Bureau credibility to simultaneously conduct longer term research into specific needs of the minerals industry.

The improved visibility system for large haulage trucks was first developed in 1978. It was developed because of the growing number of truck accidents in surface mines. Note that most trucks are designed so a driver can see only about 35 percent of where he is supposed to drive. The prototype hardware consisted of improved right- and left-hand mirrors, a ruggedized, closed circuit rearview television (not included in the commercial system), and novel fresnel lens blind area viewers. A short Technology Transfer film titled "Improved Visibility Aids for Large Haulage Vehicles"[2] summarizes the project.

Fire protection systems for large mobile mining equipment have likewise been recently developed and in-mine tested. The next Technology Transfer film, "Automatic Fire Protection Systems for Surface Mining Vehicles,"[2] delineates this work. Note that the research results from both projects are now commercially available and are gaining wide acceptance in the industry. The fresnel lens blind area viewers not only help prevent collisions, but also help the driver to be more productive by giving him better control over his vehicle. Over 15 percent of the mining industry's fleet of large trucks now utilizes fire protection systems. One reason is that the use of Bureau-developed hardware can reduce the vehicles very expensive insurance premiums.

Long-Term Surface Haulage Safety Projects

The Bureau's long-term surface haulage projects, along with the Bureau's efforts to improve driver training, will only be listed here. Positive results are expected from this work, but in-mine application is still a ways away.

Current long-term R&D involves developing--

1. Driver Alertness
2. Anticollision Systems
3. Improved Maintenance Tools and Procedures
4. Improved Seat Belts
5. Novel Cab Designs (to design out many of the vehicle's inherent dangers)

At another time I hope to be able to describe in detail the above longer term "cures" to our problems. By working together, plus involvement in such forums as the Society of Automotive Engineer's Subcommittee 29 -Mining Equipment, improved mine haulage safety can be achieved.

Conclusion

The job of underground mining is definitely more dangerous than surface mining, but so many more miners work in surface mines and are exposed to haulage hazards that a great impact on overall mine safety can be accomplished by improving truck safety. The Bureau's efforts to develop and in-mine test reliable, cost effective, retrofit fire protection and collision avoidance systems are thus depicted. It should also be noted that much of this technology, such as the blind area viewers, will also have a positive effect on mining productivity.

[2]The technology transfer films are available from: Motion Pictures, Bureau of Mines, 4800 Forbes Ave., Pittsburgh, Pa., 15213.

TABLE 1. - Surface Mining Equipment Safety Analysis--Statistical Information*

	Coal		Noncoal summary	Coal and Noncoal summary
	1978	1979	1979	1979
All fatals	106	144	123	267
Surface mining (SM)	17 (16%)	15 (10%)	97 (79%)	112 (42%)
Accidents reported (number of injuries)	20,163	23,634	21,411	45,045
Surface mining	3,841 (19%)	3,636 (15%)	12,803 (60%)	16,439 (36%)
Number of workers	245,659	250,226	308,085	558,311
Production (tons)	631,751,096	741,699,439	-	-
Number of operations	7,134	6,714	13,747	20,461
Combined Surface Mining - "Who" Injured:				
Dozer or mobile vehicle operator	468 accidents	428 accidents	339 accidents	767 accidents
Dragline or shovel operator	174 accidents	167 accidents	271 accidents	438 accidents
Drill operator	242 accidents	203 accidents	257 accidents	460 accidents
Front-end loader operator	281 accidents	278 accidents	372 accidents	650 accidents
Truck driver	371 (10% of SM)	373 (10% of SM)	841 (7% of SM)	1,214 (7% of SM)
Total**	1,536 (40% of SM) (8% of all accidents)	1,449 (40% of SM) (6% of all accidents)	2,080 (16% of SM) (10% of all accidents)	3,529 (21% of SM) (8% of all accidents)

Surface Mining -- Accident Classification:	Fatals	Accidents	Fatals	Accidents	Fatals	Accidents	Fatals	Accidents
Powered haulage	6	390	8	299	31	744	39	1,043
Machinery	4	605	1	471	6	832	7	1,303
Slips and falls	3	866	-	969	6	1,477	6	2,446
Total	13	1,861	9	1,739	43	3,053	52	4,792
	(76% of SM) (12% of all)	(48% of SM) (9% of all)	(60% of SM) (6% of all)	(48% of SM) (7% of all)	(44% of SM) (35% of all)	(24% of SM) (14% of all)	(46% of SM) (19% of all)	(29% of SM) (11% of all)

*Source: 1978 and 1979 MSHA Injury Experience Reports for Coal, Metallic, Nonmetallic, Stone, and Sand and Gravel Mining. Information prior to 1978 was organized differently; thus only 1978 and 1979 data are reported.

CONCLUSION: In surface mining, equipment was involved in between 40 and 50 pct of all accidents and in the majority of deaths.

**Many injuries in other "who" classifications (such as laborers, mechanics and maintenance personnel, supervisors and foreman, etc.) were caused by mining equipment.

TABLE 1. - Surface Mining Equipment Safety Analysis--Statistical Information* - Continued

	Metallic		Nonmetallic	
	1978	1979	1979	1979
All fatals	49	30	13	27
Surface mining (SM)	10 (20%)	8 (27%)	1 (8%)	9 (33%)
Accidents reported (number of injuries)	8,713	9,619	3,844	3,497
Surface mining	1,699 (20%)	1,988 (21%)	748 (19%)	583 (17%)
Number of workers	92,927	102,051	53,007	53,239
Production (tons)	-	-	-	-
Number of operations	815	890	1,737	1,636
Combined Surface Mining - "Who" Injured:				
Dozer or mobile vehicle operator	76 accidents	114 accidents	39 accidents	49 accidents
Dragline or shovel operator	43 accidents	48 accidents	37 accidents	30 accidents
Drill operator	45 accidents	64 accidents	30 accidents	31 accidents
Front-end loader operator	46 accidents	38 accidents	42 accidents	39 accidents
Truck driver	194 (11% of SM)	193 (10% of SM)	61 (8% of SM)	49 (8% of SM)
Total**	404 (24% of SM) (5% of all accidents)	457 (23% of SM) (5% of all accidents)	209 (28% of SM) (5% of all accidents)	198 (34% of SM) (6% of all accidents)

Surface Mining -- Accident Classification:	Fatals	Accidents	Fatals	Accidents	Fatals	Accidents	Fatals	Accidents
Powered haulage	7	173	2	222	-	76	4	68
Machinery	-	195	3	199	-	82	-	70
Slips and falls	-	376	1	391	-	119	1	113
Total	7	744	6	812	-	277	5	251
	(70% of SM) (14% of all)	(44% of SM) (9% of all)	(75% of SM) (20% of all)	(41% of SM) (8% of all)	-	(37% of SM) (7% of all)	(56% of SM) (19% of all)	(43% of SM) (7% of all)

*Source: 1978 and 1979 MSHA Injury Experience Reports for Coal, Metallic, Nonmetallic, Stone, and Sand and Gravel Mining. Information prior to 1978 was organized differently, thus only 1978 and 1979 data are reported.

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