INCREASING COAL OUTPUT WILL REQUIRE BETTER DUST CONTROL

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BACKGROUND

In 1969, the Federal Coal Mine Health and Safety Act (FCMHSA) was passed for the purpose of reducing the incidence of Coal Workers' Pneumoconiosis (CWP), or black lung, a chronic lung disease caused by coal dust inhalation. The FCMHSA limited the average exposure of coal miners over an eight hour working shift to 3.0 mg/m^3 (milligrams of respirable dust per cubic meter of air); this maximum dust level was reduced to 2.0 mg/m^3 in late 1972, effective in 1973. Additionally, in order to reduce the incidence of silicosis, a lung disease caused by the inhalation of silica dust, the FCMHSA requires that the Mine Safety and Health Administration (MSHA) enforce a more stringent standard if dust samples contain silica in excess of 5.0 percent. (Dust standard = 10/(percent SiO_2 in sample); the standard is less than 2.0 mg/m^3 if the silica content of the sample exceeds 5.0 percent.)

The annual costs of the black lung program, which include compensation payments to retired miners or their survivors and the program costs of the Departments of Labor and Health & Human Services, have leveled off in the $1.6–1.7 billion range since 1979. The cumulative cost of the program from 1970 through 1985 is estimated at $18.4 billion.[2,5] In constant 1970 dollars using the Consumer Price Index (CPI) to adjust for inflation, however, the cumulative cost of the program was $10.0 billion, and annual costs have declined every year since 1979, from $834 million to $585 million in 1985.

Due to the time lag between initial exposure of miners to respirable coal dust and the filing of black lung claims, sometimes as long as 25–30 years, it is likely that future compensation payments will decline, if compliance with the standard is maintained, as miners who worked in dustier conditions prior to passage of the FCMHSA leave the compensation rolls. Based on a British study predicting the incidence and progression of CWP over a ten year period as a function of mean dust concentration and assuming compliance with the 2.0 mg/m^3 dust standard, Attfield forecasted the future incidence of CWP Category 1, a less debilitating form of the disease, to be about 9 percent of the underground work force and the incidence of CWP Category 2/Progressive Massive Fibrosis, a disabling form of the disease, at 1–2 percent.[1,10]

Throughout the remainder of this analysis, it is accepted as given that there is a direct relationship between lower dust levels and reduced worker morbidity and mortality. Therefore, this paper evaluates the relationship between dust control and mine worker health indirectly through its impact on mine dust levels rather than directly on incidence of dust related disease.

UNDERGROUND COAL MINING METHODS

The three major underground mining methods employed by the domestic coal industry are conventional, continuous, and longwall mining. Since conventional mining currently accounts for only 11.7 percent of underground coal production and is predicted to decline to 4.2 percent by 1995 it will not be further considered in this analysis.[3,8,11,17]

Longwall mining is more productive than continuous mining and generates more coal dust.[12,13] The silica dust problem, however, is currently almost entirely restricted to continuous mining due to the cutting pattern used in this mining method.

DUST LEVELS AND COMPLIANCE

Due to improvements in dust control technology, average dust levels of continuous and longwall mining sections are currently at or below the required dust levels (Figure 1). These data are average values, implying that not all mines operate in compliance with the dust standard. This is evident when the standard deviations of these average data are examined (Table I). Furthermore, compliance data indicate that the problem is far from having been solved—through May 1987, 70 percent of longwall sections were in compliance and only 59 percent of continuous mining sections could comply with more stringent dust standards due to the presence of silica in excess of 5 percent (Figure 2). As an example of the remaining problem, several U.S. longwall mining sections having the highest output per shift recorded an average dust exposure value of 3.8 mg/m^3, more than two standard deviations above the longwall average.[15]

The costs to the underground coal mining industry of the decline in the average dust level fall into two categories: (1) direct costs, and (2) opportunity (i.e., lost production) costs. In fiscal year 1986, for example, mine operators submitted 83,985 samples at a cost of $10.3 million.[14] The General

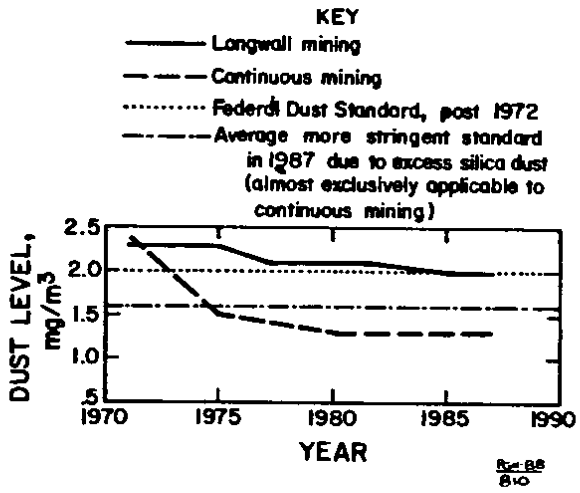

Figure 1. Average dust levels of operator samples from selected underground mining methods.

Table I

Dust Levels, by Underground Mining Method (mg/m^3)

Year	Continuous Mining		Longwall Mining	
	Ave.	Std. Dev.	Ave.	Std. Dev.
1975	1.5	0.62	2.3	1.40
1980	1.3	0.53	2.1	0.71
1985	1.3	0.42	2.0	0.52
1987	1.3	0.48	2.0	0.87

Source: (16); Bureau of Mines records

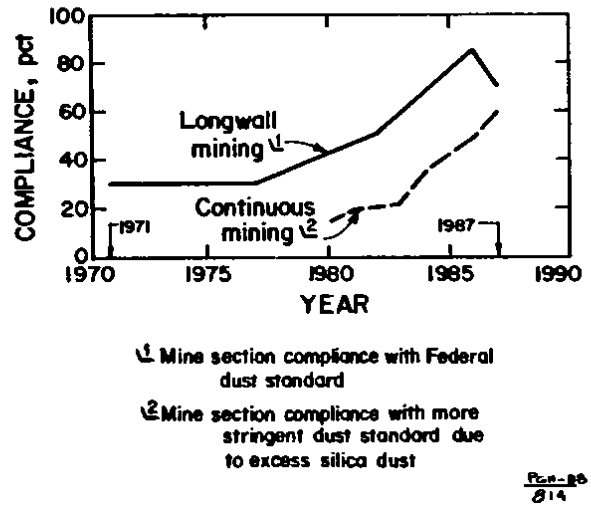

Figure 2. Compliance of selected underground mining methods with dust standards.

accounting Office cited a National Coal Association claim in 1977 that 15–20 percent of the total payroll in large underground coal mines is paid to employees involved with MSHA-related tasks; it is uncertain whether this figure is still accurate.[9]

The opportunity costs associated with lowering dust levels include: (1) the present value of production lost due to reductions in production rates to generate less dust per eight hour shift and thereby maintain compliance, and (2) the present value of production lost as a result of closure of mines unable to meet the standard. Longwall operators employ unidirectional cutting methods instead of bidirectional cutting solely to comply with dust regulations, resulting in an estimated production loss of 12 percent per working face. (Estimated based on personal communications with Consolidation Coal, Old Ben Coal, Jim Walters Resources, and Island Creek Coal Corp.) In 1985 this translated into a loss in potential revenues of approximately $200 million. (Revenue Loss = {[(350.8 million tons mined underground in 1985) × (14.7 pct longwall mining underground)/(100−12 pct)]—[(350.8 million tons) × (14.7 pct)]} × {$28.18 per ton average underground coal price in 1985} = $198.2 million.)

EFFECT OF COAL OUTPUT ON DUST LEVELS

A fundamental fact of coal mining is that as coal is mined at a faster rate, more dust is generated. Coal producers must balance increased production per eight hour shift against the reduction of average dust levels per eight hour shift.[4] This has become more difficult in recent years since: (1) the use of longwall mining, a more productive yet dustier mining method than continuous mining, has increased from only 3.6 percent of underground coal production in 1975 to 20.8 percent in 1987 (Figure 3), and (2) longwall mining technology has advanced dramatically. The average production of longwall sections per shift was approximately 850 short tons in 1978 and has increased to 1,968 short tons in early 1987, an increase of 132 percent.[14]

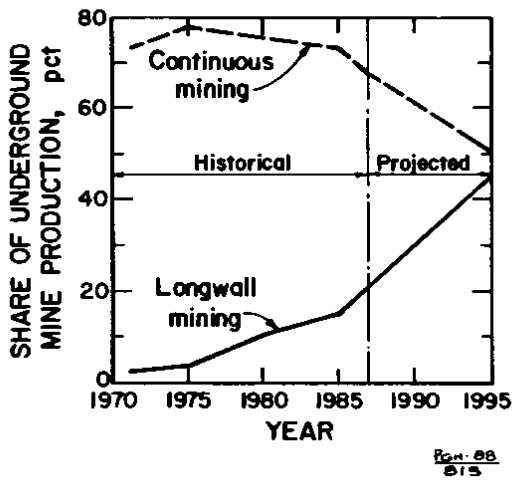

Figure 3. Production by underground mining type.

Due to the direct positive relationship between output and dust generated by longwall mining and its growing share of underground coal production, plots of dust levels against time (Figure 1) are extremely misleading. It is evident that for a given amount of dust control technology, dust levels will rise as coal output per eight hour shift rises. Average dust levels have decreased through time despite the fact that coal output per hour has increased considerably, but not as much as they would have, given the dust control technology implemented, if output per hour had remained constant. In Figure 4, the observed path of dust reduction is indicated by the round markers. Had output per shift remained at "output level 1," dust would have been reduced even further, as indicated by the square markers.

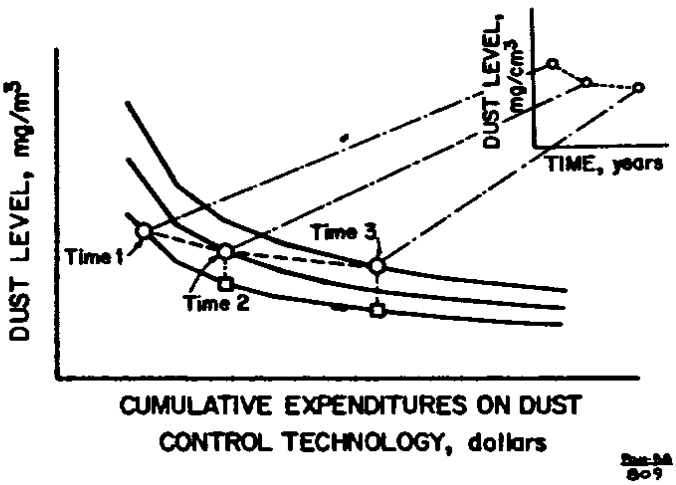

Figure 4. Effect of shifting output level on dust versus expenditures on control technology.

Dust levels of longwall and continuous mining sections adjusted for output per hour are presented in Figure 5. These adjustments were made as follows: output per hour data for the years 1970, 1978, and 1986 were indexed to 1986 levels and these ratios were used to adjust the raw dust data. The adjusted curves, then, show the dust level assuming output per hour had been held constant at the 1986 level, ceteris paribus. The adjusted average dust level in longwall sections declined from 7.29 mg/m³ in 1970 to 5.50 mg/m³ in 1978 to 2.0 mg/m³ in 1986. Raw data indicate a decrease from 2.3 mg/m³ to 2.1 mg/m³ to 2.0 mg/m³ in these years, respectively. Thus, these curves indicate that, particularly in longwall sections, average dust levels have been lowered more drastically since 1970 than is apparent from the raw data.

The 1986 average dust level was then adjusted to the year 1995 given forecasted output per hour of the two mining methods. Output per hour data for 1986 were indexed to forecasted 1995 levels and these ratios were used to adjust the 1986 dust data. (Output per hour is forecasted to increase by 28 percent for longwall mining and by 25 percent for continuous mining by 1995.) Under this scenario, if output per hour were allowed to increase to the forecasted values, by 1995 dust levels would exceed the current dust standards by 28 percent in longwall sections and by 2 percent in continuous mining sections (Figure 5).

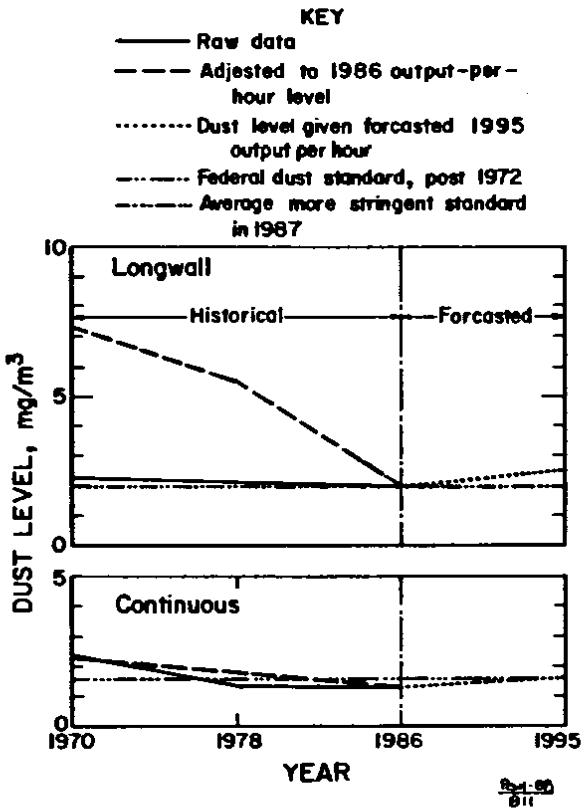

Figure 5. Dust levels of longwall and continuous mining sections adjusted for output per hour.

Unless new dust control technology is developed which enables compliance to be reached at these higher production rates, it is likely that output per hour will be significantly constrained in the future due to required compliance with the dust standard. Indeed, because the average dust level of longwall mining sections is already at the 2.0 mg/m³ standard, future increases in output per hour are already constrained, on average.

Barring the introduction of new dust control technology, the lost 28 percent increase in longwall mining output per hour forecasted for 1995 translates into a loss in potential revenues in 1995 of $584 million from currently existing longwall sections. (Coal production from longwall mining is expected to total 74 million tons in 1987 (based on calculations from data in 3, 8, 11)). Revenue Loss = {[1.28 × (74 million tons)] − [74 million tons]} × {$28.18 per ton average underground coal price in 1985} = $583.9 million.) This estimate is a maximum figure because even if no new dust control technology is developed by 1995, it is expected that more of the existing technology will be implemented by the industry before 1995.

COMPETITIVENESS

The United States is a major coal exporting nation; exports totalled 85.5 million short tons in 1986, 50 percent going to Europe and 17 percent to Canada.[6] There are numerous indications, however, that the U.S. is losing market share to foreign competitors despite the transition to more efficient

underground mining technology. Coal exports have dropped significantly from the 1981 high of 112.5 million tons. The Energy Information Administration reported that the U.S. share of the European market declined from 42 percent in 1981 to 31 percent in 1985; Australia and South Africa appear to have gained market share at the expense of the U.S.[7]

The reason for this loss in competitiveness is apparent from a comparison of the price of delivered coal to Europe (Figure 6)—the U.S. price is by far the highest of the major coal exporting nations to this market. The U.S. has been losing market share even though European coal imports have been rising. And European coal imports have been forecasted to increase from 139 million tons in 1985 to 174 million tons in 1995. Thus, unless the U.S. is able to improve its competitiveness, a continued loss of market share in Europe can be expected.

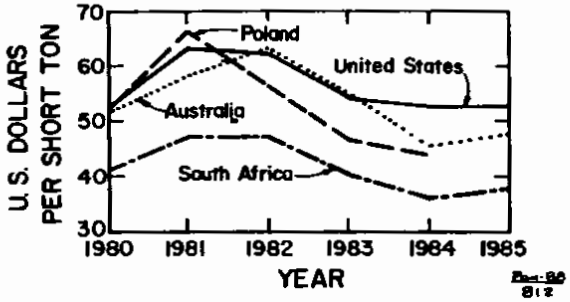

Figure 6. C.I.F prices of non-EEC coal delivered to Europe.

CONCLUSION

To reduce unit costs and thereby ameliorate its competitive position in world markets, the domestic coal industry must continue to increase output while holding the line on production costs. Output from longwall mining sections is forecasted to increase to 45.0 percent of underground coal production, from 20.8 percent currently as the industry attempts to achieve this goal.

The silica dust problem, presently uncommon in longwall sections, is anticipated to become more prevalent as a consequence of increased longwall production because continuous mining machines are used to develop coal panels for extraction by longwall methods. In addition, due to geological conditions—mining of thinner and more heavily faulted and fractured coal seams—the amount of silica dust in airborne respirable dust is expected to increase.

In light of the industry trend toward longwall mining, advancement of dust control technology is necessary to enable associated increases in production while maintaining compliance with the mandated standard. If no new control technology is made available, the dust standard will act as a binding constraint on future output per hour. This is especially pertinent to longwall mining where the average dust level is already 2.0 mg/m^3.

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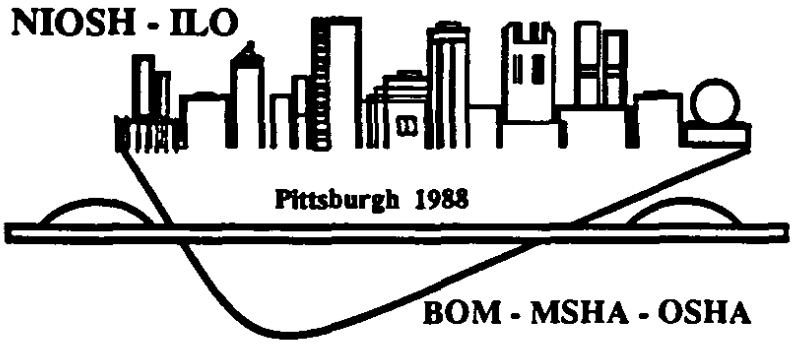

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