ENVIRONMENTAL QUALITY CONTROL AND MINERALS

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During the past several years an increasing concern for the quality of our national environment has arisen. Within the last two years the volume of articles and speeches—of criticism, accusations, and demands—has crescendoed and shows no signs of subsiding.

Some persons, whether sincerely concerned or merely seeking attention, have gained national prominence by declaring that the nation will be doomed within the next year, 5 years, or 10 years. Other voices are more moderate, but nonetheless insistent that many of the patterns of activity and material consumption within the United States must be altered, if not totally abandoned.

Most of the environmental effects that concern our nation today are not the result of deliberate intent or disregard. They are the by-product of activities aimed at very worthwhile goals. The farmer who applies nitrate or other fertilizer that can run off his field to add to pollution in streams and rivers is only trying to make his land more productive and obtain a larger crop yield. The housewife who uses phosphate detergent hopes to make her clothes cleaner. Those who mine by surface methods are attempting to produce materials at the lowest practicable cost.

As is true of many activities, efforts to correct or avoid the detrimental effects of mineral production will bring into play factors that are not anticipated or desired. Ultimately, the goal must be that of achieving the best balance possible.

Although various activities have come under criticism, it appears, at least to those of us who are connected in any way with minerals, that minerals have been a special target—not only the production of minerals but their transportation, processing, and utilization as well.

There are perhaps three principal reasons why so much attention has been focused on minerals.

1. By virtue of their manner of occurrence and their physical and chemical makeup, minerals are actually an integral part of the environment. Therefore, their production, movement, or utilization without modification of the environment would be entirely unrealistic.

2. The quantities involved are so huge and mineral production and consumption activities so widespread geographically that their effects are observable to everyone. As sources of energy, as metallic and nonmetallic materials, and as plant foods, minerals are directly related to or involved in almost every form of industrial, economic, and recreational activity. Between 3 and 4 billion tons of solid fuels and minerals, 5 billion barrels of liquid fuels, and 22 trillion cubic feet of natural gas are consumed each year. Furthermore, the rate of use of some minerals has been doubling every 9 to 15 years.

3. Many mineral materials are so durable they remain as scrap long after the product has served its useful purpose. Reclamation may not be economic, but the production of new materials is criticized because old materials are so obviously available.

MINERALS AND THE ENVIRONMENT

The problem that confronts the minerals industry today is that of finding ways to comply with the requirements for environmental quality protection and still provide the nation with the minerals it requires at an acceptable cost. The environmental components we most frequently think of are the atmosphere, the water, and the land, but recently increased public attention has been turned to plant and animal wildlife as well.

Let's examine for a moment the relation between the environment and mineral production and use. Any production of minerals will, without exception, involve financial costs and will result in some effects on the environment. The balance of these three factors is illustrated in figure 1, where mineral production on the one hand is accompanied by costs and environmental effects on the other. In some instances these effects may consist only of the void left by
removal of the minerals. In other instances the effects may be detrimental, completely benign, or even beneficial. The nature and extent of the effects will vary in degree and character, depending on the type of mineral, the manner of its occurrence, the method of production used, and other factors. But its very removal will cause some modification of the environment.

If we accept the premise that any mineral production or use will inevitably carry with it some environmental effects and financial costs, a logical corollary appears to be that our steadily expanding demand for and use of minerals will, other things being equal, also result in an increase in the magnitude of these effects. Thus an increase in the mineral output on the left side of the scale in figure 1 brings a parallel increase on the right side.

Although greater mineral output is accompanied by increases in both total costs and over-all environmental effects, from the public standpoint a significant difference exists between these factors that cannot be ignored by the mineral industry. Production expenditures quickly become identified as unit costs, and the cost of each unit to the consumer may not change significantly as total quantity produced increases. On the other hand, seldom, if ever, are the incremental environmental effects (unless expenditures are made to correct them) identified with, or allocated to, the additional units of material produced or energy consumed. Instead, within a given mining area the total cumulative environmental effects are observed in their entirety rather than as a series of discrete units.

To provide for the industrial growth of our nation and supply the demands of a growing population for material goods and energy, a steady increase in the use of minerals of all types has occurred. Expansions in the output of fuels and metals have tended to parallel each other, increasing on the average of about 3 percent per year.

The growth in use of nonmetallics, which consist primarily of construction and plant-food materials, has been considerably more rapid than that of metals. An especially significant aspect of this growth is the extremely large total quantity of minerals material involved. The combined output of the major construction minerals—crushed stone, sand, and gravel—currently amounts to about 1.8 billion tons per year and it is projected to reach 5.6 to 8.0 billion tons per year by 2000 (U. S. Bur. Mines, 1971, p. 22). Because most construction activity normally occurs in or near large centers of population and industrial activity, most production of construction materials is highly visible to a large segment of the public and is therefore subjected to increasing objections and regulations.

REDUCING ENVIRONMENTAL EFFECTS

Once we recognize that environmental effects are inherent in the production and use of any mineral, we might ask what, if anything, can be done to reduce the undesirable or adverse effects. One obvious way would be to
ENVIRONMENTAL EFFECTS CAN BE REDUCED THROUGH DECREASED CONSUMPTION

Figure 2

it also has provided a dramatic increase in the average per capita consumption.

Consumption of electric power, most of which is generated by mineral fuels, has been doubling every 10 years, and in the 1970s it is expected to equal the total amount consumed during the past 70 years.

Another way to reduce environmental effects is through increased expenditures (fig. 4). Increased costs may result from changes made in production procedures to protect the environment, from expenditures to restore the environment after production has occurred, or from expenses related to other types of action, such as installation of pollution-control devices.

In the past, the minerals industry's primary assignment has been to provide minerals to meet the nation's needs at the lowest possible cost. In at least some cases, environmental protection now is taking precedence over lowest cost as the prime objective. An added demand now is that these mineral materials be produced with a minimum of undesirable environmental disruption.

While some members of the public no doubt partially realize that increased costs will be involved in this shift of emphasis, it is doubtful that the general public fully recognizes the extent of these costs or the fact that these increased production costs must ultimately be borne by the consumer through increased prices if production is to continue.
As the effort toward environmental improvement progresses and the relative magnitudes of both the costs and benefits become more apparent, a greater public tendency to balance one against the other may develop. It may be decided that, beyond a certain point, the incremental benefits do not justify the added costs. Nonetheless, there is a public mood today that reflects a strong conviction that the quality of the environment must be protected from further deterioration, and the official government attitude reflects that public mood. An effort to point out the magnitude of the costs involved in complying with new regulations is unlikely to receive much sympathetic attention today. Nor will the fact that a proposed regulation or procedure appears completely impractical or infeasible necessarily mean that legislation requiring such procedure will not be enacted.

Still another way in which some environmental effects may be reduced is through improved technology in the production and use of minerals (fig. 5). Such technological improvements may or may not result in increased costs. They may, in fact, bring the desired results at a reduced cost. But new technology does not just happen. Its development requires time, concerted effort, and increased investment.

EFFECTS OF ENVIRONMENTAL REGULATION

Some of the impact of environmental regulations is already apparent, and the effect of many others will be felt during the next few years. New regulations will be applied to production, transportation, and utilization of mineral materials. A brief review will serve to point out some of these.

Mineral Production

Increasingly stringent regulations controlling production techniques and reclamation procedures have recently been enacted. Some proposals have been made that would completely halt certain types of mineral production because of their effects on the environment. Already pits and quarries have been banned in some urban areas and strip mining has been prohibited in certain regions. Proposals have been introduced in Congress to halt all offshore drilling and both in Congress and in certain state legislatures to prohibit strip coal mining completely.

The banning of pits and quarries by zoning ordinances makes near-by, short-haul resources unavailable and increases the transportation cost and, in turn, the delivered price of construction materials to builders within the metropolitan area.
The proposed banning of further offshore drilling would make inaccessible more than 9 percent of the nation's known oil reserves and almost 13 percent of the known gas reserves. In addition, it would remove from exploration large areas that offer some of the greatest potential for the future discoveries that will be required to meet our fuel needs. If the proposed ban on offshore drilling were extended to current production, a significant portion of the current oil and gas output would be halted.

The total prohibition of strip mining of coal would eliminate about one third of the current output in the United States. At present there would be no means of replacing, through underground mining, the approximately 200 million tons per year of strip coal that would be lost, and there would be other effects also. In 1969, underground mining costs were, on the average, about 40 percent higher than strip mining costs. In the same year, about 22,000 men produced almost 200 million tons of coal from strip mines. To produce the same amount of coal from underground mines would have required about 27,000 additional miners because underground miners have a lower average of productivity. The total coal mining labor force would thus need to be increased by 21.5 percent at a time when there is a shortage of mining manpower. Too, since underground mining recovers only about 50 percent of the coal in the ground, nearly twice as much coal resource would be exhausted in providing the same amount of output. Finally, the loss of lives in underground coal mining has historically been about 3½ times that for the same production by strip coal mining.

Complete banning of strip mining of all solid minerals other than coal would have even more impact, because 94 percent of the nation's production of nonfuel minerals comes from surface mining operations.

Transportation

The transportation of solid minerals has not, in general, resulted in major environmental problems, although the noise and traffic of trucks has been partly responsible for objections to pits and quarries in and near metropolitan areas.

Recently, much more attention has been directed to the effects of oil spillage, occasionally from ruptured pipelines but most frequently from water-borne shipments. Oil spillage is not a new problem. A publication issued in 1925 dealt with pollution of bathing beaches by oil spilled from ships along the east coast from Connecticut to Florida, parts of the Gulf Coast, and the Pacific Coast (U. S. Public Health Service, 1925).

As the water transportation of oil increases, problems of tanker spillage also are likely to increase. Our own increasing dependence on foreign sources will bring more of these shipments to our shores. The increased size of tankers should reduce the number of tankers required and perhaps the incidence of tanker accidents. On the other hand, as tanker size increases, any accidents that do occur are likely to have far greater effects. A tanker of 372,400 DWT (dead weight tons) capacity is reported currently under construction, and one of 477,000 DWT capacity is reportedly being planned.
(Industry Week, 1971). The cargoes of two ships of this size will exceed the reported 794,000 tons of combined capacity of 95 ships sunk by U-boats in World War II (Bachman, 1971). Some of these ships, with their cargoes still intact, are reported to remain on the ocean bottom off the east coast of the United States.

The oil transportation project currently receiving the greatest attention is the proposed Alyeska Pipeline from Prudhoe Bay to Valdez, Alaska (fig. 6). About 80 percent of the 800 miles of 48-inch pipe required for the project is reported already on hand, but latest reports indicate that at least another year may pass before approval will be granted for construction of the pipeline, if, indeed, approval is to be granted at all. Approval to begin construction is being delayed pending further study of potential environmental effects of the construction and operation of the pipeline and the designing of methods to control these effects. The greatest uncertainty relates to the impact of the passage of oil through the pipes at high temperatures in an Arctic environment. Anyone who has worked at construction in Arctic areas is aware of the problems that permafrost can bring, even for normal, small-scale excavations.

Nearly 500 oil pipeline leaks were reported to have occurred in the United States in 1968. Most of these resulted in only minor spillage, and only about one fifth involved spills of as high as 1,000 to 12,000 barrels (Carter, 1969). Because of the operating conditions that will prevail in Alaska and the large spillage likely to occur if the 48-inch pipeline should be ruptured, it is considered especially critical that pipeline breaks should be prevented.

Attention has also been called to the possibility of oil spills along the Canadian Pacific Coast from tankers moving between Valdez and the coastal parts of the western United States. To avoid this danger it has been proposed that, instead of crossing Alaska, the pipeline be constructed along an alternative route through Canada to the United States border (Wall Street Journal, 1971). Although the Canadian route would avoid some of the mountainous terrain of northern Alaska and the zone of high seismic activity in Alaska, a much longer pipeline would be needed.

Whatever the final outcome, the cost of the delays and of compliance with environmental regulations will add significantly to the cost of the oil when it is finally delivered in the United States.

Mineral Utilization

A third type of environmental quality regulation affecting minerals is directed at the consumer rather than the mineral-producing industry. These
consumer-directed regulations may well have greater impact than those applying to mineral production activities, for already they are radically changing the patterns of mineral use.

One of the proposals would prohibit the use of tetraethyl lead in gasoline. Besides altering the refinery product, the prohibition of lead as a gasoline additive, if fully implemented, would immediately reduce the market for lead by about 20 percent and create a drastic impact on the producers of lead and associated minerals.

Recent discoveries of the transformation, through bacterial action, of metallic mercury to highly toxic methyl mercury have led to laws for control of spillage of mercury into lakes and other natural waters. The modification of processes has led to a reduction in the loss of mercury, which, in turn, has resulted in a significant decline in demand for that metal.

Perhaps the most dramatic and far-reaching impact has been that resulting from recently proposed and already established sulfur dioxide emission standards for fuels. The standards are such that much of the coal currently being produced and most of the reserves throughout the country cannot meet them without the use of emission control devices on combustion units. Unfortunately, such control devices have not yet proved effective on a commercial basis. In an effort to comply with the new air quality standards, fuel consumers attempted to procure natural gas as a substitute for coal. As present supplies of gas cannot even meet the growth in the traditional markets, the sudden additional demand for gas as a substitute fuel could not be met.

Unable to get either low-sulfur coal or natural gas, utilities and large industrial firms attempted to obtain low-sulfur residual fuel oil. Residual traditionally had been so low in value that only a minimum amount was produced by most refiners. Because there was so little low-sulfur residual to meet the sudden demand, it quickly became a premium product with a premium price.

Hopefully, within the next few years, satisfactory devices and techniques for the control of sulfur oxide emission will be available so that high-sulfur coal can be burned without violating air quality standards. In the future, coal will also be processed into sulfur-free synthetic pipeline gas to supplement the declining reserves of natural gas and into liquid fuel to supplement natural petroleum products. In the meantime, it will be necessary to use those fuels that are available, for in many instances there are no alternatives to either doing that or shutting down.

CONCLUSIONS

The widespread concern for the environment and the intensity of the demand for corrective action appear to be rather recent phenomena, but they do have a history extending back several decades. Expression of environmental concern has taken many forms, and some of the demands and regulations resulting from it are beyond the present technology and capability of the nation. It is to be hoped that demands that are patently unreasonable or impossible
to comply with will give way to a more rational approach. But for the minerals industry to think that all of the present concern for the environment is merely a passing public fancy would be a serious mistake.

The mineral producers of this nation and the world, and the mineral consumers as well, are faced with a future in which mineral costs will increase as prices rise to cover the additional costs of environmental protection activities.

It is too early to measure accurately just what price increases will be required and what impact on demand these increases will ultimately have. The nation's industrial growth for two centuries has been assisted by the availability of low-cost energy and mineral materials.

Secretary of the Interior Rogers C. B. Morton was recently quoted as stating:

Now, because we have finally achieved the measure of concern for the environment that we should have summoned 30 years ago, these social costs are at last going to be charged to the proper accounts. Those who benefit from the production and consumption of energy will be asked to pay the full tab, and for the first time the user will have some feel for the true cost of the energy he consumes.

(AGI Report, 1971.)

Although the statement referred specifically to energy, it applies equally to all other mineral products.

The Secretary is correct in that the consumer ultimately will pay the full tab. But for the minerals industry to take this too literally and become complacent about allocation of environmental costs could be extremely hazardous. The public still has the option of paying the cost or doing without. There is at present no way of pinpointing the level at which the consumer will balk at paying increased prices.

It behooves the industry to pass along the necessary costs involved in protecting the environment and to identify these costs as such for the public. But it is also extremely important that the minerals industry continue to produce and provide its products at the lowest possible cost.
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