CHAPTER 3

SURFACE MINING METHODS AND EQUIPMENT FOR SMALL MINE OPERATIONS

The Surface Mining Control and Reclamation Act (1977) does not specifically outlaw any method of mining, but it outlaws certain practices such as the placement of spoil on the downslopes above 20 degrees in steepness [Section 515(d)(1) of the Act]. Each mining method is described in Chapter 4. These illustrations do not try to show how the operation should be carried out, but are intended to give the operator an easy, quick method of identifying sections of the Regulations which are relevant to the mining method chosen.

Skelly and Loy found that mining methods can generally be subdivided by region as shown in Table 6.

TABLE 6

Region	Predominant Terrain	Mining Method	States
1	Steep Slopes	Contour Mining	E. KY, WV TN, VA
2	Rolling	Modified Area & Multiple-Cut Contour	PA, MD, AL, S.E. OH
3	Flat Terrain Thick Overburden	Area Mining	W. KY, IL, IN, OH, MO, OK, KS, AR, IA

Source: Skelley and Loy, February 1975, "Economic Engineering Analysis of U.S. Surface Coal Mines and Effective Land Reclamation," USBM Contract S0241049.

Each mining method has different environmental and reclamation problems which are covered by the Regulations. The choice of the method of mining will still be determined mainly by economic factors. The smaller operator will often be constrained by the equipment which he has available and therefore may not have much choice in the method of mining.

SELECTION OF MACHINERY

Operators should be very aware of the capability of machinery in terms of capacity to shift overburden economically. The Regulations, however, do have some implications in terms of the choice of machinery. The following requirements should be considered carefully before selecting equipment: 1) Stripping and stockpiling of topsoil [816.22, 816.23]; 2) Selective handling, placement and consolidation of overburden [816.41(d)(2)(vii)-(viii), 816.71]; 3) Contemporaneous backfilling [816.101(a)]; 4) Grading, ripping, etc. [816. 101-816.106]; 5) Replacement of topsoil, revegetation and management [816.111-816.117].

Mine operations in hill terrain used to prefer to move overburden by blasting and pushing rather than hauling. However, techniques using blasting and pushing are not possible with the new Performance Standards. This means a different emphasis in machinery requirements with heavy investment in loaders and haul trucks. It also means more precise planning of earthmoving operations to keep the equipment fully utilized. These considerations may be difficult for the small operator to meet.

Clearly, versatility is one of the most important factors governing the choice of equipment and mining method by the small operator. Machinery that can perform at least two tasks will be preferred (dozers, pan scrapers, front-end loaders, etc.). For instance, it is important that whatever machinery is used for coal removal on a small site, it can be deployed on

another task also as coal removal can usually be done much faster than removal of overburden.

Some new developments in mining machinery seem to be emphasizing versatility but there is also a strong trend towards the development of various continuous (rather than cyclic) methods of handling overburden removal, involving huge capital investments far beyond the resources of the small operator. Yet, as continuous, largely automated methods are adopted by the large companies, the role of the small operator in exploiting deposits unsuitable for those methods becomes increasingly important.

SCRAPERS

The removal, stockpiling and replacement of topsoil required in the new Regulations [816.21-816.25] is likely to be carried out mostly by scrapers. Therefore there may be a tendency to use mining methods which can also use scrapers to remove overburden where it is unconsolidated and where terrain makes it possible. Operational costs are usually higher for scrapers than for a dragline of a shovel but scrapers can selectively place overburden material, consolidate it and regrade in the same operation. Scrapers may cause excessive consolidation making ripping necessary. However Section 816.24(a) requires that the surface be scarified.

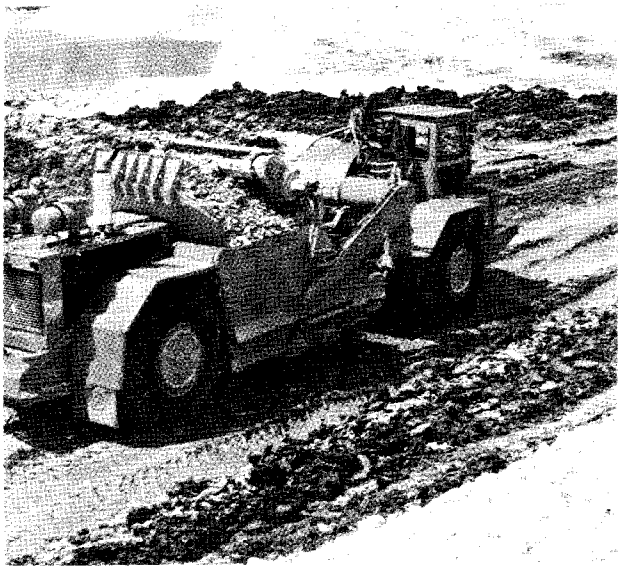


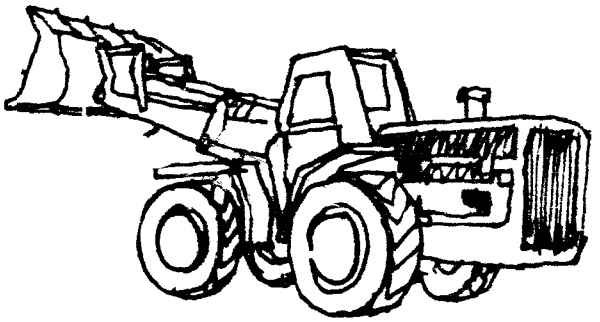
FIGURE 2
The scraper has many advantages though the small operator might only justify its employment in multiple use situations.

The flexibility of scrapers and their ability to dig, load and haul makes them especially valuable for meeting the contemporaneous reclamation requirements of the Regulations. In addition, their ability to handle overburden selectively makes them valuable in meeting the requirements for selective handling and placement of acid-forming spoil [816.48]. They also have the versatility of being able to build and maintain their own haul roads. Scrapers are an expensive investment for the small operator. Unless he has plans for also using it for tasks other than topsoil removal he may be better off to use bulldozers or front-end loaders.

FRONT-END LOADERS

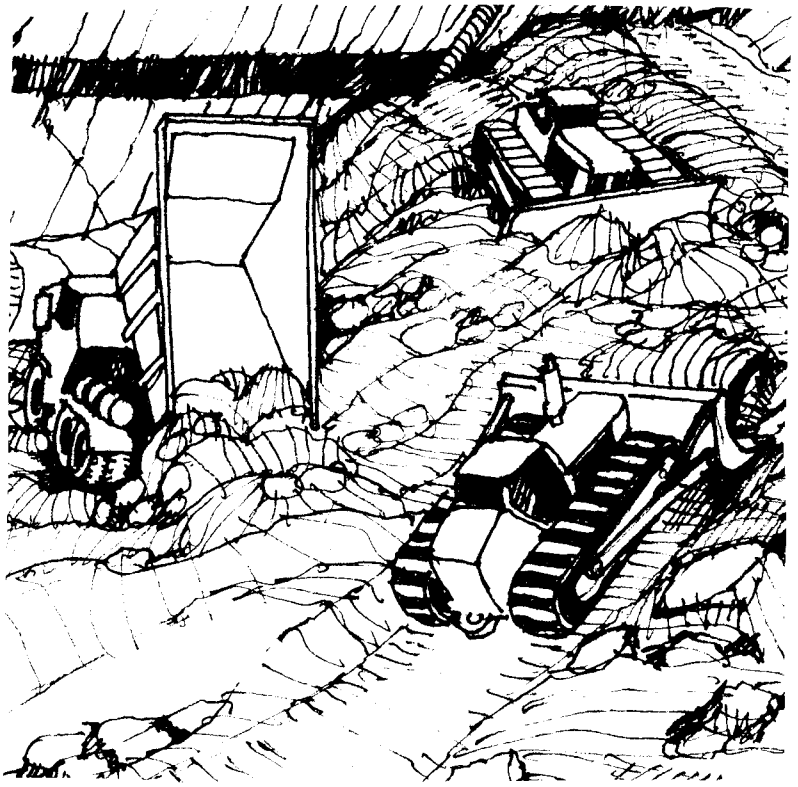
The requirement of the Regulations for selective handling and placement of overburden materials and the precision with which this can be done by front-end loader/haul truck combination, together with the great range of tasks for which front-end-loaders can be used, makes these highly versatile machines ideal for use on many small surface mine operations. The

mobility of the front-end-loader-and-loaders, its ability to dig and load, and its uses in construction of sedimentation ponds, diversions, etc. makes it especially useful. The tracked versions used for difficult terrain do not have the speed and maneuverability for most applications. They do however have a lesser bearing pressure making them useful on sites where compaction is to be avoided. Front-end loaders are now being used increasingly on sites of all sizes.



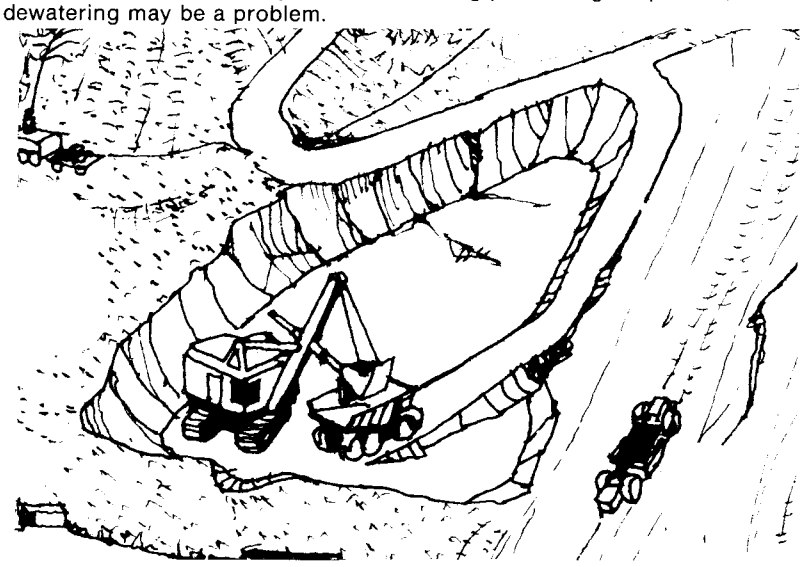
DOZERS

Bulldozers will continue to be used heavily in all surface mining operations both for earthmoving and increasingly for other operations such as root grubbing (during site clearance prior to topsoil removal), regrading, ripping, various cultivation operations, and push-loading scrapers, etc. However, their use in shifting overburden may become less important particularly in contour mining where haulback is necessary to keep spoil off the downslope, though they will continue to be used widely for this purpose in area mining on small sites.



LOADING SHOVELS

Though large stripping shovels have low operating costs they do not have the flexibility required for most small mine operations. When being used to cast overburden, their ability to place material selectively is limited, nor is spoil consolidated when cast. This can lead to AMD problems. Also when casting spoil the pit is very confined, making pit drainage important; and dewatering may be a problem.



Loading shovels (illustrated) used in combination with haul trucks solve the problems of selective placement of acid-forming and toxic-forming spoil. Consolidation is also achieved through the use of haulage trucks, and the pit will be less confined. Because of their high breakout capacity however, shovels avoid the need for blasting in lightly consolidated material, and thus the blasting restrictions in the Regulations would not apply.

HYDRAULIC EXCAVATORS

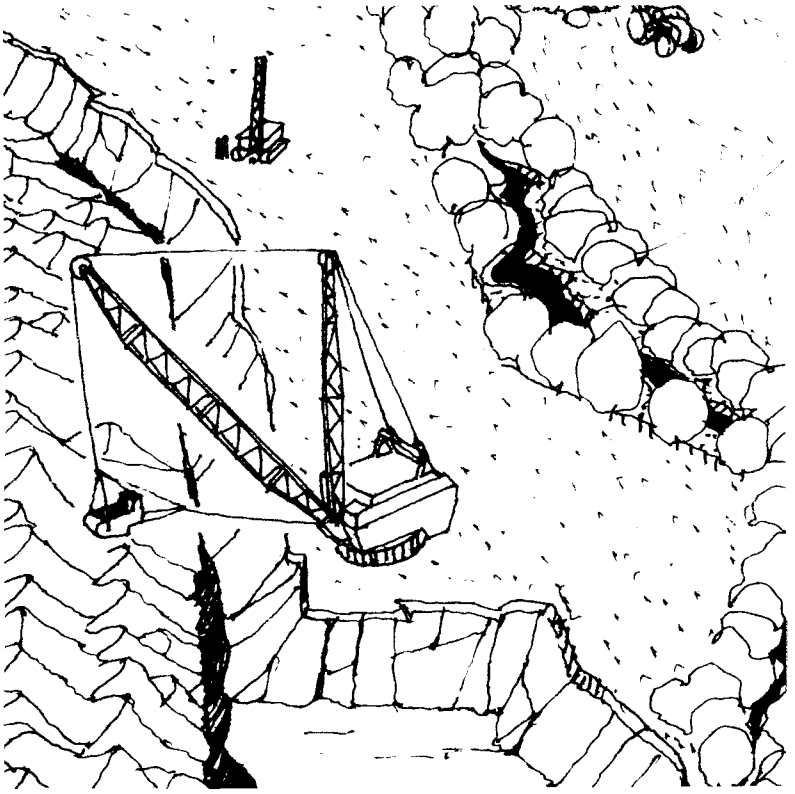
Hydraulic excavators are very versatile and may perform a number of tasks on the mine site besides that of excavating overburden. Excavation of sedimentation ponds with excavators with back-hoe configuration can be accomplished quickly and easily due to their long reach.

If the excavator is digging and casting overburden, spoil is not consolidated. If used to load haul trucks, careful placement and consolidation is possible. Crawler tracks enable excavators to negotiate poorly drained land.

Hydraulic excavators have much more breakout capacity than loaders but loaders are more economic and maneuverable for loading loose material. Thus the excavator might be used on sites with more consolidated overburden.

DRAGLINES

Operating costs of large draglines, like shovels, are low but their requirements for secondary equipment and their lack of maneuverability make them inflexible for most small operations. Many small operators in northern Appalachia though do own small draglines. They can segregate spoil quite well but cast spoil will need grading and consolidation. In some cases, where high infiltration rates are required, the high permeability of ungraded spoil may be an advantage. Where scrapers have dumped the spoil and heavy tires have compacted them the infiltration may be one or two orders of magnitude less than dragline-dumped spoils. (3).



The lack of consolidation of dragline cast spoil could result in groundwater pollution where overburden contains large amounts of acid-forming material. In cases where the proposed post-mining use is for industrial, commercial or residential development, settlement of unconsolidated spoil may give problems for several years.

BUCKET WHEEL EXCAVATORS

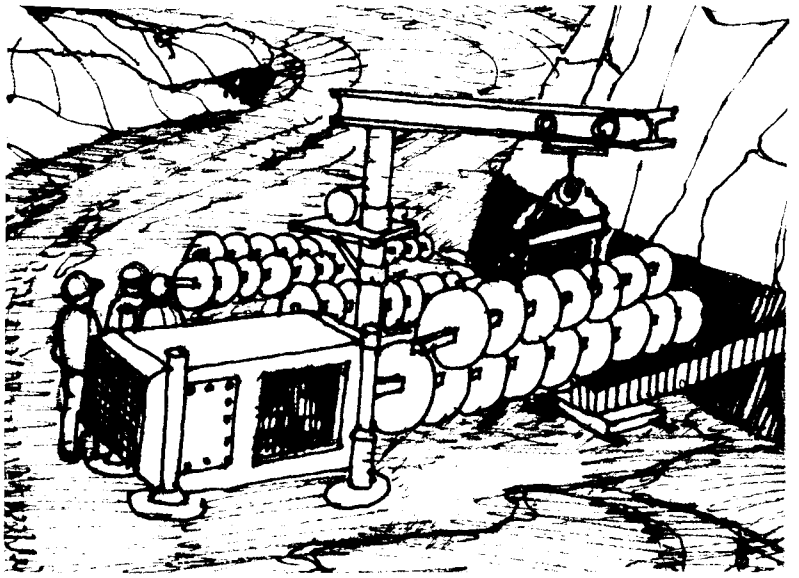
- not applicable

REVEGETATION EQUIPMENT

Reclamation requirements will create the need for various pieces of agricultural equipment. The more sophisticated reclamation equipment (hydroseeders, tree planters, etc.) will be provided by contractors but small operators may find it advantageous to own disc harrows, rippers, seed drills, fertilizer spreaders, etc.

AUGERING

Although auger mining gives a poor recovery of coal it may increase the overall recovery rate in situations where coal cannot be further exploited by other methods (seams too thin for underground mining or overlaid by a thick hard sandstone stratum) but the conditions for auger mining are rather restrictive.



The Regulations contain specific Performance Standards for augering [Part 819]. Probably the most difficult problem which the Regulations pose for small mine operators is that of contemporaneous backfilling. The expense of auger equipment makes it unlikely that small operators will operate their own and will therefore rely on contractors. But to justify using contractors, the small operator must either have sufficient highwall exposed at any one time to make the operation economic, or be able to operate at sufficient speed to keep ahead of an auger outfit which is unlikely. It may be that on submission of a "written analysis" [780.18(b)(3)] additional time may be granted for backfilling and grading [816.101].

The danger of penetrating abandoned (or active) surface mines forbids any auger hole closer than 500' (horizontally) to underground mine workings [816.11(b)]. The problem of unmapped underground workings and the danger of sudden release of large quantities of groundwater, often seriously polluted, is a constant hazard of auger operations in previously mined regions.

Auger holes can be a serious source of acid mine drainage and Section 819.11(c) contains very specific requirement for plugging auger holes (within 72 hours for holes discharging polluted water or within 30 days for holes not discharging water).

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