CHAPTER XIV.

WASTE IN COAL MINING.

Perhaps one of the most difficult problems to solve in connection with the mining of coal is the reducing to a minimum the waste in the form of coal dust and slack. It is a well known fact that in getting out the coal from a mine there are more or less dust and small fragments which must be cast aside as valueless. When the coal reaches the surface of the ground and is screened, there is another very noticeable loss in the marketable portion, part in the form of dust, part in the condition of fine particles commonly called slack, which is sold very much below the regular price of the product. With the soft bituminous coals, such as are supplied by Iowa and the neighboring states, the depreciation is very much greater than in the case of the hard or anthracite varieties of eastern Pennsylvania. This average loss in fine coal, before the product leaves the mine, is at the present time a considerable per cent of the total quantity mined. Although the waste in coal before it gets to market is a subject which deserves thoughtful consideration, little attention has been paid to it in Iowa. In reality, this factor in mining economy has been largely disregarded in most mining districts, not only at home but abroad. In only a few of these places has careful investigation of coal waste been undertaken; and only within the past few years has serious attention
been directed to the importance of such a line of work. In other industries, and especially in other mining activities, one of the most difficult problems of solution is the reduction of waste to a minimum. There is no doubt that in the Iowa field at least a very considerable portion of the waste could, with the proper precautions, be easily avoided. In the anthracite region of Pennsylvania inquiry into economy in coal production has already awakened interest, but as yet little work has been undertaken in the country as a whole, in the application of the principles to the bituminous coals.

While it is not possible to enter very deeply into this subject at the present time, a brief presentation of some of the leading points bearing on the subject may not be out of place. A more comprehensive treatment must wait until further detailed work concerning the nature and capabilities of Iowa coals has been accomplished.

Briefly it may be said that the principal sources of waste in the Iowa coal fields are three-fold:

(1) Waste resulting from the methods of mining, by which more or less of the coal is left in the ground undisturbed.

(2) Waste resulting from the breaking of the coal in mining and in the preparation of it for market.

(3) Waste resulting from failure to properly use the smaller sizes.

Waste Due to Methods of Mining.—In regard to the first source of waste it is to be remembered that in all mining a certain portion of the coal must always be sacrificed. Any method of mining now in use requires a certain amount to be left for pillars and fire walls, and the problem is in reality to find the method which is best adapted to the particular coal seam worked; one which allows the maximum amount of coal to be removed.
Most of the mines in Iowa are worked by the room and pillar method, or by various adaptations of this plan. The long wall system is in use in some places. The exact plan varies in different mines, being modified to meet the different conditions. In some mines the rooms are worked in panels and in some not. The coal vein is in all cases never highly inclined and the thickness is seldom very different from an average, so that the conditions for this kind of work are exceedingly favorable. In this way some of the best results have been reached. Careful estimates based upon work done in some of the larger mines in Mahaska county show that under favorable circumstances seventy-eight per cent of the total amount of coal has been removed. This makes no allowance for faults and is only valuable in showing what may be done by this method. As a matter of fact the average percentage of coal removed in the whole field is very low. A large number of small mines are run on a haphazard plan, often without maps, and they render almost valueless much good territory without an adequate return.

A considerable number of the mines are now worked by the long wall plan and many more could adopt the same method with profit. This plan, where it can be used, seems to give the best of results, especially with the thinner seams. Much might be done to reduce the amount of coal left in the ground by the introduction of better engineering skill and the more liberal investment of capital. At present capital is at such a premium that quicker though smaller returns are usually preferred.

Waste in Removal of Coal.—The second source of waste is perhaps that in which the greatest improvement may ultimately be expected. In all mining it becomes necessary to break the coal in order to carry it to the
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surface. This is usually done by some form of mining machinery, wedging or blasting. The last is the method in general use in the Iowa mines. Too much powder, of course, shatters the coal badly and allows much to be wasted in the form of dust or small pieces which are not handled; too little fails to accomplish the purpose, and leaves the coal in pieces too large to handle. In many of the mines of the state a much larger quantity of powder is used in loosening the coal for handling than is necessary. The deleterious effect on the coal is readily seen in the unnecessarily large proportion of dust and pieces too small to be profitably moved. In these cases not only does the operator lose a goodly percentage of the total output it would be otherwise possible to ship, but it is very extravagant for the miner, who could otherwise make from twenty to thirty per cent more in wages. Operators should, therefore, endeavor to encourage undermining the seam and wedging, with a judicious use of smaller amounts of powder. The results would doubtless be eminently satisfactory to both parties; and the economy resulting would be a matter of considerable surprise.

In the preparation of the coal for the market it becomes necessary to break it more or less in order to separate the slate, "sulphur" and dirt from the merchantable product. This is a process which in the large eastern mines is accomplished by various machines together constituting the breaker. At present no such process is known to be carried on at any Iowa mine. The miner usually, in loading his car, separates the trash from the coal as well as he is able with his hand tools and poor light. The result is that a large percentage of material properly classed as fuel is thrown into the gob or upon the dump. The amount of waste from this source alone
is extensive. The almost utter lack of system in preparing the coal for shipment is largely responsible for much of the total waste. It is customary to dump the coal into the railway cars, causing it to pass over a series of screens which allow a rough separation into three or occasionally four sizes. In many mines not even this separation is made but the coal is sold "run of the mine" with corresponding dissatisfaction to the consumer and low prices to the producer. The full value of Iowa coal cannot be realized until more systematic methods are introduced by which it may be cleaned and sized.

Waste in Fine Coal.—The third source of loss is that arising from the depreciation in the value of coal when it becomes fine. This is quite important with the soft bituminous coals, such as are supplied by Iowa and the neighboring states, and the depreciation is very much greater than in the case of the hard or anthracitic varieties of eastern Pennsylvania. This average loss in fine coal before the product leaves the mine is probably not far from twelve per cent of the total quantity mined in the state. This proportion, of course, varies in the different localities, in some it is somewhat greater, in others considerable less. After deducting the amount returned by the sales of slack, the net loss for the entire state each year is probably not far from a half million of dollars; that is, if the fine coal now wasted or disposed of at a low figure could be sold at the average price of lump coal it would have the valuation just named. In all coal fields this subject has attracted more or less attention. The utilization of the slack has been carefully studied in many localities, while quite recently a state commissioner has investigated it in connection with the anthracite fields of Pennsylvania. Up to the present time the bituminous coals of the
western fields have not been so closely studied, though it is believed that a greater percentage is wasted here than in the eastern districts. A number of remedies have been proposed, and most of them are in more or less successful operation.

The manufacture of both coke and gas from fine coal has been experimented upon, in some cases quite successfully. How far the Iowa coals could be used for such purposes is not known and can only be determined by the proper tests. Slack coal has been used in some instances in clay work. The coal, reduced to a fine powder, is mixed with clay and thus a great saving in the fuel used in burning the bricks is effected. Coal dust may, therefore, be utilized to great advantage in the manufacture of certain grades of clay goods.

Probably the greater portion of the fine coal could be used just as it comes from the mine. This may be accomplished in several ways. By means of grates especially adapted to its use all but the finest particles may be burned. It also has been used as a powder, the fire being fed by fine jets of coal dust driven by steam or air pressure. More recently it has been proposed to grind the coal, mix it with water and burn it under pressure in this form, pumping it across the country like oil instead of employing the ordinary means of transportation. All of these plans have proven to be more or less successful, but each requires a special furnace to burn the coal. They are also largely dependent for their success upon the cheapness of the fuel. Among other ways of dealing with the problem various methods of pressing into cakes or blocks have been tried. In this direction Spring, in his many experiments showing the behavior of different substances in a powdered condition under great pressure, has subjected
coal dust to a pressure as high as 90,000 pounds. Under this enormous weight the fine particles are welded together into a bright block, hard and perfectly solid. Commer-
cially the operation is known as briquetting and might in this region be quite successful. In general the process consists in mixing the powdered coal with some cement or bond, and then under pressure molding it into blocks of suitable size. This method has been in quite general use in Europe for some time; and recently several plants have been established in America. Since the sub-
ject has had attention directed to it a company has been organized in Iowa for the special purpose of utilizing the dust and fine slack of the mines in manufacturing bri-
quettes. Arrangements have been made by which the fuel will probably soon be placed upon the market. The method of preparation is essentially the same as that followed in some parts of Europe, and which has recently been described by Dumble in connection with the brown coals of Texas. From his work the following has been largely gleaned.

The manufacture of briquettes consists of two pro-
cesses: the preparation of the coal and the briquetting proper. In the first part of this process the coal must be separated, crushed and cleaned.

In the crushing of coal various forms of machines may be used, either grinding it by means of an exaggerated coffee mill or passing it between rolls. The rolls formerly used were of cast iron with an irregular surface, very little attention being paid to the details of their construction. The best forms now in use are set with interlocking steel teeth. They do their work thoroughly and effect a consider-
able saving over the older forms. In some places a dis-
integrator of special construction is preferred, the object
being to produce a very fine coal of uniform size and homogeneity.

The cleaning of the coal is usually done by washing, by which the coal is freed from its clay, sand and pyrite. Thus a considerable reduction in the percentage of ash is effected. In some cases it amounts to a reduction from twenty-five to five per cent. A process of dry cleaning is known which, while it costs more to install the plant, effects a diminution as high as twenty per cent in the cost of cleaning, the whole cost of drying being saved.

The bond used is a matter of considerable importance. So far it has not been found practicable to make a good briquette without bond from bituminous coal, though it may be done with some other forms of coal. Practically but two bonds are largely used at present, one being pitch and the other magnesia cement. In the plant of the Anthracite Pressed Fuel Company, of Mahanoy City, Pa., eight per cent of pitch is added to ninety-two per cent of pure anthracite coal. The pitch, while usually more expensive, has several advantages over the magnesia cement. The latter does not increase the heating power of the coal and adds considerably to the percentage of ash. In mixing the bond with the coal heat is in most cases required. If pitch be used it may be pulverized and mixed with the coal dust and then the mixture raised to a suitable temperature, preferably by superheated steam, or either or both may be heated separately. It is, of course, important that the two materials be thoroughly mixed. This may be accomplished by a modified form of the pug mill used in clay work. The pressure is applied in different ways, depending on the intended form of the product. In considering the form to be adopted the object for which the particular briquette is to be used must be
It may be said in general, however, that an irregular form is usually found better, especially for domestic use. Such a form does not allow the coals to pack tightly enough to exclude a natural draft. In the briquettes made on the Loisseau press, which is in use at several points in North America, the material is pressed into egg form. This is accomplished by passing the mixture between two heavy rolls whose faces contain semi-oval cavities, arranged so that the two halves on the opposite rolls match. The other forms, cubical, oblong and irregular, are produced by presses of various kinds which do not vary much in principal from each other, and are essentially modified forms of the hydraulic press. The power used is usually steam.

It is of importance that briquettes should be of a size easily handled, so as to avoid loss in transportation or breaking in the fire, they must have a low per cent of ash and moisture and must be easily kindled and burn with a lively and as nearly as possible smokeless flame. The superiority of such a fuel for the better kinds of domestic use is apparent at once. Another superior point is the well proven fact that briquettes have a higher heating power than the coal from which they are manufactured, and that, too, more than can be attributed to the addition of the pitch in the bond. It seems probable that the preliminary cleaning of the coal as well as the form in which it is put has considerable to do with this. A more complete combustion is obtained. Another advantage is in the fact brought out by its use in the French marine that it is possible to stow in the same space ten per cent more briquettes than coal.

The cost of manufacture will of course be largely a controlling factor in the introduction of briquettes. Some
years ago the Whitebreast Coal Company experimented at its mines, in Monroe county, upon briquetting coal for steam purposes. It was decided that, while the briquettes could be made readily, the profit was not great enough to warrant the erection of a plant. This was, so far as now known, the first series of experiments on a large scale which were carried on with the western coals.

More recently the Fuels Patent Company have established a plant at Huntingdon, Arkansas, which is in successful operation. The Anthracite Pressed Fuel Company, at Mahanoy City, Pa., are producing an excellent fuel from anthracite waste, at a cost of $1.80 per ton. A number of other plants have been recently erected and it seems probable that this fuel will grow in favor.

A considerable amount of anthracite coal is annually imported into Iowa, being used largely for base burners and other domestic uses where a considerable heat with little ash is desirable. This coal brings a high price, usually from $7.00 to $9.00 per ton. The consumer is willing to pay the extra price because of its better heating qualities, cleanliness and the little care needed in burning it. It seems probable that briquettes properly made would be able to command a large share of this trade. The competition the new fuel would meet would not be with the bituminous coal used for steam, but with the more expensive anthracite. The cleanliness and many other advantages which such a fuel possesses renders it especially desirable for open fires.