

**UNITED STATES GEOLOGICAL SURVEY,
BULLETIN NO. 339, THE PURCHASE OF COAL
UNDER GOVERNMENT AND COMMERCIAL
SPECIFICATIONS ON THE BASIS OF ITS
HEATING VALUE, WITH ANALYSES OF COAL
DELIVERED UNDER GOVERNMENT CONTRACTS**

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GEORGE OTIS SMITH, DIRECTOR

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AND COMMERCIAL SPECIFICATIONS ON THE
BASIS OF ITS HEATING VALUE

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THE PURCHASE OF COAL UNDER GOVERNMENT AND COMMERCIAL SPECIFICATIONS ON THE BASIS OF ITS HEATING VALUE.

By D. T. RANDALL.

INTRODUCTION.

The people of this country have been purchasing coal for years on the statement of the selling agent as to its quality, or on the reputation of the mine or district from which it was obtained. The farmers of the country show more business judgment in the purchase of fertilizer than do many manufacturers in buying coal, for the farmer demands a chemical analysis of the fertilizer before he accepts it.

Until recently there has been but little reliable information regarding the character of the coal supply of the United States. This fact was recognized in the establishment of the fuel-testing plant of the United States Geological Survey at St. Louis in 1904. Extended general investigations have been conducted at this plant and its successors and in the field, and in addition the technologic branch of the Survey has been charged with the duty of analyzing and testing the coals used by the Government.

The Government is a large purchaser of coal, reports from the various Departments indicating that nearly \$6,200,000 is expended each year for fuel. Some time ago the necessity for a more uniform standard in the purchase of coal became apparent and the plan of buying it on the basis of its heating value was introduced in a few Departments. Many of the large commercial consumers in the United States have been purchasing their coal on contracts of this nature for some time.

The present paper summarizes the information on this subject obtained by the Survey, including examples of specifications that are now in use and analyses of some of the coal purchased by the Government during the winter of 1906-7.

ADVANTAGES OF DEFINITE SPECIFICATIONS IN THE PURCHASE OF COAL.

Under the old plan of purchasing coal, when the consumer had cause or thought he had cause to find fault with the quality of the fuel he received, he was in many cases assured that it must be good because, like all the other coal sent him, it came from a mine with an established reputation. Such a state of affairs made it difficult to take advantage of the competition which usually results when a considerable number of bidders are asked to submit prices. The purchaser was afraid to buy from any but such dealers as he knew and trusted, because, although each dealer claimed that his coal was equal in quality to that of the others, yet if it did not prove to be satisfactory there was no standard for settlement or for cancellation of the contract. Many thousands of dollars' worth of coal are bought each year in this manner, but the purchasers would consider it ridiculous if they were asked to contract for a building with no specifications and simply on the agreement that it should be of a certain size and well constructed. Neither would they buy gold, silver, or even copper and iron ores on the mere information that they were mined at certain localities. All products of mines are now purchased to a great extent on the basis of their value as shown by chemical analysis. This is true of coal in only a small degree, but the number of contracts made on this basis is increasing every year.

The purchase of coal on a specification is as advantageous as a definite understanding regarding the quality and other features of any other product, or of a building operation or engineering project. The man who buys under a specification gets what he pays for and pays for what he gets.

When the bidder is allowed to specify the quality of the coal he proposes to furnish as determined by a chemical analysis, he is placed on a strictly competitive basis with other bidders. Such a procedure broadens the field for both the bidder and the purchaser. It makes the bidder's proposal, when accepted, a contract that specifies an established standard of quality. This furnishes a basis for settling disputes regarding the quality of the coal delivered and the price to be paid if the fuel is either better or poorer than has been guaranteed. If other coal must be substituted, as often happens, there is a standard for settlement. If the coal is uniformly poorer than the standard as specified there is a basis for cancellation of the contract.

The quality of coal from a given mine may vary from time to time through the failure of the miners to reject impurities. Sometimes different beds of coal are mined at the same time and the output is mixed. When there is need of further preparation, such as picking

slate and other impurities, or jigging or washing, a great deal depends on the care used in these processes. The mining companies are responsible in a large measure for variations in the grade of prepared coal. The purchase of coal under a contract on the basis of quality stimulates the operator to make a better preparation of the coal before it is shipped to market. An example of fluctuations in quality is furnished by the tables on pages 24-26, which show variations in the ash and British thermal units in coal delivered to some of the Government Departments at Washington.

It evidently will not be satisfactory to either the buyer or the seller to establish a standard for the coal unless this liability to variation is recognized and provision made for settlement when the coal is better or poorer than the standard. Experience with any method of buying coal shows that it will seldom be rejected when of poor quality, because of the difficulty, delay, and cost of removing it from the bins. The buyer is often confronted with the alternative of burning the coal delivered or going without fuel until more can be procured. Unless the coal is very bad it is usually expedient to use it and pay a smaller price. This is also more favorable to the contractor, as to remove the coal would be costly and it would not be satisfactory as fuel to any other customer.

VALUE OF COAL AS A FUEL.

The purpose of burning coal under boilers is to abstract the heat for use in developing power, in drying various materials, or in warming buildings. The most valuable coal, therefore, is that which gives up the most heat to the boiler for a given weight burned.

Coal is now burned for power purposes in gas producers and boiler furnaces. For coals and lignites high in moisture or high in ash, the gas producer, used in connection with a gas engine, is best adapted to develop power. But for the generation of steam, which can be used for heating as well as for power purposes, a more convenient method is to burn the coal in a specially constructed furnace under a boiler.

The aim in the purchase of coal for any power plant should be to obtain a fuel which will produce a horsepower for the least cost, all things being considered, such as the equipment, the price of coal, and the cost of labor and repairs. Experiments have been made which seem to indicate that almost any fuel may be burned with reasonable efficiency in a properly designed apparatus. The recognized requirements are as follows:

A supply of fuel fed to the furnace as uniformly and continuously as possible.

An air supply slightly in excess of the theoretical amount required for complete combustion.

A sufficiently high temperature to ignite the gases which are driven off from the fuel.

A complete mixture of these gases with the air supplied before they reach a cooling surface, such as the shell or tubes of a boiler.

Some of the factors which may influence the commercial results obtained in a boiler are the cost of the coal, as determined by price and heating value; care in firing; design of the furnace and boiler setting, size of grate, etc.; formation of excessive amounts of clinker and ash; draft available; size of the coal (uniformity of size is desirable).

The value of a coal is indicated by the number of heat units it contains. This heating value is expressed in terms of British thermal units* (abbreviated B. t. u.) per pound of coal, and is determined by means of a special apparatus called a calorimeter.

When coal is mined it contains moisture to a greater or less extent. It is exposed to the air in shipment and may either dry out or be drenched by rain. The moisture in the coal delivered is worthless to the purchaser, and really costs him a considerable amount in freight and cartage, and in the loss of the heat absorbed during its evaporation in the furnace. If all coal had the same proportion of moisture, or if the moisture in coal delivered by a given dealer was constant in amount, the purchaser's problem, so far as this factor is concerned, would be simplified. Under present conditions the moisture is an important element in the valuation of a ton of coal. It is evidently necessary to consider the coal just as it is received in order to determine its value to the consumer, but chemical reports should be made on the basis of both the "dry coal" and the "coal as received." The dry-coal basis is convenient for comparing several coals in regard to the relation of each element to the others; this is important because the moisture in the same coal varies from day to day. The dry-coal basis is also convenient for comparing the performance of boilers when burning the same or similar coals. Of several coals having a similar composition, the one which has the least moisture and the least ash will generate the most steam when burned under a boiler.

Ash is made up of earthy matter and other impurities which will not burn. In commercial coals its proportion may range from 4 to 25 per cent. Coals containing small percentages of ash are most valuable, not only because of their correspondingly higher heating capacity, but because there is less resistance to the free and uniform distribution of air through the bed of coal. The labor and cost of managing the fires and of handling the ashes are also correspondingly

* The British thermal unit is the amount of heat required to raise the temperature of 1 pound of water 1° Fahrenheit.