Ash and Calorimeter Tests of Coal Purchased by Indiana University.

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Coal is purchased by Indiana University under a contract that all coal with ash greater than 15 per cent. shall be rejected. The analyses given in this paper represents the ash tests (and some determinations of British Thermal Units, B. T. U.) of the nut and slack coal which has been delivered by the Summit Mine under this contract.

The sampling was done by an employe of the University in the following manner: The coal from six holes, each about 1.5 feet deep which were dug at uniform intervals into the car of coal, was mixed thoroughly. This large sample weighed 50-75 pounds. After the large lumps had been broken, the sample was quartered until about one pint remained. This sample was then brought to the laboratory.[1] The analyses are upon samples dried at 103 to 110 degrees Centigrade for 0.5 hour. A Parr calorimeter was used in determining the British Thermal Units.

The results are as follows:

	No. of cars analyzed.	Dates between which delivered.	Maximum.	Minimum.	Average.
B. T. U.	148	9/1/09 & 7/16/10	13,470	11,525	12,719
Ash %	276	9/1/09 & 6/20/11	22.6	6.37	11.647

The ash determinations when averaged by months are as follows:

September, 1909, 10.66; October, 10.53; November, 10.97; December, 16.64.

January, 1910, 11.25; February, 12.35; March, 11.39; April, 11.50; May, 11.88; June, 10.26; July, 13.32; October, 11.80; November, 13.15; December, 10.81.

January, 1911, 10.76; February, 10.07; March, 12.37; April, 11.41; May, 11.33.

[1] The analysis of the sample obtained by taking portions of coal from each wagon load from a car did not differ materially from the analysis of the sample obtained from the car in the manner described. This showed that the method of sampling was accurate.

There is no relation between time of year and low ash values. This indicates that the variation in ash and heating value is due to variation in the quality of the coal and not to any greater carelessness in mining due to rush periods, since high ash tests do not coincide with winter months.

These determinations are presented on account of their value. They represent actual coal and show exactly[1] the kind of coal that can be delivered to customers. Many of the samples of coal which are furnished by the mine operators for analysis are improperly taken and do not represent the average character of the coal. A small sample taken in a mine will almost always show a better analysis than a sample taken from a car. The official taking the sample leaves out the slate and takes only the coal. The miner puts in the car as much slate as the boss will allow. A black, shiny lump of coal, picked up at random and submitted for analysis will show a higher grade than the dull, lusterless pieces. A United States bulletin advises mine officials to have analyses made of samples taken from cars and warns them that analyses of samples taken from mines will generally show a quality which cannot be reached in car lots. For example, the analyses of coals "from nineteen of the leading mines of the State[1] (Indiana)" show an average ash of 6.09 per cent. The analysis of coal from the Summit Mine as given in the same report shows 5.42 per cent. ash on the dry basis. No analysis in this laboratory of samples of Indiana coal, which were known to be accurately taken from cars, has shown such a low ash. Of course nut and slack coal is higher in ash and lower in B. T. U. than run-of-mine coal, but the difference between 11.64 and 6.09 in ash is greater than really exists between the two grades of coal.

It is of value to compare this Indiana coal with the coal purchased by the United States under rigid tests and specifications during the year 1908-9. The following table shows the analyses of bituminous coals which were delivered under these specifications. The analyses of the coal purchased by Indiana University are also included in the table.

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[1] The rejected cars are included in the averages.

[1] 31st Annual Report of Indiana Department of Geology and Natural Resources, page 21 (1906).

State	Ash.	B. T. U. (Average for each State.)
Pennsylvania	7.85	14,321
West Virginia	6.06	14,715
Illinois	13.33	12,437
Alabama	9.50	13,917
Virginia	5.40	14,941
Maryland	7.81	14,480
Average of the six States	8.325	14,133.5
Indiana	11.64	12,719

All the coal received by the United States Government from Virginia and West Virginia had percentages of ash 0.03 and 0.69 lower respectively than the average ash from "nineteen of the leading mines of the State (Indiana)."[1] Pennsylvania coal showed 1.70% more ash than the Indiana coal. No one thinks that Indiana coal is as good as comparisons from these analyses indicate. However, if Indiana coal is given the value of 11.64% ash and 12,719 B. T. U., it will occupy a position where it seems to belong. While there are objections to Indiana coal, nevertheless it makes a good showing when compared with the eastern coals, which are actually of a higher grade. A maximum number of heat units for a dollar is what one wishes in a coal and "* * * it is possible to burn coal of low heating value as efficiently as high grade coals."[2] Indiana coal, as delivered, generally contains more moisture than eastern coal, say 10 per cent. in the place of 3 per cent. There is, say 1 per cent., additional expense for the extra cost of handling the greater amount of ash in the Indiana coal. This gives eastern coal an advantage of, say 8 per cent., over Indiana coals, i. e., if two samples of coal (dried at 103 degrees Centigrade) have equal calorimetric value, the Indiana coal, as delivered (with the water in it) is worth 8 per cent. less than the eastern coal. The B. T. U. values of Indiana coal, after deducting 8 per cent. for the excess of water and ash, were compared with the B. T. U. values of coals from the different States which are represented in the United States Purchase Bull.[3]

If one ton of Indiana coal is worth $2.00; then
One ton of Pennsylvania coal is worth $2.45;
One ton of West Virginia coal is worth $2.52;

[1] Indiana Geological Report, loc. cit.
[2] U. S. Geol. Survey Bull., No. 325, p. 94. "Four Hundred Steaming Tests."
[3] Loc. cit.

One ton of Illinois coal is worth $1.95;

One ton of Alabama coal is worth $2.38;

One ton of Virginia coal is worth $2.55;

One ton of Maryland coal is worth $2.48.

This gives a method of figuring the value in dollars and cents of eastern coals compared with Indiana coal. This table is for average values of many grades of eastern coal, but for only one coal from Indiana.

For example, if one ton of this Indiana nut and slack costs $1.60, the value of one ton of Pennsylvania coal (7.85% ash and 14,321 B. T. U.) is (160 x 245) /200, or the eastern coal is more economical, if it costs less than 196 cents.

If Virginia coal is $2.50 per ton, then Indiana coal is more economical if it costs less than (250 x 200) /255, or 196 cents per ton.

Summary.

The nut and slack coal which has been delivered to Indiana University from the Summit Mine showed an average ash of 11.64% and an average B. T. U. of 12,767.

A comparison of this coal with the coal purchased by the United States during the year 1908-9 shows that the Indiana coal is inferior to the coal from Virginia, West Virginia, Pennsylvania, Maryland, Alabama, but superior to that from Illinois.

A method is given for calculating from the B. T. U. the relative value of Indiana coal compared with eastern coal.

This article is an attempt to show the real worth of Indiana coal and to make clear the errors due to inaccurate sampling. The buyer of coal should know exactly what he purchases. Eastern coal has been incorrectly sampled, the same as Indiana coal. Analyses and method of sampling given in the Government bulletin are without doubt correct. Analyses of Indiana coal from samples incorrectly taken are worthless for use in calculating the comparative values of the coals and should not be given the least weight or consideration by a purchaser of coal.

It is urged that coal samples for analysis be taken from cars by some one who understands sampling.

The figures given in this paper for Indiana coal are not assumed to be average values, since coal from only one mine is represented. The average value of Indiana coal can not be determined without making a series of analyses of proper samples from many Indiana mines.

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