RI bureau of mines
report of investigations 7421



# PREDICTION OF COAL GRINDABILITY FROM EXPLORATION DATA


UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

August 1970

# PREDICTION OF COAL GRINDABILITY FROM EXPLORATION DATA

By Manuel Gomez and Kathleen Hazen

* * * * * * * * * * * * report of investigations 7421


UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

This publication has been cataloged as follows:

Gomez, Manuel, 1921-

Prediction of coal grindability from exploration data, by Manuel Gomez and Kathleen Hazen. [Washington] U.S. Dept. of the Interior, Bureau of Mines [1970]

34 p. illus., tables. (U.S. Bureau of Mines. Report of investigations 7421)

1. Coal—Analysis. I. Hazen, Kathleen, jt. auth. II. Title. (Series)

TN23.U7 no. 7421 622.06173

U.S. Dept. of the Int. Library

CONTENTS



ILLUSTRATIONS



TABLES

# PREDICTION OF COAL GRINDABILITY FROM EXPLORATION DATA

by

Manuel Gomez[1] and Kathleen Hazen[2]


## ABSTRACT

A general prediction model for the Hardgrove grindability index was constructed from 735 coal samples using the proximate analysis, heating value, and sulfur content. The coals used to develop the general model ranged in volatile matter from 12.8 to 49.2 percent, dry basis, and had grindability indexes ranging from 35 to 121. A restricted model applicable to bituminous coals having grindabilities in the 40 to 110 range was developed from the proximate analysis and the petrographic composition of the coal. The prediction of coal grindability within a single seam was also investigated.

The results reported support the belief that mechanical properties of the coal are related to both chemical and petrographic factors of the coal. The mechanical properties of coal may be forecast in advance of mining because the variables used as input to the prediction models can be measured from drill core samples collected during exploration.


## INTRODUCTION

The Hardgrove grindability test[3] is one of several procedures developed to measure the hardness, strength, and fracture properties of coal. It has come into wide use as a measure of the relative ease of grinding coal.

Callcott[4] observed that the grindability test is a measure of a strength characteristic of coal particles and is related to the physicochemical properties of the coal. The index has been found to be related to coal rank.[5]

---

[1]Research chemist, Mine Systems Engineering Group, Bureau of Mines, Denver, Colo.

[2]Chemist, Mine Systems Engineering Group, Bureau of Mines, Denver, Colo.

[3]American Society for Testing and Materials, ASTM Standards on Coal and Coke. Standard Method of Test for Grindability of Coal by the Hardgrove-Machine Method. ASTM Designation D409-51. Philadelphia, Pa., 14th ed., December 1962, pp. 115-118.

[4]Callcott, T. G. Coal Grindability--A Standardized Procedure for the Determination of Coal Grindability and a Survey of the Grindabilities of British Coals. J. Inst. Fuel, v. 29, 1956, pp. 207-217.

[5]Brown, R. L., and F. J. Hiorns. Mechanical Properties. Ch. in Chemistry of Coal Utilization, ed. by H. H. Lowry. John Wiley & Sons, Inc., New York, 1963 (suppl. volume), pp. 119-149.

Coal hardness is known to be influenced by petrographic composition.[6] Peters and coworkers[7] reported that the total tough coal, defined as the sum of the micrinoids, resinoids, and exinoids, was related to the microstrength index. A later report by Terchick and coworkers[8] revealed that for bituminous coals the microtumbler strength correlated well with the grindability index.

It has been shown[9] that the power required by a continuous miner to rip Pittsburgh-seam coal is related to the petrographic properties of this coal and its microstrength index. It appears likely, therefore, that grindability along with the petrographic composition of the coal, should be useful as predictors of the power required for mining coal using a continuous miner.

Leonard[10] correlated the coke physical strength index of stability with coal volatile matter and grindability. He suggested that individual coal producers might upgrade the quality of their product by taking advantage of differences in coal grindability. By controlling production from various mine sections and/or by mining selected elevations at coal faces, it appeared possible to quality control the mine output on the basis of grindability to produce a product capable of yielding stronger coke.

A later report[11] indicated that bulk density and pulverization level, in addition to grindability and volatile matter, influenced coke stability. It was observed that, for coals above approximately 36 to 37 percent volatile matter, the quantities of hard and soft constituents as measured by the Hardgrove grindability index become important when defining coal rank for correlation to the coke stability index.

Since the mechanical properties influence both the mining and utilization of the coal, it appeared desirable to develop a mathematical model that would permit prediction of the grindability index in advance of mining. Forecast of this index would provide information for mine design, as well as allow advanced planning for preparation, handling, and utilization of the coal. This information is necessary to achieve one of the principal objectives of the Bureau of Mines program: To design optimum, total mining systems for mining problems and programs of national scope and importance.

---

[6] Harrison, J. A. Application of Coal Petrography to Coal Preparation. Trans. SME, v. 226, December 1963, pp. 346-357.

[7] Peters, J. T., N. Schapiro, and R. J. Gray. Know Your Coal. Trans. AIME, v. 223, 1962, pp. 1-6.

[8] Terchick, A. A., R. W. Shoenberger, B. Perlic, and L. F. DeRusha. Mechanical and Related Properties of Some Eastern Coals. Preprints of Papers pres. at the 145th Nat. Meeting ACS, Div. Fuel Chem., New York, Sept. 8-13, 1963. V. 7, No. 2, pp. 95-109.

[9] Work cited in footnote 7.

[10] Leonard, J. W. Grindability Tests--Short Cut to Blending Coals for Strong Coke. Min. Eng., v. 16, No. 3, 1964, pp. 45-47, 60.

[11] Leonard, J. W. Advanced Work on the Determination of Coke Stability From Coal Hardgrove Grindability Index, Bulk Density, Pulverization Level, and Volatile Matter. Trans. AIME, v. 232, 1965, pp. 45-48.

## DISCUSSION AND RESULTS

### Data Analyzed

The variables used to construct the prediction model for the Hardgrove grindability index are presented in table 1. This tabulation includes the range, mean, and standard deviation for each of the seven independent variables listed. The data represent Bureau of Mines published analyses of tipple and delivered samples for fiscal years 1951 and 1952.[12] Complete data were available for 735 samples.

TABLE 1. - Range of values for variables used to construct grindability prediction model

| Variable | Range | | Mean | Standard deviation |
|---|---|---|---|---|
| | Low | High | | |
| Heating value, moist, mineral-matter-free.....Btu.. | 6,506 | 15,571 | 13,976.3 | 1,576.1 |
| Fixed carbon, dry, mineral-matter-free.....percent.. | 45.7 | 87.6 | 63.70 | 8.64 |
| Moisture, as-received.....do..... | 1.3 | 43.8 | 6.51 | 6.23 |
| Volatile matter, dry.....do..... | 12.8 | 49.2 | 33.59 | 7.75 |
| Fixed carbon, dry.....do..... | 37.4 | 81.4 | 56.55 | 7.79 |
| Ash, dry.....do..... | 1.9 | 24.0 | 9.87 | 3.31 |
| Sulfur, dry.....do..... | 0.2 | 8.7 | 1.75 | 1.25 |
| Hardgrove grindability index..... | 35 | 121 | 66.9 | 20.6 |

The coals represented by this population ranged in volatile matter from 12.8 to 49.2 percent, dry basis, in moisture from 1.3 to 43.8, percent, as-received basis, and in sulfur from 0.2 to 8.7 percent, dry basis. This range of coals includes most of the coals currently mined in the United States.

All independent variables listed in table 1 may be measured from drill core samples collected during exploration. Drill core samples are useful to study the chemical, physical, and petrographic characteristics of the coal along both the vertical and horizontal aspects of the seam. This information is useful to interpret the effect of seam characteristics on the breakage properties of the coal, on the mining rate, and on the operation of the mining equipment.

### Development of Mathematical-Statistical Models

No theoretical models were available; therefore, empirical nonlinear models were constructed in several steps. Initially, the linear correlation

[12] Aresco, S. J., and C. P. Haller. Analyses of Tipple and Delivered Samples of Coal (Collected During the Fiscal Year 1951). BuMines Rept. of Inv. 4934, 1953, 93 pp.
Aresco, S. J., and C. P. Haller. Analyses of Tipple and Delivered Samples of Coal (Collected During the Fiscal Year 1952). BuMines Rept. of Inv. 4972, 1953, 84 pp.

coefficients were computed for the independent variables listed in table 1 and for transformations of these independent variables. The independent variables and the transformed variables having the highest correlation with the dependent variable were selected for regression analysis.

The first step in the construction of empirical models presented in this report was to decide on various mathematical forms (that is, trigonometric, exponential, logarithmic, etc.) of the independent variables selected as input to various models. The necessary transformation on the independent variables were then made, and the linear correlation coefficients were computed. This procedure was necessary to determine the intercorrelations between the independent variables and to determine the correlations between those independent variables that would quite likely contribute most to the reduction in variance of the dependent variable.

Based on this information, the partial regression coefficients for the independent variables of the model were determined by stepwise regression. The stepwise regression method was used because as new variables are added to the model the resulting solution of coefficients and the relationships between the independent and dependent variables may be easily followed. The intermediate models were obtained by adding one variable at a time. The variable added was the one that produced the greatest reduction in variance of the parameter of interest. At each step the remaining unexplained standard error (variance) of the dependent variable, the $R^2$ or multiple correlation coefficient squared (fraction of the total variance in the dependent variable explained by the independent variables included in the model), and the standard error for each partial regression coefficient was computed.

The process was repeated with nonsignificant variables eliminated and other variables introduced until a minimum standard error of the predicted value or a maximum $R^2$ was obtained. After each successive model was formed, variables with a computed t-test of less than about 0.5 were considered insignificant and eliminated from the model. Although a t-test with 25 or more degrees of freedom would be approximately 2.0, the lower limits were used because experience has shown such variables do contribute to the reduction in variance. Other variables were then decided upon and another complex model was constructed. This process was repeated until the fraction of the variance, in the dependent variable, explained by the model was greater than 0.9 ($R^2$ = 0.9 or 90 percent). It was felt the experimental error in the data was something less than 10 percent, and therefore a model which explained 90 percent or more of the variance was sufficient. The final selection of the desired model was made after an examination of the individual residuals (residual = actual value minus predicted value), in which the model giving the minimum residuals was chosen. The model selected was then evaluated to predict the parameter of interest within the range of the experimental data.

## Prediction of Hardgrove Grindability Index

The model selected for prediction of coal grindability follows:

$$\begin{aligned}
\text{Hardgrove grindability index} = {} & 1.2905645 \times 10^{3} + 48.887035\,(\text{WAT}) \\
& + 29.087288\,(\text{AD}) + 860.48021\,(\text{VD/FX}) + 132.75922\,(\text{SL}) \\
& - 4.4491717\,(\text{FC}) - .83831248\,(\text{WAT} \times \text{VD}) - 1.3516192\,(\text{WAT} \times \text{SL}) \\
& - .26852324\,(\text{AD} \times \text{VD}) - 25.086544\,(\text{AD} \times \text{VD/FX}) \\
& - .63219884\,(\text{AD} \times \text{SL}) + 3.1813304 \times 10^{-3}\,(\text{AD} \times \text{BT}) \\
& - 1.5980983\,(\text{VD} \times \text{SL}) + .92516776\,(\text{VD} \times \text{FC}) \\
& - 2.4358097 \times 10^{-3}\,(\text{VD} \times \text{BT}) - 1.1301949\,(\text{SL} \times \text{FC}) \\
& - 1.1068219 \times 10^{-3}\,(\text{FC} \times \text{BT}) + 1.1555370 \times 10^{-3}\,(\text{WAT} \times \text{FC} \times \text{AD}) \\
& + .026097159\,(\text{WAT} \times \text{FC} \times \text{SL}) - 3.1682251 \times 10^{-5}\,(\text{WAT} \times \text{FC} \times \text{BT}) \\
& - 4.7932782 \times 10^{-5}\,(\text{FC} \times \text{BT} \times \text{AD}) + 3.2265178 \times 10^{-8} \\
& (\text{WAT} \times \text{FC} \times \text{BT} \times \text{AD}) + 3.7266704 \times 10^{-7}\,(\text{WAT} \times \text{FC} \times \text{BT} \times \text{VD}) \\
& - 1.9572999 \times 10^{-4}\,(\text{WAT} \times \text{FC})^{2} + 4.3494489 \times 10^{-8}\,(\text{WAT} \times \text{FC})^{3} \\
& + 2.0335521 \times 10^{-3}\,(\text{WAT} \times \text{BT}/1000)^{2} - 4.9464998 \times 10^{-7} \\
& (\text{AD} \times \text{BT}/1000)^{3} + 1.8102988 \times 10^{-7}\,(\text{FC} \times \text{BT}/1000)^{3} \\
& + 1.9722109 \times 10^{3}\left(\text{SL}/e^{\text{SL}}\right) - 1.4488470 \times 10^{6}\left((\text{FC}/4) \,/\, e^{(\text{FC}/4)}\right) \\
& - 1.0301954 \times 10^{4}\left(\text{VD/FX}) \,/\, e^{(\text{VD/FX})}\right) - 2.7609855 \times 10^{3} \\
& \left(\text{SL}/e^{\text{SL}} \times (\text{VD/FX}) \,/\, e^{(\text{VD/FX})}\right) - 190.88758 \\
& \left(\text{SL}/e^{\text{SL}} \times (\text{FC}/4) \,/\, e^{(\text{FC}/4)} \times \text{BT}\right) + .40691093 \\
& \left(\text{BT} \times (\text{VD/FX}) \,/\, e^{(\text{VD/FX})}\right) - 17.062624\left(\text{FC} \times \text{SL}/e^{\text{SL}}\right)
\end{aligned}$$

Where WAT = moisture, as-received, percent; AD = ash, dry, percent; VD = volatile matter, dry, percent; FX = fixed carbon, dry, percent; SL = sulfur, dry, percent; FC = fixed carbon, dry, mineral-matter-free, percent; BT = heating value, moist, mineral-matter-free, BTU.

The model explains 93 percent of the variance and has a standard error of estimate of 5.58. Of the 34 terms contained in the model, 30 were statistically significant at the 95-percent confidence level.

The predicted grindability values for the 735 samples used to construct the model are presented in the appendix. Agreement between predicted and experimental values is close for most of the data shown.

## Evaluation of Grindability Prediction Model

The prediction model was evaluated with independent data; that is, with data that were not used to construct the model. For this purpose, Bureau coal analyses for tipple and delivered samples for fiscal years 1953, 1954, 1955, 1965, and 1966[13] were used. Grindabilities were predicted for 1,029 samples having complete data. These results are presented in figures 1 through 4, respectively. Agreement between experimental and predicted values is good for each of the four sets of data reported. Predicted values for 67 percent of the 1,029 test samples were within ±1 standard error of estimate from the corresponding observed values; 95 percent of the predicted values were within ±2 standard errors of estimate; and 99 percent of the predicted values were within ±3 standard errors of estimate. This information supports the contention that the prediction model is valid for a wide range of coals.

## Development of Grindability Prediction Model for a Single Seam

The development of a grindability prediction model for coal from a single seam was of interest since this situation approximates the examination of a single coal deposit prior to mining. For this purpose, 160 samples from the Lower Kittanning seam in Pennsylvania and West Virginia[14] were considered adequate for study. The independent variables available for model construction included moisture, volatile matter, fixed carbon, ash, sulfur, and the free swelling index.

---

[13]Aresco, S. J., C. P. Haller, and R. F. Abernethy. Analyses of Tipple and Delivered Samples of Coal (Collected During the Fiscal Year 1953). BuMines Rept. of Inv. 5085, 1955, 82 pp.
Aresco, S. J., C. P. Haller, and R. F. Abernethy. Analyses of Tipple and Delivered Samples of Coal (Collected During the Fiscal Year 1954). BuMines Rept. of Inv. 5221, 1956, 77 pp.
Aresco, S. J., C. P. Haller, and R. F. Abernethy. Analyses of Tipple and Delivered Samples of Coal (Collected During the Fiscal Year 1955). BuMines Rept. of Inv. 5270, 1956, 66 pp.
Aresco, S. J., J. B. Janus, and F. E. Walker. Analyses of Tipple and Delivered Samples of Coal Collected During the Fiscal Year 1965. BuMines Rept. of Inv. 6792, 1966, 38 pp.
Aresco, S. J., and J. B. Janus. Analyses of Tipple and Delivered Samples of Coal. Coal Collected During Fiscal Year 1966. BuMines Rept. of Inv. 6904, 1967, 43 pp.

[14]Abernethy, Roy F., and E. M. Cochrane. Free-Swelling and Grindability Indexes of United States Coals. BuMines Inf. Circ. 8025, 1961, 83 pp.

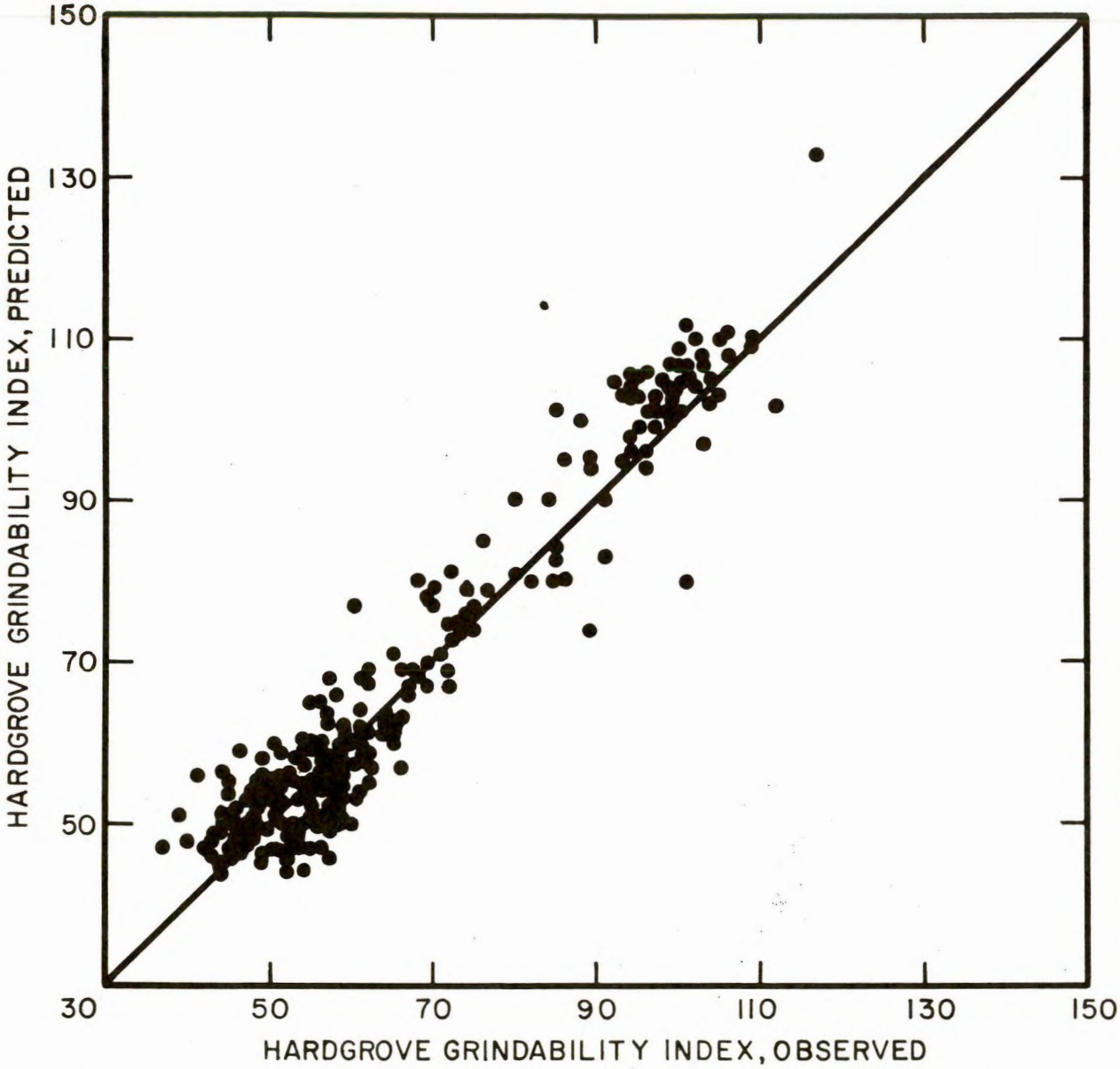


FIGURE 1. - Predicted and Observed Hardgrove Grindability Indexes for Various Mine and Tipple Coal Samples Collected During Fiscal Year 1953.

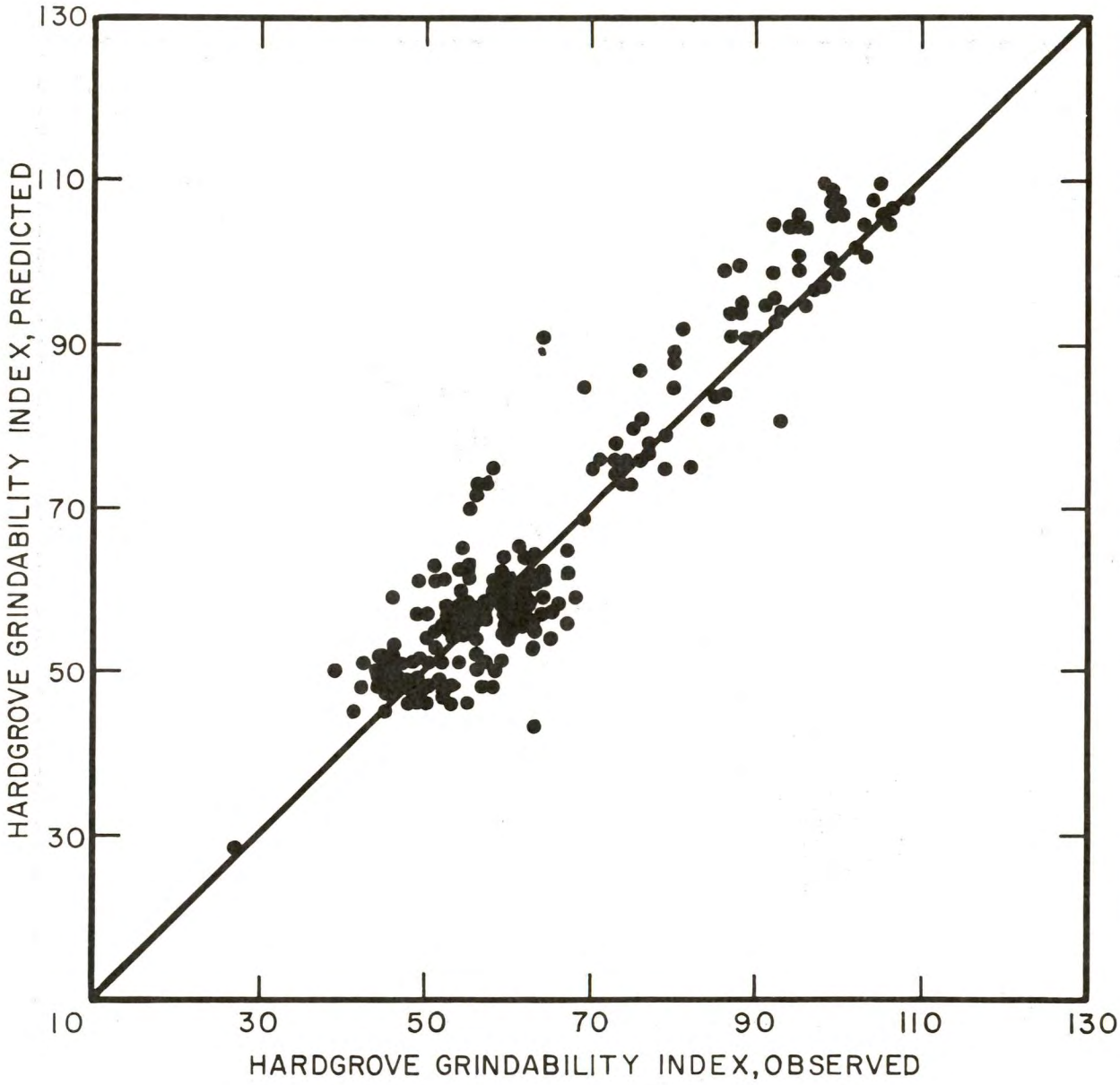


FIGURE 2. - Predicted and Observed Hardgrove Grindability Indexes for Various Mine and Tipple Coal Samples Collected During Fiscal Year 1954.

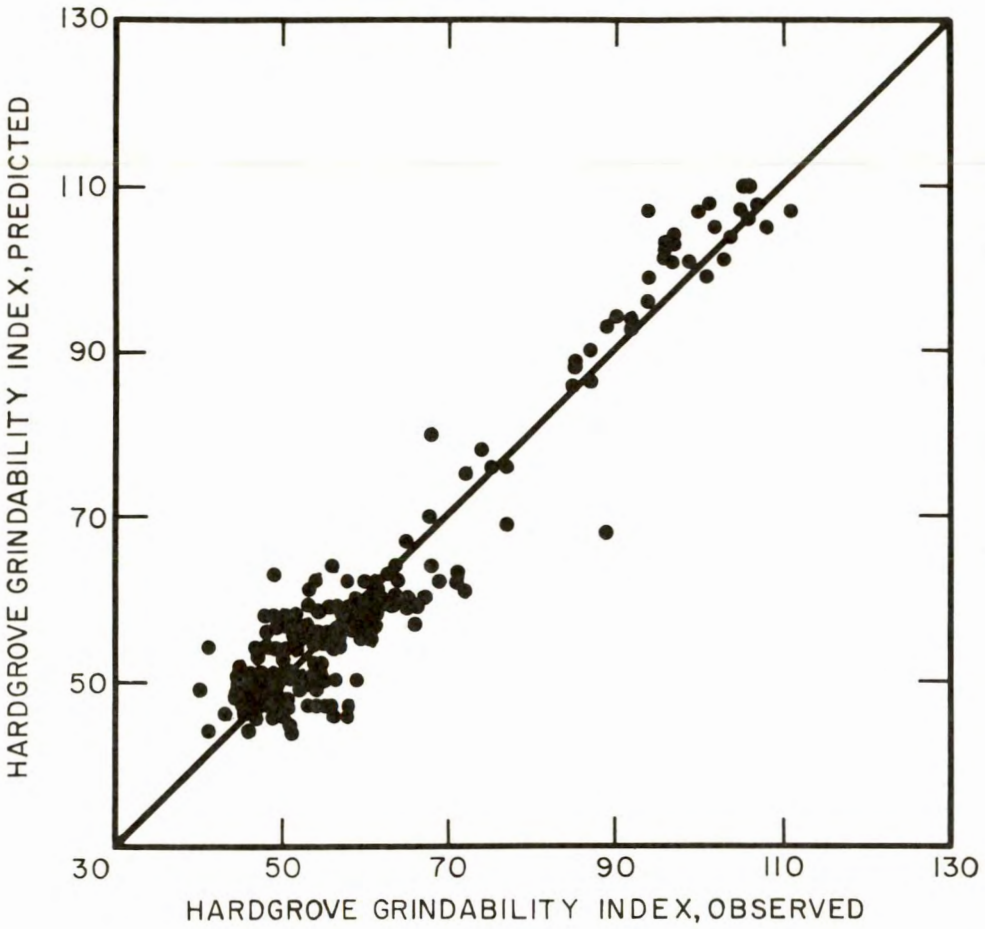


FIGURE 3. - Predicted and Observed Hardgrove Grindability Indexes for Various Mine and Tipple Coal Samples Collected During Fiscal Year 1955.

Data in table 2 present the ranges, means, and standard deviations for the Lower Kittanning seam data. The range of Hardgrove grindabilities for these samples is approximately the same as that reported for the 735 samples in table 1.

TABLE 2. - Range of values for Lower Kittanning seam coal

| Variable | Range | | Mean | Standard deviation |
|---|---|---|---|---|
| | Low | High | | |
| Moisture, as-received...percent.. | 1.0 | 15.3 | 3.52 | 1.77 |
| Volatile matter, dry.....do..... | 16.0 | 39.5 | 25.37 | 6.68 |
| Fixed carbon, dry.....do..... | 50.0 | 75.8 | 64.27 | 7.25 |
| Ash, dry.....do..... | 5.4 | 17.7 | 10.36 | 2.19 |
| Sulfur, dry.....do..... | 0.6 | 5.4 | 2.12 | 1.07 |
| Free swelling index..... | 0.0 | 9.0 | 7.74 | 1.82 |
| Hardgrove grindability index..... | 39 | 117 | 91.0 | 26.6 |

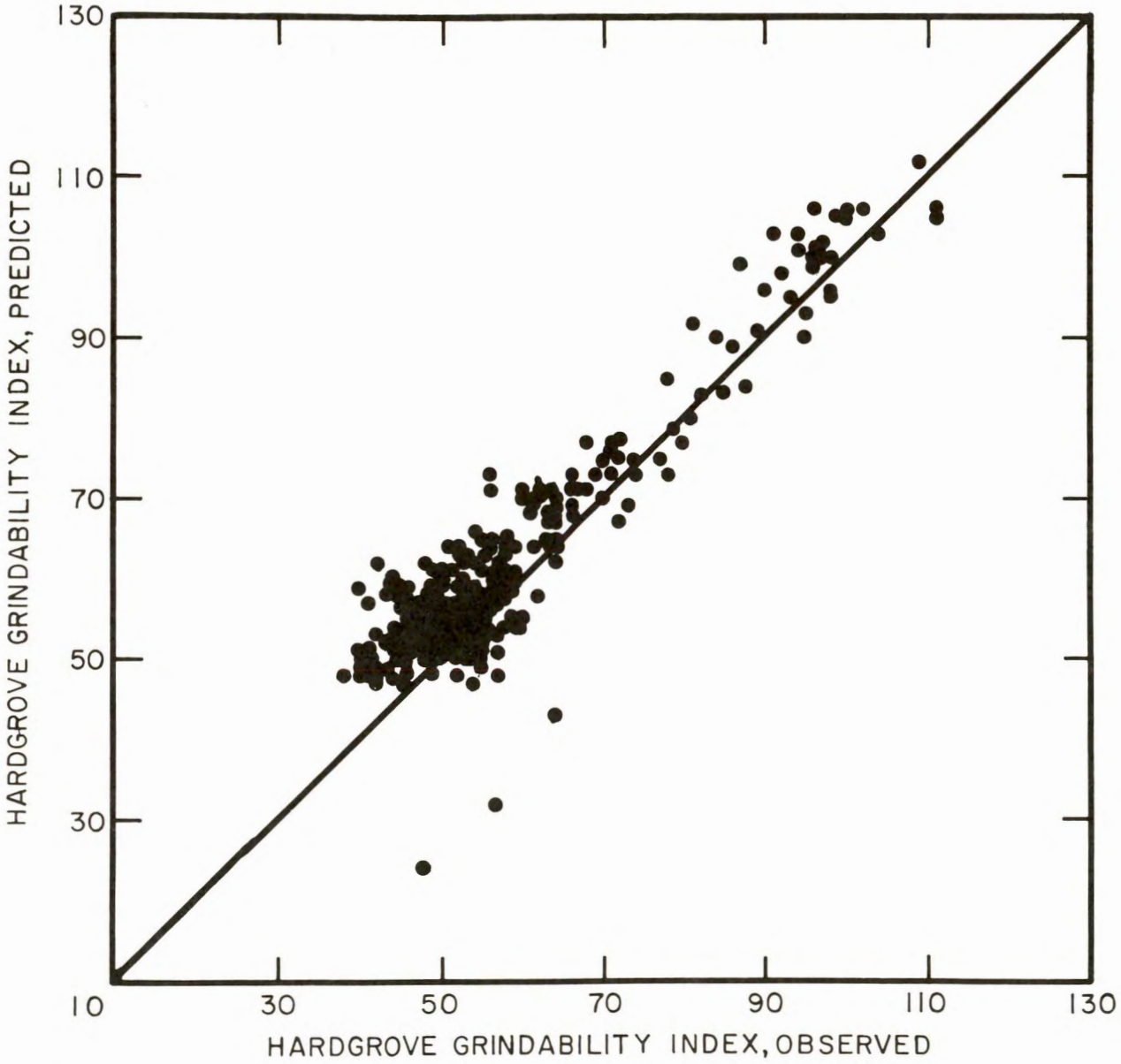


FIGURE 4. - Predicted and Observed Hardgrove Grindability Indexes for Various Mine and Tipple Coal Samples Collected During Fiscal Year 1965 and 1966.

Since the variability shown by data in table 2 was not as large as that exhibited by data in table 1, the construction of a simple model was considered appropriate. The prediction model for Lower Kittanning seam coal grindability follows:

$$\text{Grindability (Lower Kittanning Seam)} =$$

$$+ 328.7519 + 0.11167831\ (\text{WAT})$$

$$- 2503.9253\ (1/\text{VOL}) - 0.00274043$$

$$(\text{AD})^3 + 0.66989154\ (\text{SL})^2$$

$$- 398.3781\ (\text{VOL/FIX}) + 180.82428$$

$$(\text{VOL/FIX})^3$$

Where WAT = moisture, as received, percent;

VOL = volatile matter, maf, percent;

FIX = fixed carbon, maf, percent;

AD = ash, dry, percent; and SL = total sulfur, dry, percent

This model contains the as-received moisture, the moisture- and ash-free volatile matter and fixed carbon, the dry ash, and the dry total sulfur as independent variables.

The free swelling index did not contribute significantly to the reduction in variance for grindability and is not included in the model. The six variable model has a standard error of estimate of 5.71 and a multiple correlation coefficient squared of 0.933.

Observed and predicted grindabilities for the 160 samples used to construct the prediction model are shown in figure 5. Agreement is good for most of the data shown.

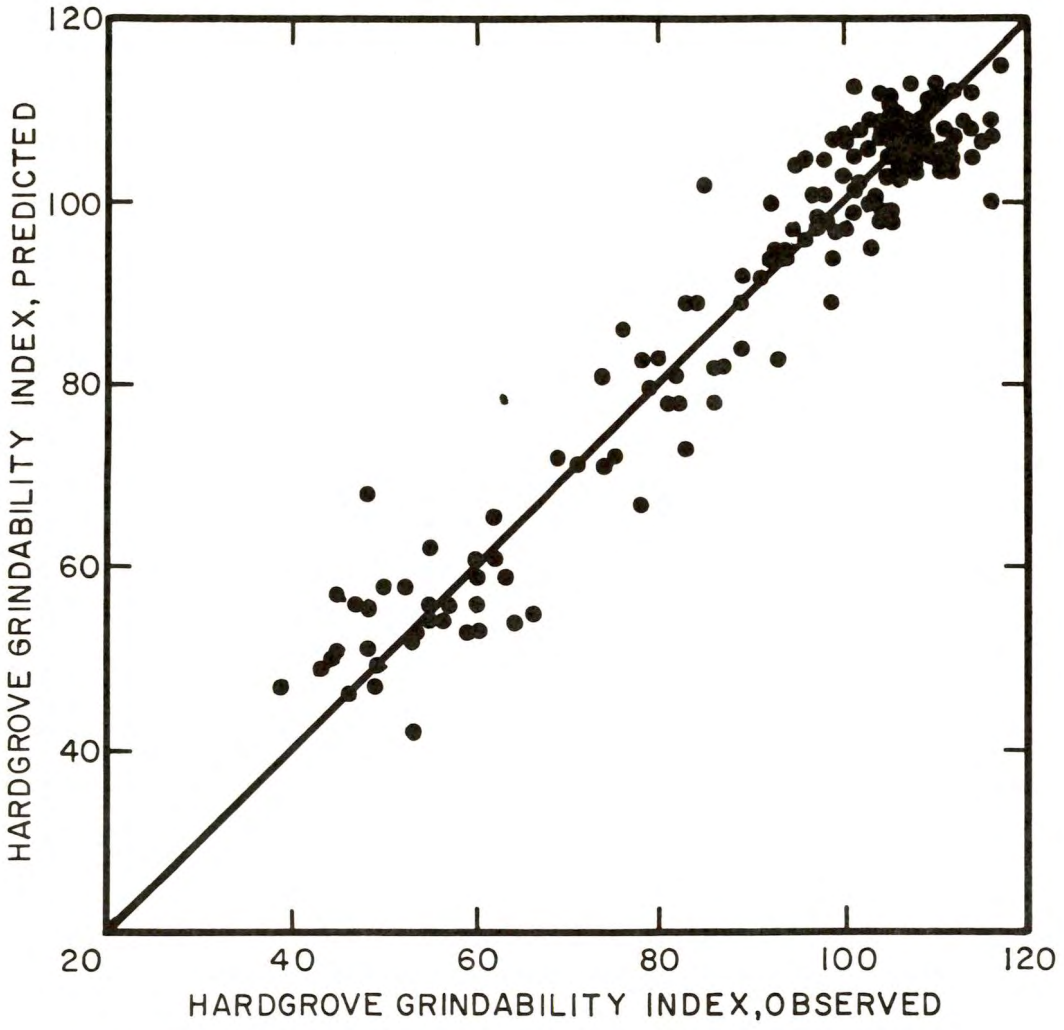


FIGURE 5. - Predicted and Observed Hardgrove Grindability Indexes for Lower Kittanning Seam Coal.

The prediction model for Lower Kittanning seam coal grindability was tested with 39 samples reported by Aresco and coworkers.[15] Observed and predicted grindabilities for these samples are shown in figure 6. The predicted values are in good agreement with the observed grindabilities.

[15]Aresco, S. J., C. P. Haller, and R. F. Abernethy. Analyses of Tipple and Delivered Samples of Coal (Collected During the Fiscal Year 1961). BuMines Rept. of Inv. 6086, 1962, 41 pp.
Aresco, S. J., J. B. Janus, and F. E. Walker. Analyses of Tipple and Delivered Samples of Coal Collected During the Fiscal Year 1962. BuMines Rept. of Inv. 6300, 1963, 46 pp.
Aresco, S. J., J. B. Janus, and F. E. Walker. Analyses of Tipple and Delivered Samples of Coal Collected During the Fiscal Year 1963. BuMines Rept. of Inv. 6461, 1964, 38 pp.
Aresco, S. J., J. B. Janus, and F. E. Walker. Analyses of Tipple and Delivered Samples of Coal Collected During the Fiscal Year 1964. BuMines Rept. of Inv. 6622, 1965, 38 pp.

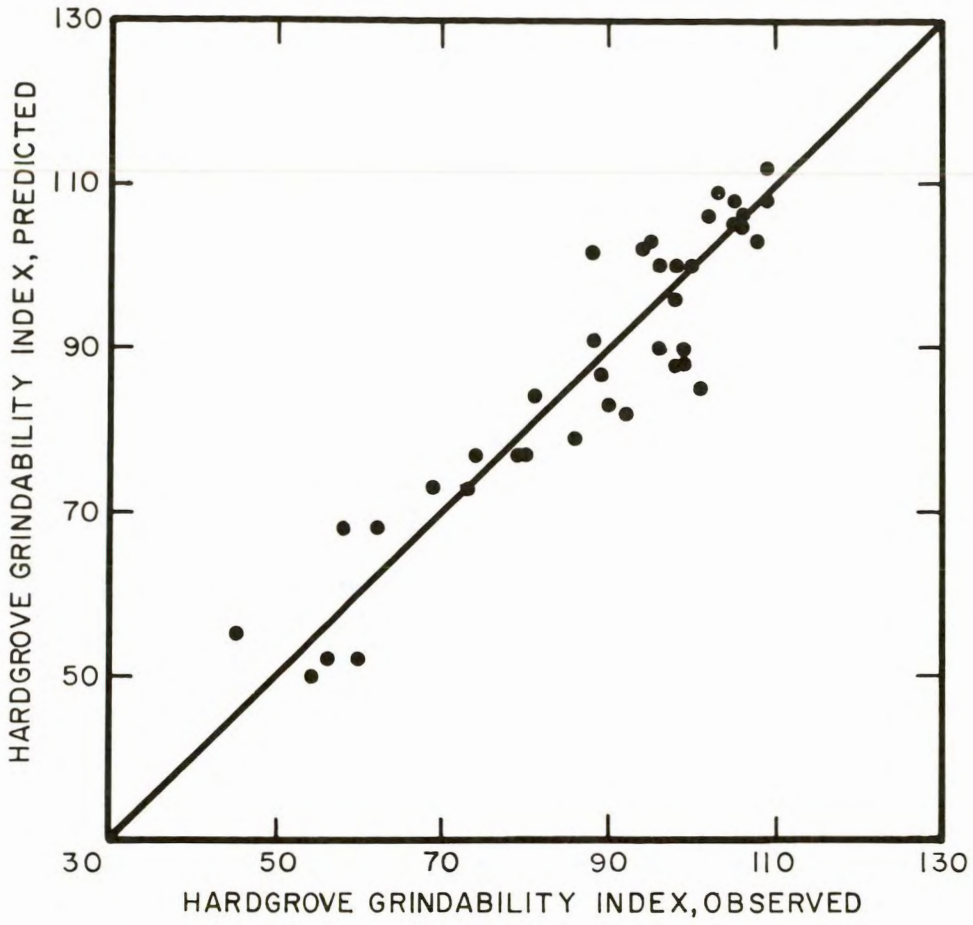


FIGURE 6. - Evaluation of Hardgrove Grindability Index Model for Lower Kittanning Seam Coal.

## Relationship of Grindability to Coal Petrographic Composition and the Proximate Analysis

The petrographic composition of the coal influences its mechanical characteristics. McCabe[16] reported that fusain required the least horsepower for breakage. Vitrain required approximately 2 times the horsepower needed to break fusain; clarain required about 3 times as much; and 7-1/2 times as much power was needed to break durain. Terchick and coworkers[17] obtained a good correlation between the Hardgrove grindability index and the sum of the micrinoids, resinoids, and exinoids from the Pittsburgh seam coal and with high-volatile bituminous coals from eastern Kentucky. With these coals the grindability index decreased as the total micrinoids, exinoids, and resinoids increased. The influence of these petrographic entities on the low-volatile bituminous coal was considered doubtful.

From the foregoing discussion, it was considered pertinent to construct a model for grindability using both the proximate analysis and the petrographic

[16] McCabe, L. C. Practical Significance of the Physical Constitution of Coal in Coal Preparation. J. Geol., v. 50, 1942, pp. 406-410.

[17] Work cited in footnote 8.

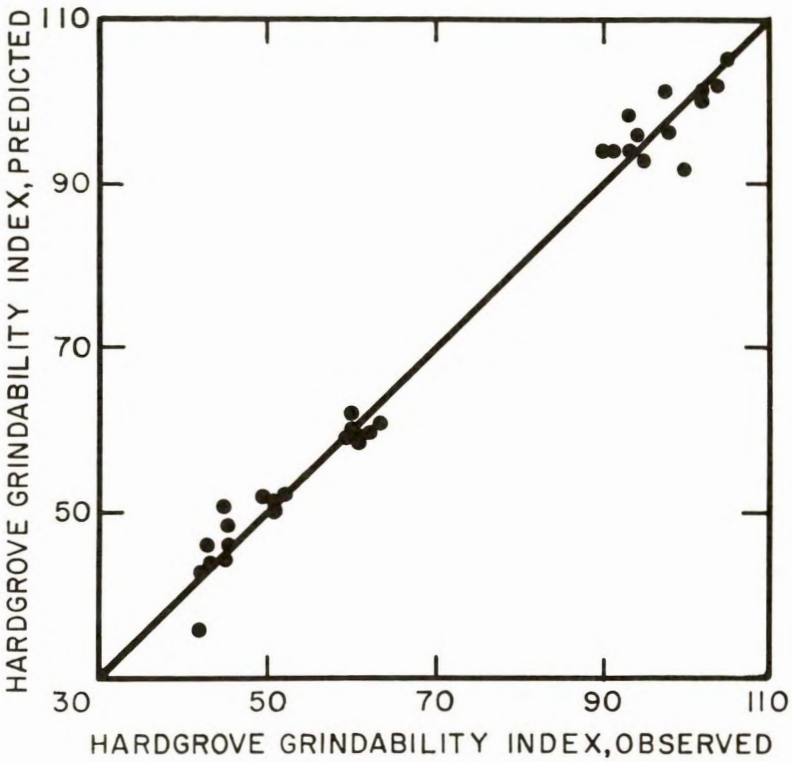


FIGURE 7. - Predicted and Observed Hardgrove Grindability Index Using Prediction Model Based on Petrographic Composition and Proximate Analysis Data.

composition of the coal as independent variables. Data of Terchick and coworkers[18] were used for this purpose.

The model developed follows:

$$\text{Hardgrove grindability} = -190.68725 - 232.73325\,(\text{VOL/FIX}) - 5781.3015\left((\text{VOL/FIX}) / e^{(\text{VOL/FIX})}\right) + .56197543\,(\text{VIT}) - 1.6082502\,(\text{EXIN}) + 8779.3683\left((\text{VOL/100}) / e^{(\text{VOL/100})}\right)$$

Where VOL = volatile matter, maf, percent;

FIX = fixed carbon, maf, percent;

VIT = vitrinoids, volume-percent;

EXIN = exinoids, volume-percent.

[18]Work cited in footnote 8.

The total variance explained by the model is 98.5 percent, and the standard error of estimate is 3.17. Predicted values for each experimental data point are shown in figure 7.

To test this model, petrographic data for 24 samples reported by Kuchta and coworkers[19] were used. Observed and predicted values are presented in table 3. These data include 18 samples from the Pratt seam, from three different mines, and six samples from the Mary Lee seam. No grindabilities were reported for these coals; the observed grindabilities are values reported in the literature for coals of comparable volatile matter content. Agreement for the observed and predicted Hardgrove grindabilities is close for the data shown.

Previous discussion has shown that the Hardgrove grindability index and the microstrength index are correlated mechanical properties of coal. It was of interest, therefore, to develop a model for the microstrength index in terms of the proximate analysis and the petrographic composition of the coal. Data of Terchick and coworkers[20] were used for model construction. The model developed is presented as follows:

$$\begin{aligned}\text{Microstrength index} = {} & 3094.1050 - 502.55497 \\ & (\text{VOL/FIX}) - 27.890415\ (\text{FIX}) \\ & - 2.6632061\ (\text{SFI} + \text{MIC} + \text{FUS} + \text{MM}) \\ & - 2.0617170\ (\text{VIT}) + 1.0737686 \\ & (\text{MIC}) + 1.5581696\ (\text{MM}) \\ & - 3207.1562\ \left((\text{VOL}/100) \,/\, e^{(\text{VOL}/100)}\right)\end{aligned}$$

Where VOL = volatile matter, maf, percent;

FIX = fixed carbon, maf, percent;

VIT = vitrinoids, volume-percent;

SFI = semifusinoids, volume-percent;

FUS = fusinoids, volume-percent;

MIC = micrinoids, volume-percent;

MM = mineral matter, volume-percent.

The microstrength index model explains 98.8 percent of the variance and has a standard error of estimate of 2.36.

---

[19] Kuchta, B. R., B. Perlic, R. J. Gray, and J. D. Clendenin. A Further Study of the Relationship Between the Chemical, Plastic, and Petrographic Properties of Alabama Medium-Volatile Coals and Their Carbonization Behavior. Preprints of Papers pres. at the 145th Nat. Meeting ACS, Div. Fuel Chem., New York, Sept. 8-13, 1963. V. 7, No. 2, pp. 7-18.

[20] Work cited in footnote 8.

TABLE 3. - Evaluation of grindability prediction model developed from petrographic and proximate analysis data

| Coal | Sample | Volatile matter, percent | Hardgrove grindability index | |
|---|---|---|---|---|
| | | | Observed[1] | Predicted |
| Pratt seam: | | | | |
| Mine A..... | 1 | 26.3 | 90 | 89 |
| | 2 | 27.6 | 90 | 86 |
| | 3 | 26.2 | 90 | 91 |
| | 4 | 25.8 | 90 | 92 |
| | 5 | 25.7 | 90 | 92 |
| | 6 | 26.6 | 90 | 93 |
| Mine B..... | 1 | 29.8 | 77 | 74 |
| | 2 | 30.8 | 77 | 70 |
| | 3 | 30.2 | 77 | 76 |
| | 4 | 29.9 | 77 | 70 |
| | 5 | 29.9 | 77 | 71 |
| | 6 | 29.9 | 77 | 73 |
| Mine C..... | 1 | 27.9 | 90 | 84 |
| | 2 | 27.4 | 90 | 83 |
| | 3 | 27.7 | 90 | 88 |
| | 4 | 26.0 | 90 | 89 |
| | 5 | 27.9 | 90 | 84 |
| | 6 | 27.8 | 90 | 84 |
| Mary Lee seam..... | 1 | 28.0 | 76 | 74 |
| | 2 | 28.1 | 76 | 72 |
| | 3 | 27.6 | 76 | 76 |
| | 4 | 27.7 | 76 | 74 |
| | 5 | 28.1 | 76 | 75 |
| | 6 | 28.2 | 76 | 77 |

[1]Data for mines A and C, Pratt seam from: Aresco, S. J., J. B. Janus, and F. E. Walker. Analyses of Tipple and Delivered Samples of Coal Collected During the Fiscal Year 1962. BuMines Rept. of Inv. 6300, 1963, p. 4. Data for mine B, Pratt seam, and Mary Lee seam from: Hertzog, Ellis S., and James R. Cudworth. Grindability of Alabama Coals. BuMines Rept. of Inv. 3382, 1938, 8 pp. (Ball mill grindabilities were converted to Hardgrove grindabilities using data of: Yancey, H. F., and M. R. Geer. Ball-Mill Grindability Indexes of Some American Coals. BuMines Rept. of Inv. 3409, 1938, 9 pp.)

Petrographic data of Kuchta and coworkers[21] were used to evaluate the microstrength index model. No experimental microstrength indexes were reported by Kuchta and coworkers; however, these values were estimated using the relationship between grindability and microstrength index first observed by Terchick and coworkers.[22]

[21]Work cited in footnote 19.
[22]Work cited in footnote 8.

A least squares treatment of Terchick's data yielded the following regression equation used to calculate the microstrength index:

Microstrength index = 79.8081 - 0.6874 grindability.

Data in table 4 compare microstrength indexes computed from the grindability index with those computed with the microstrength index model. Agreement is close for the data shown and lends support to the belief that the microstrength index models are valid.

TABLE 4. - Comparison of computed microstrength indexes

| Seam and mine | Sample | Hardgrove grindability index[1] | Microstrength index | |
|---|---|---|---|---|
| | | | Grindability model[2] | Petrographic model[3] |
| Pratt seam: | | | | |
| Mine A..... | 1 | 89 | 18.4 | 20.6 |
| | 2 | 86 | 20.7 | 18.7 |
| | 3 | 91 | 17.2 | 18.7 |
| | 4 | 92 | 16.5 | 17.7 |
| | 5 | 92 | 16.5 | 18.9 |
| | 6 | 93 | 16.1 | 15.4 |
| Mine B..... | 1 | 74 | 28.8 | 24.7 |
| | 2 | 70 | 31.9 | 27.2 |
| | 3 | 76 | 27.8 | 24.3 |
| | 4 | 70 | 32.0 | 29.7 |
| | 5 | 71 | 31.0 | 28.8 |
| | 6 | 73 | 29.5 | 23.7 |
| Mine C..... | 1 | 84 | 22.2 | 18.8 |
| | 2 | 83 | 22.9 | 20.4 |
| | 3 | 88 | 19.3 | 13.1 |
| | 4 | 89 | 18.5 | 20.7 |
| | 5 | 84 | 21.9 | 20.0 |
| | 6 | 84 | 22.1 | 20.4 |
| Mary Lee seam..... | 1 | 74 | 29.1 | 29.0 |
| | 2 | 72 | 30.2 | 29.8 |
| | 3 | 76 | 27.4 | 27.4 |
| | 4 | 74 | 29.2 | 29.9 |
| | 5 | 75 | 28.4 | 28.1 |
| | 6 | 77 | 26.9 | 26.0 |
| American seam..... | 1 | 86 | 21.0 | 21.3 |
| | 2 | 87 | 20.4 | 21.2 |
| | 3 | 82 | 23.4 | 24.6 |
| | 4 | 86 | 20.5 | 20.1 |
| | 5 | 83 | 23.1 | 21.5 |

[1]Predicted values obtained using model reported on page 14.
[2]Predicted values obtained using microstrength index = 79.8081 - 0.6874 grindability.
[3]Predicted values obtained using model reported on page 15.

The data presented support the contention that both chemical and petrographic factors influence the mechanical properties of coal. Prediction of breakage properties for a given seam, and for a given area of interest, necessitates the examination of the local variability of chemical and petrographic factors.

## SUMMARY AND CONCLUSIONS

The following trends and conclusions are supported by the data:

1. A statistical-mathematical model for the Hardgrove grindability index was developed using the proximate analysis, the heating value, and the sulfur content of the coal.

2. The grindability prediction model is applicable to U.S. coals having Hardgrove grindability indexes in the 35 to 121 range.

3. Grindabilities may be predicted in advance of mining because the variables used as input to the model can be measured during exploration.

4. Prediction models for the Hardgrove grindability index and the microstrength index, applicable to bituminous coals having grindabilities in the 40 to 110 range, were developed from the proximate analysis and the petrographic composition of the coal.

APPENDIX.--OBSERVED AND PREDICTED COAL HARDGROVE GRINDABILITY INDEXES FOR 735 MINE AND TIPPLE SAMPLES

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 14943 | 64.5 | 2.2 | 31.2 | 53.6 | 15.2 | 1.4 | 54 | 58 | -4 |
| 14723 | 65.1 | 4.0 | 33.9 | 62.1 | 4.0 | 1.1 | 59 | 62 | -3 |
| 13535 | 60.8 | 7.5 | 36.9 | 56.1 | 7.0 | 0.8 | 41 | 50 | -9 |
| 14262 | 62.3 | 5.7 | 33.7 | 53.8 | 12.5 | 0.6 | 56 | 56 | 0 |
| 13677 | 65.3 | 8.2 | 32.9 | 59.8 | 7.3 | 1.6 | 62 | 67 | -5 |
| 13824 | 63.3 | 5.9 | 33.7 | 56.5 | 9.8 | 0.3 | 47 | 56 | -9 |
| 13925 | 61.3 | 5.4 | 35.9 | 55.7 | 8.4 | 0.4 | 50 | 50 | 0 |
| 14674 | 64.1 | 4.5 | 34.2 | 59.7 | 6.1 | 0.7 | 61 | 58 | 3 |
| 14776 | 60.0 | 2.8 | 38.4 | 56.8 | 4.8 | 0.7 | 50 | 48 | 2 |
| 14633 | 62.6 | 3.2 | 35.2 | 57.8 | 7.0 | 0.4 | 45 | 53 | -8 |
| 13694 | 64.9 | 8.4 | 31.3 | 55.3 | 13.4 | 0.8 | 56 | 64 | -8 |
| 13171 | 64.8 | 10.7 | 31.4 | 55.4 | 13.2 | 0.7 | 70 | 66 | 4 |
| 14168 | 62.0 | 4.3 | 33.2 | 51.8 | 15.0 | 0.8 | 46 | 51 | -5 |
| 13816 | 58.0 | 7.0 | 40.5 | 54.6 | 4.9 | 1.9 | 43 | 50 | -7 |
| 14141 | 62.9 | 4.5 | 32.4 | 52.6 | 15.0 | 0.5 | 50 | 54 | -4 |
| 14533 | 62.7 | 4.8 | 36.6 | 60.7 | 2.7 | 0.7 | 47 | 53 | -6 |
| 10409 | 58.7 | 20.7 | 38.2 | 53.2 | 8.6 | 0.4 | 45 | 51 | -6 |
| 9649 | 55.3 | 23.9 | 40.3 | 48.5 | 11.2 | 0.5 | 47 | 49 | -2 |
| 9137 | 52.9 | 24.8 | 43.9 | 48.6 | 7.5 | 0.3 | 39 | 49 | -10 |
| 12301 | 58.0 | 9.7 | 36.1 | 47.7 | 16.2 | 1.1 | 45 | 46 | -1 |
| 12039 | 58.3 | 10.5 | 35.9 | 48.2 | 15.9 | 0.6 | 45 | 46 | -1 |
| 11861 | 57.6 | 10.8 | 38.0 | 50.3 | 11.7 | 0.3 | 47 | 47 | 0 |
| 11871 | 56.4 | 11.4 | 38.9 | 48.9 | 12.2 | 0.4 | 44 | 47 | -3 |
| 11648 | 58.0 | 12.8 | 33.4 | 43.2 | 23.4 | 0.9 | 55 | 48 | 7 |
| 11652 | 57.6 | 11.7 | 38.4 | 51.0 | 10.6 | 0.3 | 49 | 48 | 1 |
| 12095 | 57.2 | 10.6 | 36.9 | 46.7 | 16.4 | 2.0 | 50 | 49 | 1 |
| 12190 | 56.6 | 9.4 | 37.0 | 46.3 | 16.7 | 0.5 | 44 | 44 | 0 |
| 11826 | 56.8 | 11.0 | 38.4 | 49.0 | 12.6 | 0.3 | 46 | 46 | 0 |
| 11833 | 57.3 | 11.8 | 39.0 | 50.8 | 10.2 | 1.0 | 48 | 49 | -1 |
| 11514 | 58.8 | 13.2 | 37.6 | 52.4 | 10.0 | 0.4 | 46 | 50 | -4 |
| 11951 | 58.2 | 11.4 | 37.1 | 50.1 | 12.8 | 0.5 | 45 | 48 | -3 |
| 12116 | 57.8 | 10.6 | 37.9 | 50.5 | 11.6 | 0.6 | 45 | 47 | -2 |
| 13508 | 55.4 | 4.6 | 41.0 | 49.7 | 9.3 | 0.6 | 52 | 45 | 7 |
| 13537 | 54.7 | 5.0 | 40.9 | 48.1 | 11.0 | 0.4 | 50 | 46 | 4 |
| 13171 | 57.6 | 8.1 | 40.1 | 53.7 | 6.2 | 0.5 | 55 | 46 | 9 |
| 13635 | 58.0 | 6.3 | 40.5 | 55.2 | 4.3 | 0.5 | 56 | 46 | 10 |
| 13588 | 58.7 | 6.4 | 39.4 | 55.2 | 5.4 | 0.7 | 55 | 46 | 9 |
| 13029 | 55.1 | 6.7 | 39.0 | 46.2 | 14.8 | 0.8 | 44 | 45 | -1 |
| 13167 | 56.9 | 6.1 | 37.1 | 47.2 | 15.7 | 0.5 | 44 | 43 | 1 |
| 14767 | 61.7 | 2.6 | 33.7 | 52.1 | 14.2 | 0.7 | 59 | 53 | 6 |
| 14876 | 63.8 | 2.2 | 30.2 | 50.0 | 19.8 | 0.8 | 48 | 53 | -5 |
| 14997 | 59.3 | 2.1 | 33.9 | 46.9 | 19.2 | 0.7 | 49 | 55 | -6 |
| 14911 | 62.6 | 2.3 | 30.4 | 47.7 | 21.9 | 0.5 | 50 | 54 | -4 |
| 12831 | 58.4 | 9.4 | 37.8 | 51.7 | 10.5 | 0.7 | 57 | 48 | 9 |
| 13078 | 57.0 | 7.9 | 38.9 | 50.2 | 10.9 | 0.5 | 55 | 47 | 8 |
| 11944 | 56.3 | 12.1 | 41.7 | 53.0 | 5.3 | 0.2 | 55 | 49 | 6 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 14446 | 58.7 | 2.7 | 38.5 | 53.6 | 7.9 | 0.6 | 52 | 46 | 6 |
| 11894 | 53.7 | 12.7 | 43.4 | 49.5 | 7.1 | 0.6 | 57 | 52 | 5 |
| 12129 | 59.4 | 12.2 | 38.5 | 55.4 | 6.1 | 0.5 | 48 | 50 | -2 |
| 11615 | 57.4 | 13.6 | 40.1 | 53.0 | 6.9 | 0.6 | 43 | 50 | -7 |
| 12327 | 54.9 | 10.8 | 43.5 | 51.7 | 4.8 | 2.3 | 53 | 55 | -2 |
| 12068 | 58.8 | 11.8 | 37.1 | 51.4 | 11.5 | 0.4 | 48 | 49 | -1 |
| 12943 | 55.8 | 7.5 | 41.4 | 51.4 | 7.2 | 0.6 | 50 | 47 | 3 |
| 9820 | 59.5 | 25.1 | 38.6 | 56.0 | 5.4 | 0.3 | 48 | 51 | -3 |
| 9903 | 60.5 | 24.3 | 37.1 | 55.6 | 7.3 | 0.6 | 50 | 57 | -7 |
| 10171 | 58.7 | 23.3 | 39.5 | 55.4 | 5.1 | 0.3 | 45 | 47 | -2 |
| 10120 | 59.1 | 23.3 | 38.9 | 55.4 | 5.7 | 0.4 | 48 | 49 | -1 |
| 9865 | 59.5 | 25.0 | 38.1 | 55.1 | 6.8 | 0.4 | 46 | 53 | -7 |
| 10048 | 59.2 | 23.8 | 38.7 | 55.3 | 6.0 | 0.4 | 47 | 50 | -3 |
| 9916 | 57.9 | 23.1 | 39.5 | 53.4 | 7.1 | 0.5 | 50 | 49 | 1 |
| 12080 | 55.1 | 13.3 | 39.8 | 46.0 | 14.2 | 4.5 | 59 | 59 | 0 |
| 12847 | 60.4 | 10.0 | 35.4 | 51.6 | 13.0 | 1.8 | 52 | 55 | -3 |
| 12596 | 59.3 | 12.5 | 38.1 | 53.2 | 8.7 | 3.0 | 61 | 60 | 1 |
| 12563 | 61.2 | 13.0 | 36.2 | 55.2 | 8.6 | 1.7 | 52 | 57 | -5 |
| 12042 | 52.1 | 12.3 | 39.5 | 39.7 | 20.8 | 4.9 | 57 | 58 | -1 |
| 13466 | 62.5 | 8.0 | 33.4 | 52.5 | 14.1 | 2.7 | 62 | 64 | -2 |
| 12052 | 50.0 | 16.0 | 46.3 | 44.9 | 8.8 | 2.9 | 53 | 54 | -1 |
| 13779 | 57.0 | 5.5 | 38.7 | 48.6 | 12.7 | 3.4 | 59 | 54 | 5 |
| 13184 | 59.3 | 10.0 | 37.8 | 53.2 | 9.0 | 2.0 | 56 | 54 | 2 |
| 12908 | 53.1 | 10.9 | 43.3 | 46.7 | 10.0 | 4.6 | 52 | 57 | -5 |
| 13326 | 53.5 | 7.9 | 43.2 | 47.8 | 9.0 | 3.4 | 52 | 54 | -2 |
| 13167 | 53.1 | 9.0 | 43.8 | 47.4 | 8.8 | 4.8 | 52 | 56 | -4 |
| 12236 | 50.7 | 15.0 | 46.9 | 46.7 | 6.4 | 3.9 | 61 | 53 | 8 |
| 13133 | 55.9 | 9.5 | 39.4 | 47.6 | 13.0 | 2.7 | 67 | 56 | 11 |
| 13049 | 56.2 | 11.1 | 40.2 | 49.4 | 10.4 | 2.9 | 59 | 56 | 3 |
| 13623 | 60.8 | 9.5 | 35.8 | 52.7 | 11.5 | 3.2 | 65 | 65 | 0 |
| 13278 | 58.5 | 10.4 | 38.2 | 51.6 | 10.2 | 2.8 | 68 | 58 | 10 |
| 13650 | 56.4 | 7.9 | 40.2 | 50.1 | 9.7 | 2.3 | 66 | 53 | 13 |
| 14116 | 61.6 | 5.7 | 34.4 | 50.9 | 14.7 | 4.7 | 63 | 66 | -3 |
| 13769 | 58.0 | 6.4 | 37.9 | 50.2 | 11.9 | 2.2 | 71 | 53 | 18 |
| 14592 | 61.5 | 3.1 | 36.4 | 56.8 | 6.8 | 0.8 | 56 | 50 | 6 |
| 14533 | 58.3 | 4.4 | 39.1 | 52.5 | 8.4 | 2.9 | 60 | 56 | 4 |
| 12792 | 57.8 | 10.7 | 40.1 | 53.4 | 6.5 | 2.2 | 53 | 53 | 0 |
| 14242 | 60.9 | 5.3 | 37.5 | 57.3 | 5.2 | 0.9 | 48 | 49 | -1 |
| 14147 | 58.0 | 5.9 | 39.4 | 53.1 | 7.5 | 1.1 | 50 | 48 | 2 |
| 14297 | 58.6 | 4.0 | 38.4 | 53.0 | 8.6 | 0.8 | 38 | 47 | -9 |
| 14512 | 58.4 | 4.1 | 40.0 | 55.3 | 4.7 | 0.9 | 36 | 46 | -10 |
| 14612 | 61.7 | 3.3 | 36.3 | 57.4 | 6.3 | 0.7 | 52 | 51 | 1 |
| 14460 | 58.4 | 3.6 | 38.3 | 51.5 | 10.2 | 2.6 | 48 | 54 | -6 |
| 14424 | 60.0 | 4.0 | 38.0 | 55.6 | 6.4 | 1.3 | 46 | 49 | -3 |
| 13259 | 61.1 | 9.8 | 35.8 | 53.8 | 10.4 | 2.2 | 55 | 59 | -4 |
| 14692 | 55.2 | 2.7 | 41.9 | 49.2 | 8.9 | 4.6 | 52 | 57 | -5 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 14335 | 59.0 | 4.1 | 38.7 | 54.4 | 6.9 | 1.1 | 44 | 48 | -4 |
| 14463 | 59.9 | 3.3 | 37.9 | 55.3 | 6.8 | 0.9 | 50 | 47 | 3 |
| 14406 | 55.1 | 4.0 | 39.7 | 45.9 | 14.4 | 4.1 | 50 | 59 | -9 |
| 14095 | 59.0 | 5.1 | 37.7 | 52.5 | 9.8 | 1.5 | 38 | 50 | -12 |
| 13247 | 59.6 | 9.9 | 37.5 | 54.1 | 8.4 | 0.7 | 43 | 49 | -6 |
| 14523 | 58.7 | 3.4 | 39.3 | 54.9 | 5.8 | 0.5 | 38 | 46 | -8 |
| 14522 | 59.8 | 4.5 | 38.6 | 56.6 | 4.8 | 0.8 | 43 | 48 | -5 |
| 14659 | 60.4 | 2.7 | 37.0 | 55.2 | 7.8 | 0.6 | 43 | 48 | -5 |
| 14559 | 56.1 | 4.3 | 41.3 | 51.0 | 7.7 | 2.8 | 44 | 54 | -10 |
| 14798 | 66.4 | 3.9 | 32.1 | 62.3 | 5.6 | 0.6 | 57 | 66 | -9 |
| 14294 | 55.3 | 4.4 | 42.1 | 50.8 | 7.1 | 1.7 | 47 | 49 | -2 |
| 14981 | 64.9 | 2.9 | 33.0 | 59.6 | 7.4 | 0.6 | 58 | 61 | -3 |
| 14926 | 62.2 | 2.6 | 36.3 | 58.6 | 5.1 | 0.8 | 50 | 53 | -3 |
| 14992 | 63.8 | 2.5 | 33.6 | 57.7 | 8.7 | 0.6 | 50 | 58 | -8 |
| 14915 | 61.3 | 2.7 | 36.0 | 55.1 | 8.9 | 1.6 | 46 | 55 | -9 |
| 15262 | 64.3 | 2.1 | 33.6 | 58.6 | 7.8 | 1.6 | 64 | 64 | 0 |
| 12269 | 61.1 | 13.4 | 35.0 | 53.3 | 11.7 | 0.4 | 50 | 56 | -6 |
| 13802 | 60.9 | 7.4 | 37.4 | 56.8 | 5.8 | 1.3 | 48 | 51 | -3 |
| 14143 | 60.1 | 4.9 | 37.8 | 55.7 | 6.5 | 1.1 | 44 | 49 | -5 |
| 14581 | 55.9 | 3.6 | 42.6 | 52.6 | 4.8 | 2.5 | 53 | 51 | 2 |
| 14111 | 59.1 | 5.2 | 39.0 | 54.9 | 6.1 | 1.9 | 47 | 51 | -4 |
| 13644 | 55.0 | 6.7 | 42.8 | 50.4 | 6.8 | 3.4 | 58 | 54 | 4 |
| 13229 | 57.4 | 8.4 | 38.5 | 49.0 | 12.5 | 4.0 | 59 | 58 | 1 |
| 12148 | 57.0 | 13.9 | 40.6 | 51.8 | 7.6 | 3.4 | 57 | 57 | 0 |
| 13060 | 57.4 | 10.2 | 39.5 | 50.6 | 9.9 | 3.9 | 60 | 59 | 1 |
| 13322 | 55.5 | 8.3 | 41.0 | 48.6 | 10.4 | 4.2 | 57 | 57 | 0 |
| 12756 | 57.6 | 11.2 | 38.4 | 49.3 | 12.3 | 4.0 | 61 | 60 | 1 |
| 12525 | 60.5 | 14.6 | 35.4 | 51.5 | 13.1 | 2.6 | 70 | 66 | 4 |
| 12899 | 53.2 | 10.9 | 42.6 | 46.3 | 11.1 | 3.8 | 57 | 57 | 0 |
| 12258 | 51.5 | 15.2 | 44.1 | 44.6 | 11.3 | 4.7 | 58 | 58 | 0 |
| 11541 | 54.9 | 18.7 | 40.7 | 47.0 | 12.3 | 4.1 | 64 | 61 | 3 |
| 12061 | 54.8 | 15.9 | 42.1 | 48.6 | 9.3 | 4.5 | 60 | 58 | 2 |
| 13152 | 53.9 | 10.8 | 41.5 | 46.2 | 12.3 | 3.7 | 52 | 59 | -7 |
| 13059 | 53.5 | 11.8 | 42.4 | 46.8 | 10.8 | 3.4 | 58 | 58 | 0 |
| 11885 | 57.3 | 10.4 | 37.6 | 47.9 | 14.5 | 2.7 | 54 | 50 | 4 |
| 10228 | 61.4 | 20.9 | 34.4 | 52.2 | 13.4 | 1.5 | 53 | 68 | -15 |
| 11459 | 59.7 | 14.6 | 36.2 | 51.7 | 12.1 | 0.9 | 59 | 53 | 6 |
| 14807 | 60.5 | 2.4 | 32.1 | 46.1 | 21.8 | 0.8 | 56 | 51 | 5 |
| 14458 | 57.8 | 3.2 | 34.8 | 45.1 | 20.1 | 0.7 | 50 | 51 | -1 |
| 14730 | 58.8 | 1.9 | 36.4 | 50.0 | 13.6 | 0.9 | 51 | 48 | 3 |
| 12533 | 50.5 | 10.9 | 45.8 | 45.9 | 8.3 | 0.7 | 49 | 51 | -2 |
| 13815 | 56.1 | 5.9 | 39.4 | 47.3 | 13.3 | 4.8 | 58 | 57 | 1 |
| 13221 | 52.7 | 7.7 | 43.2 | 46.0 | 10.8 | 3.7 | 56 | 55 | 1 |
| 13134 | 53.8 | 8.0 | 42.8 | 48.0 | 9.2 | 3.1 | 55 | 54 | 1 |
| 13213 | 53.2 | 7.4 | 42.4 | 46.0 | 11.6 | 3.8 | 55 | 54 | 1 |
| 13262 | 53.8 | 7.6 | 42.3 | 47.2 | 10.5 | 3.4 | 55 | 54 | 1 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 13400 | 52.0 | 6.5 | 43.7 | 45.4 | 10.9 | 3.4 | 55 | 54 | 1 |
| 13987 | 57.0 | 5.4 | 38.5 | 48.6 | 12.9 | 2.9 | 61 | 55 | 6 |
| 13802 | 57.1 | 5.6 | 38.1 | 47.8 | 14.1 | 3.6 | 58 | 55 | 3 |
| 13598 | 59.3 | 7.2 | 36.3 | 50.0 | 13.7 | 3.1 | 58 | 58 | 0 |
| 13936 | 57.3 | 5.8 | 39.5 | 50.9 | 9.6 | 3.0 | 51 | 54 | -3 |
| 14173 | 56.7 | 4.4 | 40.4 | 51.0 | 8.6 | 2.8 | 53 | 53 | 0 |
| 13818 | 57.1 | 5.8 | 37.9 | 47.5 | 14.6 | 3.5 | 58 | 56 | 2 |
| 13752 | 55.0 | 6.1 | 37.9 | 42.6 | 19.5 | 5.5 | 59 | 58 | 1 |
| 13850 | 56.0 | 5.3 | 39.4 | 47.8 | 12.8 | 3.1 | 54 | 53 | 1 |
| 13729 | 59.7 | 6.7 | 35.8 | 49.7 | 14.5 | 3.5 | 62 | 59 | 3 |
| 14315 | 58.8 | 3.9 | 37.8 | 51.2 | 11.0 | 3.3 | 58 | 56 | 2 |
| 13608 | 60.5 | 7.1 | 34.2 | 50.0 | 15.8 | 0.9 | 57 | 51 | 6 |
| 13966 | 60.2 | 4.1 | 37.1 | 53.8 | 9.1 | 2.7 | 50 | 54 | -4 |
| 14218 | 57.4 | 4.3 | 39.4 | 51.1 | 9.5 | 2.3 | 50 | 51 | -1 |
| 13550 | 53.4 | 6.2 | 42.8 | 47.5 | 9.7 | 2.1 | 52 | 51 | 1 |
| 13237 | 54.9 | 7.8 | 39.9 | 46.2 | 13.9 | 3.1 | 53 | 54 | -1 |
| 13476 | 52.8 | 6.7 | 42.1 | 45.2 | 12.7 | 2.3 | 52 | 53 | -1 |
| 13157 | 53.8 | 8.2 | 42.2 | 47.0 | 10.8 | 3.8 | 48 | 55 | -7 |
| 12799 | 54.5 | 9.6 | 42.3 | 48.9 | 8.8 | 2.7 | 44 | 54 | -10 |
| 13041 | 55.2 | 7.9 | 41.9 | 49.8 | 8.3 | 3.2 | 47 | 54 | -7 |
| 12967 | 53.9 | 8.9 | 42.0 | 46.4 | 11.6 | 5.0 | 46 | 56 | -10 |
| 15292 | 74.9 | 2.4 | 24.3 | 69.3 | 6.4 | 1.5 | 101 | 101 | 0 |
| 13932 | 81.3 | 9.1 | 17.6 | 71.6 | 10.8 | 0.6 | 107 | 107 | 0 |
| 14677 | 62.0 | 3.2 | 36.2 | 56.9 | 6.9 | 2.3 | 59 | 59 | 0 |
| 14455 | 63.3 | 5.0 | 33.1 | 53.9 | 13.0 | 2.4 | 60 | 64 | -4 |
| 15032 | 60.5 | 2.3 | 36.3 | 51.6 | 12.1 | 5.4 | 62 | 66 | -4 |
| 14560 | 62.9 | 3.9 | 34.0 | 55.0 | 11.0 | 2.0 | 61 | 60 | 1 |
| 14318 | 63.1 | 4.6 | 34.3 | 56.5 | 9.2 | 1.5 | 61 | 57 | 4 |
| 15204 | 61.0 | 1.8 | 35.4 | 51.4 | 13.2 | 4.7 | 64 | 66 | -2 |
| 14775 | 63.0 | 3.8 | 33.8 | 55.1 | 11.1 | 1.7 | 63 | 60 | 3 |
| 14452 | 63.2 | 4.1 | 33.8 | 54.7 | 11.5 | 3.2 | 71 | 66 | 5 |
| 14236 | 63.2 | 6.9 | 33.3 | 54.5 | 12.2 | 1.9 | 65 | 64 | 1 |
| 15002 | 62.8 | 2.2 | 34.9 | 56.8 | 8.3 | 2.1 | 63 | 60 | 3 |
| 14926 | 69.5 | 3.6 | 28.1 | 59.0 | 12.9 | 3.6 | 87 | 89 | -2 |
| 12838 | 68.3 | 9.5 | 29.4 | 61.3 | 9.3 | 0.6 | 99 | 80 | 19 |
| 14400 | 70.8 | 5.8 | 28.0 | 65.1 | 6.9 | 1.8 | 84 | 90 | -6 |
| 14712 | 56.5 | 3.7 | 40.6 | 50.2 | 9.2 | 4.5 | 60 | 59 | 1 |
| 14917 | 61.4 | 2.5 | 35.8 | 55.2 | 9.0 | 1.4 | 59 | 54 | 5 |
| 15334 | 76.1 | 2.7 | 23.0 | 69.3 | 7.7 | 1.6 | 111 | 104 | 7 |
| 15415 | 80.9 | 2.3 | 18.2 | 71.3 | 10.5 | 1.4 | 111 | 106 | 5 |
| 15393 | 71.9 | 2.7 | 26.0 | 62.3 | 11.7 | 2.1 | 99 | 92 | 7 |
| 14942 | 71.8 | 3.3 | 26.1 | 63.9 | 10.0 | 0.7 | 89 | 86 | 3 |
| 15327 | 81.9 | 2.5 | 17.0 | 70.4 | 12.6 | 1.3 | 104 | 104 | 0 |
| 15506 | 81.0 | 1.7 | 18.5 | 71.5 | 10.0 | 2.6 | 104 | 106 | -2 |
| 15188 | 73.4 | 2.8 | 24.6 | 63.8 | 11.6 | 1.5 | 98 | 93 | 5 |
| 15069 | 71.9 | 3.4 | 25.7 | 59.9 | 14.4 | 3.3 | 84 | 92 | -8 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 15127 | 80.2 | 3.4 | 19.1 | 70.7 | 10.2 | 2.4 | 107 | 109 | -2 |
| 15199 | 78.2 | 3.4 | 20.6 | 67.6 | 11.8 | 2.4 | 99 | 106 | -7 |
| 15193 | 80.6 | 3.2 | 18.5 | 69.4 | 12.1 | 2.2 | 109 | 105 | 4 |
| 14976 | 74.1 | 3.9 | 24.3 | 65.3 | 10.4 | 1.9 | 101 | 99 | 2 |
| 15300 | 78.2 | 2.6 | 21.3 | 68.9 | 9.8 | 3.7 | 111 | 111 | 0 |
| 15178 | 75.5 | 3.0 | 22.7 | 66.3 | 11.0 | 0.9 | 107 | 98 | 9 |
| 14541 | 60.3 | 4.1 | 37.2 | 54.3 | 8.5 | 2.8 | 62 | 58 | 4 |
| 14846 | 59.4 | 2.8 | 37.5 | 52.6 | 9.9 | 2.7 | 59 | 57 | 2 |
| 14009 | 60.4 | 5.5 | 36.0 | 53.1 | 10.9 | 1.2 | 64 | 50 | 14 |
| 14828 | 57.2 | 3.0 | 39.5 | 50.3 | 10.2 | 3.7 | 56 | 59 | -3 |
| 15406 | 76.2 | 2.4 | 23.0 | 68.0 | 9.0 | 2.8 | 111 | 107 | 4 |
| 15042 | 74.8 | 3.3 | 23.9 | 67.5 | 8.6 | 1.3 | 98 | 99 | -1 |
| 14779 | 75.4 | 4.4 | 23.2 | 68.2 | 8.6 | 0.9 | 107 | 100 | 7 |
| 14856 | 75.2 | 4.9 | 23.7 | 67.5 | 8.8 | 2.1 | 108 | 105 | 3 |
| 15212 | 77.4 | 2.8 | 21.0 | 65.2 | 13.8 | 2.4 | 97 | 100 | -3 |
| 15437 | 72.8 | 1.7 | 25.7 | 63.6 | 10.7 | 3.3 | 95 | 98 | -3 |
| 15218 | 71.0 | 2.6 | 26.2 | 60.0 | 13.8 | 1.8 | 82 | 84 | -2 |
| 14536 | 72.0 | 4.1 | 26.3 | 65.7 | 8.0 | 0.4 | 79 | 85 | -6 |
| 15239 | 75.2 | 2.8 | 23.2 | 66.7 | 10.1 | 1.0 | 104 | 98 | 6 |
| 15102 | 76.9 | 3.7 | 22.3 | 72.1 | 5.6 | 0.7 | 106 | 101 | 5 |
| 14953 | 71.1 | 4.4 | 26.5 | 62.5 | 11.0 | 0.8 | 93 | 85 | 8 |
| 14565 | 74.2 | 5.1 | 24.1 | 65.6 | 10.3 | 1.3 | 100 | 98 | 2 |
| 13754 | 72.9 | 7.3 | 25.6 | 66.3 | 8.1 | 0.8 | 116 | 95 | 21 |
| 13871 | 76.7 | 8.8 | 22.3 | 70.4 | 7.3 | 1.0 | 110 | 107 | 3 |
| 15032 | 75.9 | 3.8 | 22.4 | 67.4 | 10.2 | 0.6 | 101 | 98 | 3 |
| 15139 | 74.2 | 3.9 | 24.3 | 66.4 | 9.3 | 1.5 | 103 | 99 | 4 |
| 15103 | 72.8 | 3.2 | 24.8 | 62.1 | 13.1 | 1.7 | 92 | 91 | 1 |
| 15363 | 77.2 | 2.5 | 21.6 | 69.4 | 9.0 | 1.1 | 108 | 104 | 4 |
| 15058 | 75.5 | 3.1 | 22.5 | 66.0 | 11.5 | 0.5 | 94 | 95 | -1 |
| 15243 | 77.6 | 2.8 | 21.0 | 64.6 | 14.4 | 3.3 | 104 | 100 | 4 |
| 14790 | 75.4 | 4.3 | 22.9 | 67.1 | 10.0 | 0.7 | 97 | 98 | -1 |
| 14184 | 75.9 | 6.3 | 22.2 | 66.7 | 11.1 | 0.4 | 99 | 99 | 0 |
| 14945 | 76.9 | 4.6 | 22.1 | 67.8 | 10.1 | 2.6 | 104 | 109 | -5 |
| 15215 | 78.3 | 3.5 | 20.5 | 68.0 | 11.5 | 1.9 | 107 | 106 | 1 |
| 15326 | 76.5 | 2.7 | 22.5 | 68.5 | 9.0 | 2.0 | 109 | 105 | 4 |
| 15350 | 74.1 | 2.7 | 24.3 | 64.5 | 11.2 | 2.5 | 105 | 99 | 6 |
| 13749 | 74.7 | 8.9 | 23.7 | 64.5 | 11.8 | 2.7 | 121 | 112 | 9 |
| 15169 | 66.7 | 3.0 | 30.5 | 56.9 | 12.6 | 3.3 | 87 | 80 | 7 |
| 15295 | 73.9 | 2.9 | 24.8 | 65.4 | 9.8 | 2.8 | 106 | 102 | 4 |
| 15041 | 61.1 | 2.1 | 34.9 | 51.7 | 13.4 | 2.8 | 62 | 61 | 1 |
| 14442 | 62.2 | 4.2 | 33.0 | 51.9 | 15.1 | 0.9 | 65 | 54 | 11 |
| 14227 | 70.8 | 5.7 | 27.0 | 62.9 | 10.1 | 0.9 | 96 | 85 | 11 |
| 15036 | 70.0 | 3.5 | 27.6 | 61.2 | 11.2 | 1.3 | 95 | 82 | 13 |
| 14915 | 71.0 | 4.2 | 26.5 | 60.8 | 12.7 | 1.8 | 83 | 87 | -4 |
| 15179 | 68.4 | 2.8 | 29.6 | 61.7 | 8.7 | 1.3 | 79 | 77 | 2 |
| 15425 | 75.4 | 2.4 | 23.4 | 65.9 | 10.7 | 3.1 | 106 | 105 | 1 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 15459 | 71.9 | 2.1 | 26.6 | 62.8 | 10.6 | 3.4 | 103 | 97 | 6 |
| 14962 | 64.4 | 2.4 | 31.6 | 53.8 | 14.6 | 2.2 | 65 | 63 | 2 |
| 14986 | 65.8 | 2.9 | 30.7 | 55.6 | 13.7 | 2.0 | 65 | 68 | -3 |
| 14807 | 68.5 | 4.6 | 27.7 | 55.8 | 16.5 | 2.0 | 84 | 77 | 7 |
| 15186 | 72.7 | 3.0 | 25.3 | 60.9 | 13.8 | 3.7 | 107 | 96 | 11 |
| 14863 | 69.3 | 3.5 | 28.2 | 59.8 | 12.0 | 2.1 | 76 | 81 | -5 |
| 14937 | 68.6 | 3.4 | 28.5 | 58.4 | 13.1 | 2.1 | 76 | 78 | -2 |
| 15054 | 68.2 | 2.9 | 29.8 | 61.7 | 8.5 | 1.0 | 79 | 74 | 5 |
| 14934 | 63.6 | 3.2 | 34.1 | 58.2 | 7.7 | 0.7 | 63 | 58 | 5 |
| 15414 | 81.4 | 2.0 | 17.7 | 70.7 | 11.6 | 1.8 | 105 | 104 | 1 |
| 15270 | 82.0 | 2.9 | 17.2 | 70.6 | 12.2 | 2.0 | 99 | 104 | -5 |
| 15464 | 83.4 | 2.0 | 16.4 | 72.9 | 10.7 | 2.7 | 108 | 101 | 7 |
| 15202 | 81.1 | 2.7 | 17.9 | 70.9 | 11.2 | 1.3 | 108 | 106 | 2 |
| 15259 | 83.0 | 2.9 | 16.4 | 74.0 | 9.6 | 1.3 | 111 | 106 | 5 |
| 15235 | 82.8 | 2.9 | 16.6 | 68.4 | 15.0 | 3.3 | 110 | 94 | 16 |
| 14932 | 82.4 | 4.0 | 16.7 | 72.2 | 11.1 | 1.1 | 106 | 107 | -1 |
| 15283 | 79.7 | 2.6 | 18.8 | 68.2 | 13.0 | 1.0 | 96 | 103 | -7 |
| 15381 | 81.6 | 2.4 | 17.7 | 71.3 | 11.0 | 2.0 | 107 | 105 | 2 |
| 15427 | 82.5 | 2.0 | 17.2 | 73.4 | 9.4 | 2.4 | 111 | 105 | 6 |
| 15532 | 83.8 | 2.2 | 16.2 | 75.4 | 8.4 | 2.7 | 112 | 104 | 8 |
| 15280 | 82.8 | 3.0 | 16.6 | 73.4 | 10.0 | 1.5 | 111 | 106 | 5 |
| 15048 | 83.3 | 3.6 | 16.2 | 74.5 | 9.3 | 1.3 | 111 | 107 | 4 |
| 15005 | 81.7 | 3.4 | 17.4 | 71.2 | 11.4 | 1.6 | 111 | 107 | 4 |
| 15439 | 82.1 | 2.0 | 17.3 | 66.9 | 15.8 | 4.0 | 87 | 90 | -3 |
| 15017 | 81.2 | 3.7 | 18.1 | 72.4 | 9.5 | 1.7 | 108 | 109 | -1 |
| 15380 | 81.8 | 2.2 | 17.6 | 71.0 | 11.4 | 2.3 | 101 | 103 | -2 |
| 15363 | 81.3 | 2.5 | 17.8 | 70.5 | 11.7 | 1.8 | 100 | 105 | -5 |
| 13300 | 77.5 | 10.3 | 21.3 | 69.7 | 9.0 | 1.0 | 115 | 116 | -1 |
| 15226 | 82.2 | 3.7 | 17.5 | 68.0 | 14.5 | 4.3 | 103 | 101 | 2 |
| 14947 | 81.6 | 3.8 | 17.4 | 72.0 | 10.6 | 1.0 | 96 | 107 | -11 |
| 15246 | 83.4 | 2.8 | 16.3 | 73.2 | 10.5 | 2.3 | 99 | 103 | -4 |
| 15185 | 81.6 | 3.7 | 17.3 | 67.9 | 14.8 | 2.1 | 99 | 100 | -1 |
| 15280 | 82.0 | 2.9 | 16.9 | 67.7 | 15.4 | 2.2 | 101 | 97 | 4 |
| 14532 | 82.1 | 4.5 | 16.0 | 63.8 | 20.2 | 1.2 | 92 | 97 | -5 |
| 15133 | 82.3 | 3.7 | 16.8 | 70.5 | 12.7 | 1.7 | 110 | 104 | 6 |
| 15304 | 80.4 | 2.5 | 18.8 | 69.2 | 12.0 | 2.7 | 106 | 104 | 2 |
| 15348 | 83.9 | 2.8 | 15.7 | 74.3 | 10.0 | 1.7 | 102 | 104 | -2 |
| 15252 | 82.0 | 2.7 | 17.3 | 72.2 | 10.5 | 1.8 | 107 | 106 | 1 |
| 13749 | 52.3 | 5.2 | 44.7 | 48.2 | 7.1 | 0.8 | 41 | 48 | -7 |
| 13473 | 53.3 | 6.5 | 43.5 | 48.9 | 7.6 | 0.4 | 44 | 48 | -4 |
| 13671 | 50.4 | 6.1 | 46.8 | 46.8 | 6.4 | 1.0 | 46 | 45 | 1 |
| 13862 | 53.2 | 4.6 | 44.2 | 49.4 | 6.4 | 0.7 | 46 | 48 | -2 |
| 13514 | 55.5 | 5.2 | 42.8 | 52.9 | 4.3 | 0.4 | 46 | 47 | -1 |
| 13184 | 50.7 | 7.0 | 45.6 | 46.1 | 8.3 | 0.7 | 49 | 48 | 1 |
| 13322 | 57.1 | 6.0 | 39.4 | 51.2 | 9.4 | 0.5 | 48 | 45 | 3 |
| 13408 | 57.1 | 5.7 | 39.3 | 51.2 | 9.5 | 0.5 | 46 | 45 | 1 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 13350 | 56.4 | 6.5 | 40.4 | 51.3 | 8.3 | 0.5 | 44 | 46 | -2 |
| 13462 | 56.8 | 6.7 | 39.8 | 51.1 | 9.1 | 0.8 | 47 | 47 | 0 |
| 13513 | 54.6 | 6.4 | 42.4 | 50.1 | 7.5 | 0.8 | 43 | 48 | -5 |
| 14017 | 52.2 | 5.2 | 43.3 | 46.2 | 10.5 | 0.4 | 47 | 49 | -2 |
| 13787 | 51.3 | 5.3 | 44.8 | 46.3 | 8.9 | 0.5 | 50 | 47 | 3 |
| 13718 | 52.5 | 6.3 | 45.4 | 49.6 | 5.0 | 0.6 | 48 | 48 | 0 |
| 14040 | 51.1 | 5.3 | 46.6 | 48.2 | 5.2 | 0.5 | 49 | 45 | 4 |
| 13888 | 51.5 | 5.0 | 45.1 | 47.0 | 7.9 | 0.5 | 45 | 47 | -2 |
| 13906 | 52.1 | 5.0 | 43.9 | 46.7 | 9.4 | 0.6 | 49 | 48 | 1 |
| 13407 | 56.8 | 6.1 | 37.7 | 47.8 | 14.5 | 0.7 | 46 | 46 | 0 |
| 12692 | 50.0 | 7.1 | 44.9 | 42.4 | 12.7 | 5.7 | 58 | 51 | 7 |
| 12886 | 55.3 | 7.3 | 41.2 | 49.9 | 8.9 | 0.4 | 47 | 47 | 0 |
| 12673 | 57.3 | 8.8 | 40.3 | 53.1 | 6.6 | 0.5 | 50 | 47 | 3 |
| 13264 | 51.0 | 6.3 | 45.0 | 45.9 | 9.1 | 0.6 | 48 | 48 | 0 |
| 11539 | 55.4 | 13.9 | 43.1 | 52.6 | 4.3 | 1.5 | 46 | 55 | -9 |
| 15072 | 67.1 | 3.2 | 31.4 | 62.4 | 6.2 | 0.8 | 74 | 69 | 5 |
| 15112 | 66.2 | 3.0 | 32.2 | 61.4 | 6.4 | 1.2 | 72 | 68 | 4 |
| 15198 | 68.2 | 2.5 | 30.1 | 62.7 | 7.2 | 0.8 | 73 | 74 | -1 |
| 14918 | 68.4 | 4.1 | 29.7 | 62.4 | 7.9 | 0.9 | 73 | 75 | -2 |
| 15406 | 75.9 | 2.7 | 22.0 | 63.0 | 15.0 | 2.3 | 95 | 96 | -1 |
| 15313 | 75.8 | 2.2 | 22.4 | 66.7 | 10.9 | 0.6 | 93 | 96 | -3 |
| 15251 | 68.9 | 2.5 | 29.6 | 64.0 | 6.4 | 0.7 | 78 | 76 | 2 |
| 14733 | 68.1 | 5.7 | 30.8 | 64.7 | 4.5 | 0.6 | 83 | 72 | 11 |
| 15046 | 66.2 | 2.7 | 32.3 | 61.9 | 5.8 | 0.9 | 71 | 66 | 5 |
| 15176 | 66.0 | 2.6 | 32.5 | 61.4 | 6.1 | 1.3 | 64 | 68 | -4 |
| 15201 | 77.7 | 3.9 | 21.5 | 72.7 | 5.8 | 0.5 | 104 | 99 | 5 |
| 15353 | 75.6 | 3.1 | 23.4 | 70.4 | 6.2 | 0.5 | 99 | 97 | 2 |
| 15138 | 72.9 | 4.1 | 25.7 | 67.1 | 7.2 | 0.6 | 96 | 91 | 5 |
| 15324 | 75.6 | 3.0 | 22.9 | 66.3 | 10.8 | 1.8 | 100 | 102 | -2 |
| 14819 | 67.2 | 4.0 | 30.7 | 61.0 | 8.3 | 0.8 | 66 | 70 | -4 |
| 14762 | 64.5 | 4.1 | 33.8 | 60.4 | 5.8 | 0.5 | 59 | 59 | 0 |
| 15398 | 73.6 | 2.4 | 24.8 | 66.3 | 8.9 | 1.0 | 96 | 95 | 1 |
| 15321 | 67.0 | 1.8 | 31.7 | 62.9 | 5.4 | 0.7 | 68 | 69 | -1 |
| 15220 | 64.0 | 1.8 | 34.5 | 59.8 | 5.7 | 1.5 | 64 | 61 | 3 |
| 15157 | 65.7 | 2.0 | 32.8 | 61.5 | 5.7 | 0.7 | 62 | 63 | -1 |
| 15144 | 65.4 | 2.2 | 32.8 | 60.4 | 6.8 | 0.8 | 61 | 63 | -2 |
| 14661 | 65.4 | 5.0 | 33.0 | 61.1 | 5.9 | 0.8 | 64 | 63 | 1 |
| 15319 | 69.0 | 2.7 | 29.6 | 63.2 | 7.2 | 1.8 | 82 | 83 | -1 |
| 15313 | 64.7 | 2.2 | 32.8 | 58.4 | 8.8 | 0.6 | 65 | 63 | 2 |
| 15219 | 66.4 | 2.5 | 31.0 | 59.0 | 10.0 | 1.1 | 70 | 69 | 1 |
| 15200 | 66.2 | 2.5 | 31.2 | 59.3 | 9.5 | 0.6 | 69 | 67 | 2 |
| 15270 | 62.5 | 1.8 | 35.1 | 57.2 | 7.7 | 0.7 | 58 | 56 | 2 |
| 15255 | 65.2 | 1.9 | 32.9 | 60.2 | 6.9 | 0.6 | 64 | 63 | 1 |
| 15227 | 65.9 | 2.3 | 31.8 | 59.4 | 8.8 | 1.0 | 60 | 66 | -6 |
| 15321 | 67.0 | 2.2 | 30.4 | 59.5 | 10.1 | 0.8 | 75 | 70 | 5 |
| 14638 | 57.2 | 2.9 | 39.7 | 51.3 | 9.0 | 1.9 | 49 | 51 | -2 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 14614 | 58.4 | 2.4 | 37.2 | 49.5 | 13.3 | 3.2 | 49 | 55 | -6 |
| 15007 | 61.4 | 2.3 | 35.0 | 53.9 | 11.1 | 0.6 | 51 | 54 | -3 |
| 15136 | 62.4 | 1.8 | 35.2 | 57.1 | 7.7 | 0.6 | 51 | 54 | -3 |
| 15024 | 60.4 | 3.0 | 37.2 | 55.2 | 7.6 | 1.2 | 60 | 53 | 7 |
| 15134 | 74.5 | 4.6 | 24.3 | 68.4 | 7.3 | 0.8 | 94 | 97 | -3 |
| 14497 | 78.5 | 6.9 | 20.7 | 72.8 | 6.5 | 0.7 | 109 | 102 | 7 |
| 15259 | 73.3 | 3.5 | 25.2 | 66.5 | 8.3 | 0.9 | 96 | 94 | 2 |
| 14937 | 68.0 | 4.9 | 30.4 | 63.2 | 6.4 | 0.5 | 73 | 73 | 0 |
| 14410 | 63.4 | 4.6 | 34.2 | 57.8 | 8.0 | 0.8 | 57 | 56 | 1 |
| 14758 | 62.7 | 3.5 | 34.8 | 56.9 | 8.3 | 0.7 | 48 | 55 | -7 |
| 14317 | 67.7 | 6.1 | 31.2 | 64.2 | 4.6 | 0.7 | 68 | 70 | -2 |
| 14962 | 64.7 | 3.1 | 32.7 | 58.4 | 8.9 | 0.6 | 66 | 61 | 5 |
| 15137 | 64.3 | 2.2 | 34.3 | 60.5 | 5.2 | 0.8 | 67 | 59 | 8 |
| 14971 | 63.4 | 2.2 | 35.8 | 60.4 | 3.8 | 1.9 | 65 | 61 | 4 |
| 14663 | 62.2 | 2.9 | 35.3 | 56.6 | 8.1 | 0.6 | 49 | 52 | -3 |
| 14831 | 61.8 | 4.3 | 36.5 | 57.7 | 5.8 | 1.4 | 61 | 55 | 6 |
| 15121 | 65.6 | 2.5 | 31.9 | 58.6 | 9.5 | 1.2 | 68 | 65 | 3 |
| 15042 | 66.6 | 3.1 | 32.6 | 63.8 | 3.6 | 0.8 | 67 | 67 | 0 |
| 14988 | 58.2 | 2.8 | 38.4 | 50.7 | 10.9 | 3.9 | 68 | 61 | 7 |
| 14961 | 58.7 | 2.9 | 38.0 | 51.0 | 11.0 | 4.0 | 64 | 62 | 2 |
| 14691 | 55.4 | 3.0 | 41.7 | 50.2 | 8.1 | 2.5 | 53 | 53 | 0 |
| 14461 | 56.6 | 4.2 | 39.8 | 49.8 | 10.4 | 3.0 | 60 | 55 | 5 |
| 15327 | 69.6 | 2.3 | 29.5 | 65.8 | 4.7 | 1.1 | 86 | 81 | 5 |
| 14383 | 73.2 | 7.2 | 24.9 | 64.5 | 10.6 | 1.3 | 81 | 96 | -15 |
| 14786 | 71.3 | 5.2 | 27.6 | 66.9 | 5.5 | 0.8 | 80 | 86 | -6 |
| 14754 | 73.4 | 4.9 | 25.1 | 66.2 | 8.7 | 1.2 | 84 | 95 | -11 |
| 14032 | 57.5 | 7.6 | 39.2 | 50.4 | 10.4 | 3.8 | 61 | 60 | 1 |
| 14307 | 56.8 | 5.2 | 40.1 | 50.6 | 9.3 | 3.1 | 61 | 56 | 5 |
| 13154 | 59.1 | 10.2 | 37.8 | 52.2 | 10.0 | 2.9 | 69 | 59 | 10 |
| 14720 | 57.7 | 3.5 | 39.4 | 51.2 | 9.4 | 3.6 | 60 | 58 | 2 |
| 14377 | 59.3 | 5.7 | 38.2 | 53.2 | 8.6 | 3.2 | 66 | 59 | 7 |
| 13797 | 62.3 | 8.2 | 35.8 | 57.2 | 7.0 | 2.1 | 68 | 60 | 8 |
| 14427 | 56.6 | 4.0 | 40.1 | 50.0 | 9.9 | 3.4 | 59 | 56 | 3 |
| 14622 | 57.7 | 3.4 | 39.3 | 51.2 | 9.5 | 3.5 | 63 | 57 | 6 |
| 14864 | 66.2 | 3.0 | 32.1 | 61.4 | 6.5 | 0.7 | 58 | 65 | -7 |
| 14714 | 65.3 | 4.1 | 31.4 | 56.9 | 11.7 | 0.7 | 63 | 64 | -1 |
| 14493 | 59.3 | 3.4 | 38.4 | 54.2 | 7.4 | 1.9 | 44 | 51 | -7 |
| 14464 | 58.4 | 3.5 | 39.6 | 54.1 | 6.3 | 1.9 | 46 | 50 | -4 |
| 14319 | 58.2 | 4.5 | 39.3 | 53.4 | 7.3 | 1.5 | 45 | 49 | -4 |
| 15082 | 64.2 | 1.9 | 34.6 | 61.0 | 4.4 | 0.6 | 56 | 58 | -2 |
| 15094 | 65.4 | 2.4 | 33.0 | 61.0 | 6.0 | 0.6 | 59 | 62 | -3 |
| 14705 | 62.2 | 3.9 | 35.5 | 57.0 | 7.5 | 0.7 | 57 | 53 | 4 |
| 15015 | 64.0 | 2.4 | 34.3 | 59.7 | 6.0 | 0.8 | 55 | 58 | -3 |
| 14351 | 62.4 | 4.2 | 35.4 | 57.5 | 7.1 | 0.6 | 43 | 52 | -9 |
| 14410 | 62.8 | 4.0 | 35.1 | 58.1 | 6.8 | 0.5 | 43 | 53 | -10 |
| 14712 | 63.2 | 3.7 | 34.0 | 56.4 | 9.6 | 1.1 | 52 | 57 | -5 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 14552 | 62.7 | 4.2 | 35.8 | 59.3 | 4.9 | 0.5 | 54 | 53 | 1 |
| 14592 | 60.7 | 3.5 | 35.0 | 52.1 | 12.9 | 0.7 | 47 | 52 | -5 |
| 14529 | 57.5 | 4.4 | 38.7 | 49.5 | 11.8 | 3.8 | 61 | 60 | 1 |
| 14860 | 60.3 | 3.2 | 37.7 | 55.9 | 6.4 | 1.5 | 56 | 52 | 4 |
| 14574 | 59.4 | 3.2 | 37.7 | 53.2 | 9.1 | 2.3 | 59 | 54 | 5 |
| 13186 | 52.9 | 7.8 | 42.7 | 46.3 | 11.0 | 2.5 | 46 | 53 | -7 |
| 14972 | 79.6 | 5.1 | 20.1 | 76.6 | 3.3 | 0.5 | 103 | 96 | 7 |
| 15452 | 74.9 | 1.9 | 23.8 | 68.8 | 7.4 | 0.6 | 97 | 96 | 1 |
| 14286 | 61.3 | 5.8 | 36.3 | 56.1 | 7.6 | 0.8 | 50 | 51 | -1 |
| 13916 | 60.4 | 7.1 | 36.5 | 54.2 | 9.3 | 0.7 | 43 | 51 | -8 |
| 14386 | 63.5 | 5.5 | 35.1 | 59.9 | 5.0 | 0.8 | 61 | 56 | 5 |
| 15025 | 64.4 | 2.9 | 33.3 | 58.9 | 7.8 | 0.5 | 62 | 60 | 2 |
| 14312 | 57.7 | 4.6 | 38.1 | 49.8 | 12.1 | 2.1 | 38 | 53 | -15 |
| 14660 | 61.3 | 3.9 | 36.3 | 55.8 | 7.9 | 1.3 | 43 | 53 | -10 |
| 14716 | 62.1 | 3.1 | 35.3 | 56.0 | 8.7 | 1.2 | 45 | 53 | -8 |
| 14520 | 61.0 | 4.9 | 36.5 | 55.5 | 8.0 | 1.3 | 50 | 53 | -3 |
| 14685 | 61.4 | 3.6 | 36.6 | 56.5 | 6.9 | 1.7 | 46 | 55 | -9 |
| 14630 | 63.0 | 3.6 | 34.5 | 57.0 | 8.5 | 1.2 | 51 | 56 | -5 |
| 14996 | 65.9 | 2.7 | 32.3 | 60.8 | 6.9 | 0.9 | 86 | 65 | 21 |
| 14420 | 62.6 | 6.3 | 34.6 | 55.2 | 10.2 | 2.6 | 67 | 66 | 1 |
| 14769 | 61.5 | 3.0 | 34.9 | 53.4 | 11.7 | 1.6 | 66 | 55 | 11 |
| 14992 | 58.1 | 2.9 | 39.2 | 52.1 | 8.7 | 3.3 | 63 | 59 | 4 |
| 15041 | 62.4 | 2.5 | 35.3 | 55.7 | 9.0 | 3.3 | 69 | 66 | 3 |
| 14997 | 68.7 | 3.2 | 30.2 | 64.6 | 5.2 | 1.0 | 66 | 76 | -10 |
| 14840 | 68.6 | 4.1 | 30.3 | 64.8 | 4.9 | 0.9 | 68 | 75 | -7 |
| 14720 | 69.0 | 5.2 | 29.6 | 64.1 | 6.3 | 0.7 | 68 | 76 | -8 |
| 14791 | 62.6 | 3.3 | 34.7 | 56.5 | 8.8 | 0.7 | 49 | 55 | -6 |
| 14861 | 70.9 | 4.5 | 28.7 | 68.8 | 2.5 | 0.6 | 78 | 82 | -4 |
| 14598 | 64.0 | 3.7 | 34.5 | 60.2 | 5.3 | 0.8 | 48 | 57 | -9 |
| 14651 | 63.3 | 3.8 | 34.4 | 57.8 | 7.8 | 0.8 | 49 | 56 | -7 |
| 14821 | 62.5 | 2.8 | 35.6 | 57.8 | 6.6 | 1.1 | 51 | 54 | -3 |
| 14767 | 65.2 | 3.9 | 32.9 | 60.1 | 7.0 | 0.8 | 58 | 62 | -4 |
| 14636 | 68.1 | 6.3 | 30.4 | 63.1 | 6.5 | 0.8 | 76 | 73 | 3 |
| 14735 | 67.9 | 4.9 | 29.8 | 61.1 | 9.1 | 0.6 | 72 | 73 | -1 |
| 14930 | 68.6 | 3.3 | 28.9 | 60.2 | 10.9 | 1.3 | 72 | 76 | -4 |
| 15178 | 74.8 | 3.5 | 23.8 | 67.1 | 9.1 | 1.2 | 99 | 99 | 0 |
| 15170 | 75.3 | 3.1 | 21.8 | 59.5 | 18.7 | 2.2 | 94 | 87 | 7 |
| 15039 | 67.2 | 3.3 | 30.2 | 58.1 | 11.7 | 2.9 | 77 | 80 | -3 |
| 15009 | 67.5 | 3.2 | 29.4 | 57.0 | 13.6 | 2.7 | 77 | 78 | -1 |
| 15056 | 67.7 | 3.0 | 29.4 | 57.9 | 12.7 | 2.3 | 73 | 77 | -4 |
| 15021 | 67.2 | 2.9 | 30.0 | 57.5 | 12.5 | 2.9 | 77 | 78 | -1 |
| 14884 | 68.6 | 4.2 | 29.0 | 60.6 | 10.4 | 1.4 | 78 | 78 | 0 |
| 15102 | 68.1 | 3.1 | 29.7 | 59.7 | 10.6 | 2.7 | 85 | 82 | 3 |
| 14517 | 72.3 | 5.0 | 26.0 | 63.4 | 10.6 | 2.4 | 103 | 96 | 7 |
| 15076 | 67.3 | 3.0 | 30.0 | 57.8 | 12.2 | 2.8 | 76 | 79 | -3 |
| 15077 | 70.4 | 3.1 | 27.7 | 63.2 | 9.1 | 1.3 | 82 | 84 | -2 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 15045 | 70.0 | 3.1 | 27.8 | 61.5 | 10.7 | 1.9 | 85 | 84 | 1 |
| 15114 | 69.8 | 3.1 | 28.0 | 61.0 | 11.0 | 2.0 | 82 | 84 | -2 |
| 15017 | 70.1 | 3.6 | 27.7 | 61.4 | 10.9 | 2.0 | 84 | 86 | -2 |
| 14695 | 67.7 | 4.4 | 28.6 | 55.6 | 15.8 | 2.3 | 71 | 75 | -4 |
| 15165 | 68.1 | 2.7 | 29.3 | 58.1 | 12.6 | 3.3 | 80 | 83 | -3 |
| 15166 | 68.2 | 2.6 | 30.4 | 63.1 | 6.5 | 1.2 | 82 | 75 | 7 |
| 15087 | 67.7 | 2.7 | 29.3 | 58.6 | 12.1 | 1.2 | 73 | 72 | 1 |
| 14989 | 68.3 | 3.4 | 29.6 | 60.1 | 10.3 | 2.5 | 82 | 82 | 0 |
| 15152 | 67.8 | 2.9 | 29.0 | 56.6 | 14.4 | 2.9 | 78 | 79 | -1 |
| 15089 | 66.9 | 3.0 | 30.6 | 58.4 | 11.0 | 2.5 | 77 | 77 | 0 |
| 15070 | 67.8 | 3.0 | 29.9 | 60.4 | 9.7 | 1.2 | 74 | 73 | 1 |
| 14838 | 67.6 | 4.7 | 30.0 | 59.9 | 10.1 | 1.5 | 76 | 75 | 1 |
| 14867 | 64.4 | 4.1 | 32.6 | 55.7 | 11.7 | 2.8 | 72 | 71 | 1 |
| 14936 | 61.9 | 3.5 | 35.8 | 56.3 | 7.9 | 1.5 | 59 | 57 | 2 |
| 14495 | 77.8 | 7.6 | 21.5 | 72.5 | 6.0 | 1.0 | 93 | 103 | -10 |
| 8378 | 53.4 | 32.0 | 42.3 | 47.3 | 10.4 | 0.7 | 62 | 48 | 14 |
| 11719 | 54.7 | 12.1 | 41.6 | 49.2 | 9.2 | 0.4 | 53 | 50 | 3 |
| 11616 | 53.4 | 13.2 | 43.3 | 48.7 | 8.0 | 0.4 | 49 | 53 | -4 |
| 13310 | 53.2 | 5.7 | 43.4 | 48.3 | 8.3 | 0.7 | 50 | 48 | 2 |
| 9962 | 56.3 | 22.7 | 42.7 | 54.3 | 3.0 | 0.8 | 59 | 49 | 10 |
| 9867 | 52.6 | 23.5 | 44.4 | 48.2 | 7.4 | 1.1 | 53 | 53 | 0 |
| 9793 | 55.9 | 23.8 | 42.2 | 52.7 | 5.1 | 0.7 | 43 | 47 | -4 |
| 9471 | 57.1 | 25.2 | 41.0 | 53.9 | 5.1 | 0.5 | 58 | 47 | 11 |
| 9591 | 54.1 | 25.2 | 43.6 | 50.6 | 5.8 | 0.6 | 45 | 47 | -2 |
| 9551 | 53.4 | 22.8 | 41.1 | 45.6 | 13.3 | 0.9 | 43 | 52 | -9 |
| 12746 | 53.7 | 8.2 | 44.1 | 50.3 | 5.6 | 1.0 | 52 | 52 | 0 |
| 12453 | 54.9 | 10.4 | 43.2 | 51.7 | 5.1 | 1.1 | 53 | 52 | 1 |
| 12092 | 52.6 | 12.6 | 44.7 | 48.6 | 6.7 | 1.2 | 53 | 54 | -1 |
| 11832 | 53.7 | 14.2 | 43.9 | 50.1 | 6.0 | 1.1 | 57 | 53 | 4 |
| 14029 | 60.8 | 8.1 | 36.3 | 55.0 | 8.7 | 0.7 | 51 | 52 | -1 |
| 13981 | 60.1 | 5.1 | 34.8 | 49.8 | 15.6 | 1.0 | 46 | 50 | -4 |
| 14711 | 64.8 | 3.2 | 31.6 | 55.4 | 13.0 | 1.4 | 63 | 61 | 2 |
| 15026 | 66.8 | 3.0 | 32.2 | 63.0 | 4.8 | 1.6 | 69 | 72 | -3 |
| 14396 | 64.0 | 5.2 | 33.0 | 56.6 | 10.4 | 1.2 | 63 | 60 | 3 |
| 14054 | 65.2 | 6.4 | 31.0 | 55.6 | 13.4 | 0.8 | 56 | 63 | -7 |
| 14288 | 62.0 | 4.6 | 35.3 | 55.4 | 9.3 | 1.8 | 50 | 56 | -6 |
| 13590 | 63.3 | 7.3 | 33.0 | 54.9 | 12.1 | 0.6 | 50 | 57 | -7 |
| 15163 | 87.6 | 3.0 | 12.8 | 81.4 | 5.8 | 2.2 | 83 | 90 | -7 |
| 13880 | 57.1 | 4.9 | 40.7 | 53.3 | 6.0 | 0.6 | 46 | 45 | 1 |
| 11358 | 59.0 | 17.1 | 38.3 | 54.1 | 7.6 | 0.5 | 57 | 50 | 7 |
| 11505 | 58.1 | 14.9 | 38.3 | 51.8 | 9.9 | 0.7 | 49 | 50 | -1 |
| 11780 | 58.2 | 13.1 | 37.5 | 50.2 | 12.3 | 1.6 | 53 | 52 | 1 |
| 11672 | 58.5 | 14.6 | 38.9 | 53.8 | 7.3 | 0.5 | 56 | 49 | 7 |
| 13067 | 56.8 | 7.9 | 41.9 | 54.6 | 3.5 | 0.6 | 52 | 48 | 4 |
| 11791 | 58.4 | 11.0 | 35.1 | 47.2 | 17.7 | 0.4 | 45 | 46 | -1 |
| 11786 | 60.7 | 12.2 | 35.0 | 52.2 | 12.8 | 0.4 | 43 | 53 | -10 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 12339 | 58.0 | 9.3 | 38.1 | 51.3 | 10.6 | 0.5 | 43 | 46 | -3 |
| 12878 | 56.7 | 9.4 | 39.9 | 50.9 | 9.2 | 1.0 | 51 | 48 | 3 |
| 12673 | 55.5 | 8.3 | 41.3 | 50.4 | 8.3 | 0.6 | 52 | 48 | 4 |
| 12311 | 55.4 | 9.2 | 42.0 | 51.2 | 6.8 | 0.6 | 54 | 50 | 4 |
| 12467 | 57.0 | 10.2 | 40.2 | 52.2 | 7.6 | 0.5 | 54 | 48 | 6 |
| 12180 | 56.4 | 11.4 | 40.9 | 51.9 | 7.2 | 0.7 | 53 | 49 | 4 |
| 13539 | 58.6 | 6.2 | 40.2 | 56.3 | 3.5 | 0.4 | 51 | 46 | 5 |
| 13315 | 56.8 | 7.5 | 40.8 | 52.7 | 6.5 | 0.5 | 49 | 46 | 3 |
| 13739 | 58.0 | 5.8 | 40.0 | 54.3 | 5.7 | 0.5 | 49 | 46 | 3 |
| 13501 | 58.1 | 6.6 | 40.0 | 54.7 | 5.3 | 0.4 | 55 | 46 | 9 |
| 13724 | 57.2 | 5.7 | 39.5 | 51.6 | 8.9 | 0.4 | 46 | 46 | 0 |
| 14044 | 55.8 | 4.2 | 40.6 | 50.0 | 9.4 | 0.7 | 48 | 46 | 2 |
| 12869 | 54.4 | 7.3 | 40.1 | 46.4 | 13.5 | 0.5 | 44 | 46 | -2 |
| 13139 | 53.9 | 7.2 | 41.8 | 47.7 | 10.5 | 0.8 | 44 | 49 | -5 |
| 15119 | 64.3 | 2.1 | 29.7 | 50.2 | 20.1 | 0.8 | 61 | 58 | 3 |
| 15145 | 62.5 | 1.6 | 31.1 | 48.9 | 20.0 | 0.5 | 49 | 57 | -8 |
| 14872 | 61.9 | 2.2 | 33.0 | 51.3 | 15.7 | 0.5 | 58 | 54 | 4 |
| 13084 | 57.2 | 7.6 | 38.5 | 50.0 | 11.5 | 0.6 | 52 | 46 | 6 |
| 13321 | 56.7 | 8.1 | 39.6 | 50.6 | 9.8 | 0.7 | 45 | 48 | -3 |
| 13087 | 57.7 | 7.7 | 38.6 | 51.4 | 10.0 | 0.6 | 51 | 46 | 5 |
| 12955 | 56.2 | 9.3 | 41.0 | 51.5 | 7.5 | 1.2 | 48 | 49 | -1 |
| 12928 | 57.9 | 8.8 | 38.8 | 52.2 | 9.0 | 0.6 | 47 | 47 | 0 |
| 13150 | 56.7 | 6.4 | 39.9 | 50.9 | 9.2 | 0.8 | 44 | 45 | -1 |
| 12951 | 56.8 | 7.0 | 39.2 | 50.2 | 10.6 | 0.6 | 45 | 45 | 0 |
| 13415 | 62.0 | 7.7 | 34.6 | 54.9 | 10.5 | 0.5 | 54 | 53 | 1 |
| 12656 | 56.2 | 10.1 | 38.4 | 46.2 | 15.4 | 4.2 | 58 | 57 | 1 |
| 12628 | 54.5 | 11.5 | 41.0 | 46.7 | 12.3 | 3.7 | 58 | 57 | 1 |
| 12152 | 54.9 | 14.1 | 41.0 | 47.7 | 11.3 | 3.3 | 58 | 57 | 1 |
| 12325 | 57.5 | 14.0 | 39.4 | 51.4 | 9.2 | 2.1 | 61 | 54 | 7 |
| 12888 | 52.4 | 11.0 | 44.6 | 47.4 | 8.0 | 3.6 | 61 | 55 | 6 |
| 12351 | 55.6 | 13.8 | 41.0 | 49.2 | 9.8 | 3.5 | 62 | 57 | 5 |
| 14283 | 61.8 | 5.3 | 35.5 | 55.9 | 8.6 | 1.0 | 53 | 53 | 0 |
| 13846 | 60.2 | 7.3 | 37.0 | 54.4 | 8.6 | 1.0 | 49 | 50 | -1 |
| 13569 | 60.3 | 6.4 | 36.2 | 53.3 | 10.5 | 0.8 | 47 | 48 | -1 |
| 14154 | 58.8 | 5.0 | 38.7 | 53.9 | 7.4 | 1.1 | 52 | 48 | 4 |
| 14499 | 60.7 | 4.1 | 37.3 | 56.4 | 6.3 | 0.8 | 50 | 49 | 1 |
| 14275 | 59.4 | 5.2 | 38.7 | 55.5 | 5.8 | 1.0 | 49 | 48 | 1 |
| 14607 | 59.4 | 2.9 | 38.9 | 55.8 | 5.3 | 1.2 | 47 | 48 | -1 |
| 14437 | 59.2 | 3.6 | 37.8 | 53.0 | 9.2 | 1.9 | 49 | 51 | -2 |
| 14141 | 59.1 | 5.4 | 37.1 | 51.3 | 11.6 | 2.1 | 54 | 54 | 0 |
| 14361 | 60.0 | 4.8 | 37.3 | 54.4 | 8.3 | 1.3 | 47 | 51 | -4 |
| 13177 | 62.5 | 8.8 | 35.4 | 57.6 | 7.0 | 0.9 | 57 | 55 | 2 |
| 12319 | 54.9 | 13.6 | 40.2 | 45.5 | 14.3 | 6.2 | 54 | 62 | -8 |
| 13163 | 56.2 | 9.1 | 39.5 | 47.8 | 12.7 | 4.5 | 61 | 58 | 3 |
| 13120 | 59.5 | 10.0 | 36.9 | 50.9 | 12.2 | 4.2 | 62 | 64 | -2 |
| 14498 | 77.8 | 4.8 | 20.5 | 65.5 | 14.0 | 1.8 | 101 | 105 | -4 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 15342 | 82.1 | 1.6 | 17.4 | 72.7 | 9.9 | 2.0 | 103 | 104 | -1 |
| 12626 | 55.3 | 12.5 | 41.0 | 48.3 | 10.7 | 4.1 | 58 | 58 | 0 |
| 7949 | 50.4 | 32.3 | 40.7 | 39.2 | 20.1 | 2.1 | 56 | 54 | 2 |
| 6506 | 52.2 | 43.7 | 43.1 | 45.6 | 11.3 | 1.4 | 54 | 60 | -6 |
| 7468 | 54.6 | 36.1 | 40.0 | 46.6 | 13.4 | 0.5 | 41 | 57 | -16 |
| 7729 | 53.5 | 35.5 | 42.5 | 47.8 | 9.7 | 0.6 | 53 | 47 | 6 |
| 6565 | 51.5 | 43.8 | 43.7 | 45.1 | 11.2 | 1.4 | 55 | 56 | -1 |
| 7493 | 51.0 | 33.1 | 38.6 | 37.4 | 24.0 | 2.8 | 52 | 53 | -1 |
| 7069 | 51.2 | 38.5 | 43.5 | 44.5 | 12.0 | 0.6 | 37 | 46 | -9 |
| 6925 | 52.5 | 38.9 | 41.3 | 44.0 | 14.7 | 0.9 | 54 | 56 | -2 |
| 7510 | 53.1 | 35.3 | 41.5 | 45.4 | 13.1 | 1.3 | 68 | 51 | 17 |
| 6995 | 52.0 | 39.5 | 43.3 | 45.4 | 11.3 | 1.6 | 42 | 48 | -6 |
| 7422 | 52.5 | 36.0 | 42.0 | 44.7 | 13.3 | 1.7 | 64 | 50 | 14 |
| 6773 | 55.9 | 39.1 | 39.1 | 48.2 | 12.7 | 0.3 | 81 | 70 | 11 |
| 6845 | 53.4 | 39.6 | 41.2 | 45.8 | 13.0 | 0.7 | 58 | 58 | 0 |
| 14162 | 52.1 | 3.9 | 43.6 | 44.9 | 11.5 | 5.3 | 58 | 56 | 2 |
| 14475 | 60.0 | 3.4 | 37.6 | 53.6 | 8.8 | 3.7 | 61 | 59 | 2 |
| 14251 | 59.1 | 4.6 | 37.5 | 51.9 | 10.6 | 2.4 | 54 | 54 | 0 |
| 14737 | 56.1 | 2.9 | 37.5 | 42.8 | 19.7 | 8.7 | 61 | 56 | 5 |
| 12822 | 61.1 | 10.0 | 34.1 | 50.3 | 15.6 | 2.6 | 67 | 60 | 7 |
| 10191 | 60.2 | 21.0 | 37.8 | 55.4 | 6.8 | 2.1 | 66 | 64 | 2 |
| 12630 | 55.3 | 10.8 | 40.7 | 47.6 | 11.7 | 4.4 | 54 | 57 | -3 |
| 12905 | 54.1 | 9.4 | 41.0 | 46.2 | 12.8 | 3.1 | 54 | 55 | -1 |
| 14139 | 55.1 | 4.3 | 40.6 | 47.6 | 11.8 | 3.2 | 55 | 54 | 1 |
| 13207 | 56.6 | 9.1 | 39.3 | 48.6 | 12.1 | 3.8 | 55 | 58 | -3 |
| 13726 | 55.6 | 6.2 | 39.7 | 47.1 | 13.2 | 3.8 | 57 | 56 | 1 |
| 12696 | 54.8 | 10.3 | 42.5 | 49.7 | 7.8 | 3.2 | 54 | 55 | -1 |
| 12044 | 53.4 | 14.7 | 42.8 | 47.2 | 10.0 | 3.2 | 51 | 56 | -5 |
| 13484 | 52.5 | 6.8 | 43.3 | 46.0 | 10.7 | 3.2 | 51 | 54 | -3 |
| 13237 | 52.7 | 7.3 | 42.9 | 45.7 | 11.4 | 3.6 | 49 | 54 | -5 |
| 12941 | 56.2 | 9.3 | 40.5 | 49.5 | 10.0 | 3.8 | 50 | 56 | -6 |
| 12938 | 52.5 | 9.1 | 43.5 | 46.2 | 10.3 | 3.1 | 54 | 55 | -1 |
| 13167 | 53.2 | 8.0 | 43.3 | 47.4 | 9.3 | 3.4 | 50 | 54 | -4 |
| 12852 | 54.9 | 10.5 | 43.0 | 51.1 | 5.9 | 2.1 | 51 | 52 | -1 |
| 12967 | 54.3 | 8.9 | 40.1 | 44.9 | 15.0 | 4.3 | 51 | 56 | -5 |
| 13635 | 56.7 | 6.8 | 38.3 | 47.1 | 14.6 | 3.9 | 50 | 57 | -7 |
| 15066 | 63.2 | 2.3 | 34.4 | 55.7 | 9.9 | 3.8 | 71 | 70 | 1 |
| 14348 | 64.4 | 4.4 | 33.4 | 58.6 | 8.0 | 1.2 | 59 | 60 | -1 |
| 14288 | 63.3 | 5.3 | 34.5 | 57.5 | 8.0 | 1.8 | 56 | 60 | -4 |
| 14386 | 66.0 | 5.8 | 31.1 | 57.8 | 11.1 | 1.5 | 69 | 69 | 0 |
| 15264 | 83.5 | 2.9 | 15.8 | 71.8 | 12.4 | 1.8 | 83 | 101 | -18 |
| 14225 | 61.0 | 5.1 | 36.4 | 55.0 | 8.6 | 1.9 | 52 | 55 | -3 |
| 14091 | 58.4 | 4.9 | 38.0 | 50.5 | 11.5 | 3.7 | 53 | 57 | -4 |
| 15348 | 78.6 | 2.6 | 20.8 | 71.0 | 8.2 | 2.2 | 116 | 109 | 7 |
| 15260 | 76.5 | 2.7 | 22.4 | 69.7 | 7.9 | 1.0 | 111 | 102 | 9 |
| 15180 | 75.1 | 2.9 | 23.4 | 65.7 | 10.9 | 2.0 | 110 | 100 | 10 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 15067 | 70.5 | 3.2 | 28.0 | 64.3 | 7.7 | 1.4 | 82 | 85 | -3 |
| 15439 | 72.4 | 2.3 | 25.5 | 62.1 | 12.4 | 2.6 | 91 | 94 | -3 |
| 15288 | 77.4 | 2.5 | 21.5 | 70.5 | 8.0 | 0.9 | 114 | 103 | 11 |
| 15256 | 73.3 | 2.8 | 24.8 | 64.4 | 10.8 | 1.4 | 94 | 93 | 1 |
| 15342 | 79.4 | 3.1 | 20.0 | 72.2 | 7.8 | 1.8 | 106 | 110 | -4 |
| 15474 | 73.1 | 1.8 | 25.1 | 63.5 | 11.4 | 2.4 | 92 | 95 | -3 |
| 15088 | 74.6 | 3.0 | 23.9 | 66.4 | 9.7 | 1.4 | 90 | 98 | -8 |
| 15258 | 74.9 | 2.9 | 23.3 | 66.0 | 10.7 | 1.1 | 96 | 98 | -2 |
| 14752 | 75.4 | 4.4 | 23.5 | 66.5 | 10.0 | 3.0 | 105 | 108 | -3 |
| 15126 | 72.1 | 2.7 | 25.2 | 61.5 | 13.3 | 1.0 | 84 | 85 | -1 |
| 15206 | 76.6 | 3.6 | 22.6 | 68.1 | 9.3 | 2.9 | 106 | 109 | -3 |
| 15415 | 77.5 | 3.0 | 21.7 | 66.7 | 11.6 | 3.9 | 103 | 110 | -7 |
| 15112 | 75.5 | 3.7 | 23.4 | 68.6 | 8.0 | 1.4 | 106 | 102 | 4 |
| 15056 | 75.9 | 3.5 | 22.0 | 64.8 | 13.2 | 1.1 | 92 | 98 | -6 |
| 14753 | 77.9 | 5.1 | 20.9 | 67.9 | 11.2 | 2.0 | 116 | 108 | 8 |
| 14932 | 58.5 | 3.3 | 38.4 | 51.4 | 10.2 | 3.9 | 57 | 62 | -5 |
| 14696 | 59.7 | 3.2 | 37.3 | 52.5 | 10.2 | 3.3 | 60 | 59 | 1 |
| 14678 | 55.3 | 4.0 | 42.6 | 50.4 | 7.0 | 4.5 | 49 | 57 | -8 |
| 14722 | 61.3 | 3.0 | 35.4 | 54.1 | 10.5 | 1.1 | 57 | 52 | 5 |
| 14218 | 62.5 | 5.1 | 34.6 | 55.8 | 9.6 | 1.1 | 62 | 54 | 8 |
| 15313 | 74.0 | 2.8 | 24.0 | 64.7 | 11.3 | 1.1 | 90 | 95 | -5 |
| 15362 | 71.9 | 2.8 | 27.0 | 66.6 | 6.4 | 1.2 | 93 | 91 | 2 |
| 14116 | 72.9 | 7.4 | 25.3 | 65.1 | 9.6 | 0.8 | 108 | 93 | 15 |
| 15335 | 73.7 | 2.9 | 24.8 | 65.2 | 10.0 | 2.0 | 95 | 98 | -3 |
| 15135 | 70.4 | 2.8 | 28.1 | 64.6 | 7.3 | 1.1 | 86 | 83 | 3 |
| 14467 | 71.6 | 5.1 | 26.3 | 63.6 | 10.1 | 0.7 | 91 | 86 | 5 |
| 14851 | 70.4 | 4.1 | 28.1 | 64.9 | 7.0 | 0.8 | 83 | 82 | 1 |
| 15134 | 75.4 | 3.2 | 23.2 | 68.3 | 8.5 | 0.6 | 89 | 97 | -8 |
| 14907 | 73.9 | 4.5 | 25.0 | 67.4 | 7.6 | 1.6 | 94 | 99 | -5 |
| 15383 | 76.6 | 2.7 | 22.6 | 67.2 | 10.2 | 3.4 | 102 | 109 | -7 |
| 15297 | 75.6 | 2.7 | 23.2 | 64.5 | 12.3 | 3.9 | 100 | 105 | -5 |
| 15468 | 79.2 | 1.9 | 19.9 | 71.7 | 8.4 | 1.2 | 115 | 107 | 8 |
| 15188 | 71.5 | 2.9 | 26.2 | 62.0 | 11.8 | 1.5 | 91 | 87 | 4 |
| 14775 | 77.6 | 5.4 | 21.5 | 68.6 | 9.9 | 2.4 | 100 | 110 | -10 |
| 15079 | 78.5 | 3.9 | 20.6 | 68.9 | 10.5 | 2.4 | 114 | 108 | 6 |
| 14562 | 74.8 | 5.4 | 23.7 | 67.2 | 9.1 | 1.0 | 93 | 99 | -6 |
| 15434 | 72.4 | 2.3 | 25.9 | 63.3 | 10.8 | 2.8 | 92 | 97 | -5 |
| 14883 | 75.7 | 4.6 | 23.2 | 66.0 | 10.8 | 3.2 | 98 | 109 | -11 |
| 15152 | 75.5 | 3.3 | 23.0 | 65.3 | 11.7 | 2.5 | 94 | 102 | -8 |
| 15350 | 72.5 | 1.8 | 26.2 | 64.8 | 9.0 | 2.5 | 88 | 95 | -7 |
| 14600 | 73.6 | 5.0 | 24.9 | 63.1 | 12.0 | 3.9 | 102 | 106 | -4 |
| 15018 | 59.8 | 2.6 | 36.4 | 51.3 | 12.3 | 3.3 | 67 | 62 | 5 |
| 14431 | 69.8 | 4.3 | 27.9 | 62.1 | 10.0 | 0.7 | 87 | 78 | 9 |
| 15300 | 71.4 | 2.3 | 26.8 | 63.6 | 9.6 | 1.8 | 88 | 89 | -1 |
| 15258 | 70.5 | 2.9 | 27.7 | 61.2 | 11.1 | 3.4 | 95 | 94 | 1 |
| 15325 | 69.2 | 2.4 | 28.2 | 59.8 | 12.0 | 1.7 | 79 | 80 | -1 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 15075 | 77.8 | 3.9 | 21.5 | 68.1 | 10.4 | 3.4 | 110 | 112 | -2 |
| 14924 | 69.2 | 3.7 | 28.1 | 60.5 | 11.4 | 0.8 | 81 | 77 | 4 |
| 14339 | 70.7 | 5.3 | 27.0 | 62.4 | 10.6 | 0.9 | 71 | 84 | -13 |
| 14782 | 65.0 | 3.3 | 31.8 | 55.9 | 12.3 | 2.1 | 76 | 66 | 10 |
| 14109 | 63.1 | 5.1 | 34.4 | 56.8 | 8.8 | 1.4 | 67 | 56 | 11 |
| 14997 | 63.5 | 3.1 | 33.9 | 56.3 | 9.8 | 2.2 | 65 | 64 | 1 |
| 14773 | 70.1 | 4.6 | 27.3 | 59.7 | 13.0 | 2.5 | 93 | 87 | 6 |
| 14251 | 68.5 | 5.2 | 29.9 | 63.2 | 6.9 | 0.9 | 89 | 75 | 14 |
| 14738 | 61.7 | 3.1 | 35.0 | 54.2 | 10.8 | 1.4 | 66 | 54 | 12 |
| 15380 | 82.1 | 2.2 | 17.3 | 72.2 | 10.5 | 1.9 | 106 | 105 | 1 |
| 15571 | 80.3 | 2.0 | 19.0 | 70.5 | 10.5 | 2.3 | 97 | 106 | -9 |
| 14974 | 77.8 | 3.7 | 20.8 | 69.3 | 9.9 | 0.7 | 95 | 102 | -7 |
| 15256 | 77.7 | 2.6 | 20.3 | 64.6 | 15.1 | 1.6 | 97 | 97 | 0 |
| 15280 | 82.8 | 2.8 | 16.7 | 74.9 | 8.4 | 1.3 | 102 | 107 | -5 |
| 15534 | 69.8 | 1.3 | 27.6 | 58.0 | 14.4 | 4.0 | 84 | 85 | -1 |
| 15372 | 82.1 | 2.2 | 17.1 | 72.4 | 10.5 | 1.4 | 101 | 106 | -5 |
| 15304 | 83.1 | 2.5 | 16.7 | 71.9 | 11.4 | 3.2 | 106 | 101 | 5 |
| 14998 | 82.1 | 3.6 | 16.0 | 62.3 | 21.7 | 1.9 | 86 | 81 | 5 |
| 15061 | 80.3 | 3.9 | 18.7 | 71.6 | 9.7 | 1.1 | 99 | 108 | -9 |
| 15173 | 80.8 | 3.1 | 18.6 | 69.9 | 11.5 | 3.0 | 104 | 106 | -2 |
| 15332 | 83.0 | 2.7 | 15.8 | 70.8 | 13.4 | 0.7 | 97 | 99 | -2 |
| 15285 | 79.4 | 3.1 | 19.8 | 73.5 | 6.7 | 0.7 | 102 | 104 | -2 |
| 15417 | 81.9 | 2.6 | 17.6 | 72.6 | 9.8 | 2.0 | 105 | 107 | -2 |
| 15259 | 82.4 | 2.3 | 17.1 | 72.2 | 10.7 | 2.3 | 100 | 104 | -4 |
| 14442 | 59.0 | 3.4 | 38.1 | 53.4 | 8.5 | 1.1 | 47 | 48 | -1 |
| 14288 | 60.0 | 3.8 | 35.6 | 51.3 | 13.1 | 1.2 | 46 | 49 | -3 |
| 14105 | 60.8 | 4.7 | 34.5 | 51.2 | 14.3 | 1.1 | 46 | 50 | -4 |
| 14601 | 59.7 | 2.9 | 38.5 | 55.8 | 5.7 | 1.3 | 46 | 49 | -3 |
| 14147 | 62.3 | 6.2 | 35.6 | 57.5 | 6.9 | 0.7 | 47 | 53 | -6 |
| 13405 | 61.9 | 7.9 | 35.6 | 56.2 | 8.2 | 1.0 | 55 | 53 | 2 |
| 14177 | 60.3 | 4.5 | 36.2 | 53.0 | 10.8 | 1.4 | 52 | 50 | 2 |
| 14498 | 60.8 | 3.8 | 35.7 | 53.5 | 10.8 | 1.1 | 48 | 51 | -3 |
| 14553 | 67.9 | 4.2 | 30.0 | 61.5 | 8.5 | 0.8 | 63 | 71 | -8 |
| 14905 | 68.4 | 2.7 | 29.1 | 60.9 | 10.0 | 0.6 | 58 | 72 | -14 |
| 14700 | 69.2 | 4.1 | 28.4 | 61.2 | 10.4 | 0.9 | 61 | 77 | -16 |
| 14598 | 61.9 | 2.8 | 34.7 | 54.7 | 10.6 | 0.8 | 47 | 51 | -4 |
| 14732 | 59.9 | 2.5 | 35.2 | 48.8 | 16.0 | 4.3 | 48 | 59 | -11 |
| 13215 | 62.3 | 8.3 | 34.3 | 55.0 | 10.7 | 0.7 | 63 | 54 | 9 |
| 14063 | 62.8 | 6.0 | 35.2 | 58.2 | 6.6 | 0.8 | 51 | 54 | -3 |
| 13771 | 53.9 | 4.6 | 43.5 | 50.2 | 6.3 | 0.3 | 43 | 47 | -4 |
| 13125 | 52.3 | 7.8 | 45.2 | 48.9 | 5.9 | 0.7 | 47 | 50 | -3 |
| 13487 | 53.4 | 6.4 | 44.1 | 49.9 | 6.0 | 0.4 | 44 | 48 | -4 |
| 13979 | 51.8 | 4.8 | 44.5 | 46.9 | 8.6 | 0.5 | 48 | 47 | 1 |
| 15018 | 66.1 | 3.3 | 32.0 | 60.5 | 7.5 | 1.0 | 66 | 67 | -1 |
| 14953 | 66.2 | 3.5 | 32.9 | 63.3 | 3.8 | 1.0 | 61 | 66 | -5 |
| 14965 | 60.7 | 3.2 | 36.7 | 55.4 | 7.9 | 0.6 | 46 | 52 | -6 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 14746 | 60.2 | 3.9 | 37.0 | 53.3 | 9.7 | 3.4 | 63 | 62 | 1 |
| 14552 | 58.9 | 5.0 | 37.6 | 50.8 | 11.6 | 4.2 | 60 | 63 | -3 |
| 14761 | 62.6 | 2.9 | 34.9 | 55.8 | 9.3 | 2.7 | 63 | 62 | 1 |
| 14723 | 60.7 | 3.4 | 36.8 | 55.0 | 8.2 | 1.8 | 49 | 54 | -5 |
| 14233 | 56.6 | 5.1 | 40.1 | 50.5 | 9.4 | 2.3 | 55 | 53 | 2 |
| 15289 | 80.3 | 2.8 | 18.7 | 70.9 | 10.4 | 1.2 | 97 | 107 | -10 |
| 14680 | 58.6 | 3.5 | 39.1 | 53.2 | 7.7 | 3.1 | 62 | 57 | 5 |
| 14248 | 58.0 | 6.2 | 39.6 | 52.3 | 8.1 | 3.7 | 61 | 59 | 2 |
| 14797 | 55.8 | 2.4 | 41.4 | 50.0 | 8.6 | 4.1 | 61 | 57 | 4 |
| 14913 | 56.1 | 2.5 | 40.9 | 49.9 | 9.2 | 3.8 | 58 | 58 | 0 |
| 14634 | 55.6 | 4.0 | 41.0 | 49.0 | 10.0 | 4.0 | 58 | 58 | 0 |
| 14848 | 57.5 | 2.7 | 39.4 | 50.9 | 9.7 | 3.4 | 59 | 57 | 2 |
| 14619 | 57.0 | 3.3 | 38.2 | 48.2 | 13.6 | 2.8 | 58 | 56 | 2 |
| 14708 | 57.0 | 3.2 | 39.3 | 49.4 | 11.3 | 3.7 | 60 | 58 | 2 |
| 14790 | 57.4 | 3.2 | 39.4 | 50.5 | 10.1 | 3.9 | 60 | 59 | 1 |
| 14421 | 56.2 | 4.0 | 40.6 | 49.8 | 9.6 | 3.4 | 60 | 55 | 5 |
| 14269 | 56.6 | 5.5 | 40.4 | 50.5 | 9.1 | 3.5 | 56 | 57 | -1 |
| 14482 | 56.4 | 4.2 | 40.8 | 50.7 | 8.5 | 3.1 | 57 | 55 | 2 |
| 14660 | 60.9 | 3.7 | 37.5 | 57.5 | 5.0 | 0.6 | 53 | 49 | 4 |
| 14236 | 60.1 | 4.1 | 35.0 | 50.0 | 15.0 | 2.0 | 46 | 52 | -6 |
| 14638 | 60.7 | 3.1 | 35.0 | 51.8 | 13.2 | 1.2 | 54 | 51 | 3 |
| 14714 | 60.5 | 3.2 | 37.8 | 57.0 | 5.2 | 0.8 | 55 | 49 | 6 |
| 14572 | 61.6 | 3.3 | 33.7 | 51.9 | 14.4 | 0.7 | 45 | 52 | -7 |
| 14756 | 66.4 | 4.7 | 32.1 | 61.8 | 6.1 | 1.0 | 72 | 67 | 5 |
| 14040 | 57.6 | 5.5 | 38.7 | 50.1 | 11.2 | 3.3 | 63 | 56 | 7 |
| 14505 | 54.8 | 3.3 | 41.5 | 47.8 | 10.7 | 4.3 | 59 | 56 | 3 |
| 14869 | 62.5 | 2.9 | 35.1 | 56.7 | 8.2 | 1.3 | 55 | 56 | -1 |
| 14570 | 63.1 | 4.4 | 34.7 | 57.2 | 8.1 | 1.8 | 52 | 60 | -8 |
| 14812 | 60.2 | 2.6 | 37.4 | 55.3 | 7.3 | 0.8 | 58 | 49 | 9 |
| 15043 | 58.2 | 2.0 | 39.1 | 52.4 | 8.5 | 2.8 | 59 | 56 | 3 |
| 14447 | 55.1 | 3.9 | 41.2 | 47.9 | 10.9 | 4.7 | 57 | 58 | -1 |
| 14308 | 64.5 | 5.9 | 33.1 | 58.5 | 8.4 | 0.6 | 50 | 60 | -10 |
| 14730 | 60.9 | 3.6 | 35.8 | 52.9 | 11.3 | 2.9 | 63 | 61 | 2 |
| 14697 | 65.7 | 3.2 | 31.1 | 57.0 | 11.9 | 1.3 | 67 | 63 | 4 |
| 14751 | 59.4 | 3.3 | 36.6 | 50.6 | 12.8 | 3.3 | 62 | 60 | 2 |
| 15004 | 61.8 | 2.5 | 35.4 | 54.8 | 9.8 | 2.4 | 65 | 60 | 5 |
| 15012 | 64.1 | 2.7 | 34.1 | 58.4 | 7.5 | 2.5 | 67 | 67 | 0 |
| 15059 | 60.9 | 2.8 | 35.8 | 53.2 | 11.0 | 2.5 | 63 | 61 | 2 |
| 14964 | 61.8 | 2.7 | 34.9 | 53.4 | 11.7 | 3.0 | 67 | 63 | 4 |
| 14769 | 61.6 | 2.8 | 34.9 | 53.5 | 11.6 | 2.0 | 60 | 56 | 4 |
| 14522 | 65.5 | 5.3 | 32.6 | 60.4 | 7.0 | 0.8 | 55 | 63 | -8 |
| 15028 | 68.6 | 3.5 | 28.5 | 57.3 | 14.2 | 3.3 | 79 | 84 | -5 |
| 14395 | 55.2 | 3.4 | 41.0 | 47.9 | 11.1 | 4.2 | 59 | 56 | 3 |
| 15101 | 69.3 | 3.0 | 27.5 | 58.0 | 14.5 | 2.1 | 88 | 80 | 8 |
| 14952 | 72.2 | 3.5 | 26.5 | 67.0 | 6.5 | 0.6 | 90 | 87 | 3 |
| 15039 | 70.3 | 3.1 | 27.2 | 61.1 | 11.7 | 1.5 | 85 | 83 | 2 |

| HEATING VALUE, MOIST, MM-FREE, BTU/LB | FIXED CARBON, DRY, MM-FREE, PERCENT | MOISTURE, AS-RECEIVED, PERCENT | PROXIMATE ANALYSIS, DRY, PERCENT | | | SULFUR, DRY, PERCENT | HARDGROVE GRINDABILITY INDEX | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOLATILE MATTER | FIXED CARBON | ASH | | OBSERVED | PREDICTED | RESIDUAL |
| 15081 | 69.0 | 3.1 | 28.4 | 59.6 | 12.0 | 2.1 | 81 | 81 | 0 |
| 14978 | 67.6 | 3.1 | 29.2 | 55.6 | 15.2 | 4.0 | 77 | 80 | -3 |
| 14928 | 68.6 | 3.5 | 28.7 | 59.2 | 12.1 | 1.8 | 77 | 78 | -1 |
| 15248 | 67.8 | 2.5 | 29.9 | 59.0 | 11.1 | 3.2 | 77 | 83 | -6 |
| 15209 | 67.6 | 2.4 | 29.7 | 57.8 | 12.5 | 3.2 | 78 | 81 | -3 |
| 15299 | 83.1 | 2.5 | 16.0 | 73.7 | 10.3 | 0.6 | 103 | 99 | 4 |
| 15203 | 80.8 | 3.3 | 18.3 | 72.9 | 8.8 | 0.8 | 111 | 106 | 5 |
| 14305 | 68.6 | 8.0 | 29.8 | 63.4 | 6.8 | 0.7 | 77 | 74 | 3 |
| 13536 | 68.4 | 10.7 | 30.6 | 64.8 | 4.6 | 0.7 | 80 | 72 | 8 |
| 14334 | 66.8 | 5.3 | 29.3 | 54.8 | 15.9 | 2.3 | 78 | 72 | 6 |
| 15343 | 68.6 | 2.1 | 29.6 | 62.7 | 7.7 | 0.7 | 80 | 75 | 5 |
| 14694 | 73.7 | 5.9 | 25.1 | 68.2 | 6.7 | 0.8 | 82 | 94 | -12 |
| 14854 | 67.5 | 3.6 | 29.1 | 57.4 | 13.5 | 1.2 | 75 | 71 | 4 |
| 15171 | 68.7 | 1.9 | 27.6 | 55.9 | 16.5 | 2.4 | 71 | 73 | -2 |
| 14966 | 67.1 | 3.2 | 29.6 | 56.7 | 13.7 | 2.0 | 70 | 72 | -2 |
| 15061 | 67.5 | 2.2 | 28.5 | 54.5 | 17.0 | 2.7 | 76 | 70 | 6 |
| 14803 | 69.1 | 3.2 | 27.9 | 59.2 | 12.9 | 1.2 | 75 | 75 | 0 |
| 15148 | 70.6 | 2.0 | 26.7 | 55.8 | 17.5 | 6.2 | 76 | 77 | -1 |
| 13968 | 68.7 | 6.4 | 28.8 | 60.7 | 10.5 | 1.0 | 78 | 77 | 1 |
| 14612 | 60.8 | 4.7 | 36.5 | 54.3 | 9.2 | 2.7 | 63 | 61 | 2 |
| 14888 | 60.1 | 2.4 | 38.1 | 55.9 | 6.0 | 1.8 | 61 | 53 | 8 |
| 15033 | 66.4 | 3.1 | 31.5 | 60.7 | 7.8 | 0.5 | 68 | 67 | 1 |
| 14615 | 70.1 | 4.2 | 27.7 | 62.5 | 9.8 | 0.8 | 76 | 80 | -4 |
| 15022 | 65.9 | 3.1 | 32.9 | 62.5 | 4.6 | 0.6 | 60 | 64 | -4 |
| 11894 | 50.4 | 11.6 | 46.1 | 46.0 | 7.9 | 0.5 | 50 | 55 | -5 |
| 12082 | 53.8 | 10.6 | 42.8 | 49.0 | 8.2 | 0.4 | 52 | 51 | 1 |
| 11753 | 56.9 | 12.9 | 41.5 | 54.2 | 4.3 | 0.6 | 58 | 51 | 7 |
| 13255 | 55.3 | 7.0 | 42.7 | 52.1 | 5.2 | 0.6 | 54 | 48 | 6 |
| 13172 | 53.4 | 6.3 | 43.1 | 48.4 | 8.5 | 0.9 | 54 | 49 | 5 |
| 10300 | 55.3 | 22.0 | 44.1 | 54.0 | 1.9 | 0.9 | 56 | 49 | 7 |
| 11947 | 58.3 | 12.1 | 40.8 | 56.4 | 2.8 | 0.7 | 45 | 52 | -7 |
| 11394 | 56.2 | 14.2 | 41.0 | 51.5 | 7.5 | 1.1 | 50 | 52 | -2 |
| 11427 | 56.6 | 15.6 | 41.5 | 53.1 | 5.4 | 1.3 | 48 | 51 | -3 |
| 10734 | 56.2 | 18.9 | 41.7 | 52.3 | 6.0 | 1.4 | 48 | 52 | -4 |
| 10941 | 56.5 | 17.3 | 42.3 | 54.1 | 3.6 | 1.1 | 49 | 53 | -4 |
| 10834 | 56.7 | 17.6 | 40.7 | 52.1 | 7.2 | 1.2 | 48 | 52 | -4 |
| 11675 | 53.0 | 14.3 | 45.2 | 50.4 | 4.4 | 0.8 | 51 | 55 | -4 |
| 11736 | 52.9 | 15.1 | 45.1 | 49.7 | 5.2 | 1.3 | 50 | 54 | -4 |
| 12431 | 55.4 | 12.2 | 43.7 | 53.7 | 2.6 | 0.9 | 51 | 49 | 2 |
| 12513 | 54.3 | 11.7 | 44.1 | 51.8 | 4.1 | 0.8 | 51 | 50 | 1 |
| 13393 | 55.7 | 5.5 | 38.3 | 46.3 | 15.4 | 0.8 | 50 | 45 | 5 |
| 13838 | 54.0 | 4.4 | 40.8 | 46.6 | 12.6 | 0.3 | 52 | 48 | 4 |
| 9661 | 46.6 | 21.9 | 47.3 | 40.3 | 12.4 | 0.2 | 39 | 39 | 0 |
| 9327 | 45.7 | 23.7 | 49.2 | 40.7 | 10.1 | 0.3 | 35 | 30 | 5 |
| 9600 | 46.2 | 22.5 | 49.0 | 41.3 | 9.7 | 0.2 | 36 | 38 | -2 |

INT.-BU.OF MINES,PGH.,PA. 15093