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Determination of relations connecting coking coal price with selected quality parameters

Key words

Coking coal, quality parameters, use value

Abstract

The paper presents the method of coking coal valuation. The method comprises on determination the dependence of coal price from quality parameters of coal. Technological value of coal depends on many different physical, chemical and physico-chemical parameters. The choice of the set of parameters that were taken into account was based on the criterion of coke yield and the quality of achieved metallurgical coke. The quality parameters of coal that influence the quality of coke are: the indexes that characterise rank of coal (V^{daf}, R_o), coke-making parameters (caking properties, plasticity, dilatation) as well as the content of ballast and harmful components (moisture, ash, sulphur, phosphorus, alkalis).

The impact of each particular coal quality parameters on economics of coking process, on yield of coke and on coke quality was analysed. The correction coefficients were evaluated that change the price of coal when chosen parameters deviates from the level assumed as the standard one. Two different variants of algorithms for coking coal valuation are proposed basing on selected quality characteristics. The variants differ by the way of coal valuation regarding the coke-making parameters. Assuming that coal price is a measure of use value of the coal, these algorithms can be used for forming the structure of coking coal pricing formulae.

Introduction

Coking coals are differentiated from the quality point of view both with regard to metamorphism and coking properties as well as chemical composition. They thus posses

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a various utilization value for the customer — a coke producer. The commercial value of coking coals will be decided by the quality of coke produced meant to be used in blast furnaces.

Complete characteristics of coking coals properties are determined by many different factors. From practical reasons they must be limited to several most important parameters from quality viewpoint, which will determine the utilization value of the coal. The basic selection criterion enabling to separate a group of most characteristic indices consists in the influence of coal quality for the economics of coking process and the yield as well as quality of metallurgical coke. With more and more severe requirements regarding quality parameters of blast furnace coke especially essential are those properties of coal that guarantee achievement of coke of a required quality. That especially regards mechanical strength of coke both in condition of low and high temperatures and low reactivity.

The price of coal is the measure of its utilization value so one can assume that selected quality parameters expressing coal's valuation for coking process will at the same time be the price creating parameters.

1. Selection of price creating quality parameters

Strength parameters are useful criteria of coke quality assessment and therefore indices characteristic for coal quality are analyzed in connection with coke properties. The parameters determining coal quality on the basis of which one can foresee the quality of obtained coke include:

— indices characterizing carbonization degree (R_o, V^{daf}),
— coking properties (sinterability, plasticity, dilatation),
— content of ballast and harmful components (moisture, ash, sulphur, phosphorus, alkalies).

Content and quality of organic substance decide mostly about useful value of coals. Carbonization degree and petrographic composition of coal have decisive influence of quality and yield of coking products. Coking properties of coals indicate characteristic changes depending on metamorphism degree — optimum properties are indicated by a group of coals placed in the middle of a carbonization series.

The factor of light capability reflection by vitrinite R_o is one of the best parameters for determination of coal metamorphism degree. The R_o vitrinite's value increases proportionally to the degree of carbonization and is the parameter that determines in the best way the homogeneity of coal. This factor allows determining the share of particular types of coal in the mixture. There is a high correlation between refection factor and other parameters determining degree of coals' carbonization, as C element content or volatile matter content.

The second essential parameter having strict connection with metamorphism degree of coal substance is the volatile matter content recalculated into dry and ash free basis V^{daf}. This parameter is a basic parameter used in all classifications systems of coals. The volatile matter content characterizes thermal resistance of coal's organic substance. The lower is the volatile matter content the higher is the share of C element and lower that of oxygen and hydrogen. The existence of relationships between the volatile matter content and the number of typical coking properties of coals (such as sinterability and dilatation) is an important trait used during determination of the coal's role in the mixture. The best coking properties have coals of medium metamorphism degree (V^{daf} from about 20 to 26%). With increase of metamorphism degree sinterability and plasticity decrease whereas the increase of volatile matter content above 30% is, as a rule, connected with worse and worse coking properties of coals. Volatile matter content influences both the yield of coal and volatile products of coking and quality characteristics of these products. It thus has an impact upon economic effectiveness of coking process. This parameter is used for forecasting of coke's yield in industrial scale and is also utilized in many models for forecasting of mechanical strength of coke, for instance in alternative ones to diagram MOF (Pearson 1980), model of coke's strength forecasting ASTM based on V^{daf} and *FSI* index. Meaningful correlation occurs also between CRI reactivity and coke post reaction strength CSR, and the indices characterizing carbonization degree (Herman 1997, 2002; Ryan, Price 1993; Tramer, Kosewska 1998).

Sequential group of indices on the basis of which one can forecast coke quality includes quality parameters characterizing plastic condition of coal: plasticity according to Gieseler, dilatation, expansion pressure, free swelling, and Roga index. These indices influence the most important for coke quality periods of plasticity and formation of the coke's structure. The variety of these traits and their mutual interrelations make it difficult to determine one universal quality parameter the controlling of which would enable to define the quality of coke produced. As a rule these properties are treated in a complex manner expressing them, for instance, by types of coking coals according to national classification (Tramer, Kosewska 1998; Karcz 1991). In the up-to-date Polish systems of coking coal pricing the type of coal and the structure co-efficient attributed to it were the measure unit of coking properties of a given coal.

Parameter of volatile matter content, being a fundamental index in classification of coals into types and very essential in assessment of the useful value of coal, is not always reliable enough. One can obtain coke considerably different with regard to technical strength from coal of the same volatile matter content. Therefore a need appears for additional characterization of coal with regard to its coking capability. The accepted index should, enable the differentiation of coal value, having very close in volume volatile matter content but being different in suitability, for coke production. The free swelling index *FSI* can be this parameter, being a qualitative method of sintering capability determination. Sinterability is a basic trait determining suitability of coal for coke production. It is taken as resultant of characteristic properties of coal, conditioned by capability of transfer from a coal mass into plastic status under influence of heating without access of air (Roga, Wnękowska 1966; Zieliński, red. 1986).

FSI index is a parameter providing initial direct technological information about coal. It is applied in the International System of Codification for coals with medium or high degree of carbonization. Its basic advantage consists in simplicity and fast rate of determination thanks to which within a short time period one can obtain initial information on coking properties of coal.

In the light of the aforementioned information one can assume that introduction to determination of useful properties of coal of an index determining the content of volatile matter V^{daf} in connection with sinterability expressed by free swelling index *FSI*, will enable to better differentiate coals with regard to their coking properties than the type of coal attributed to them in Polish classification.

Very important parameters of coal which to meaningful degree influence the course of coking process and the quality of produced coke include the indices determining the quantitative share of ballast and harmful elements in coal i.e.: moisture, ash, sulphur, alkalies, phosphorus and chlorine.

Moisture content in feed coal does not have a direct influence on coke quality but decides about the course and economics of coking process. Increase in moisture content in coal mixture causes the necessity to prolong coking time and thus lower the productivity of the batteries, increases heat consumption needed for coking process and the volume of generated sewage waters that had to undergo treatment process.

Ash content in coal influences both the economics of coking process and the quality of coke and thus the economics of blast furnace process. Ash comprised in coal deteriorates coke generation parameters and besides it directly influences the ash content in coke. Increased ash content causes the elevation of coke reactivity, deterioration of its mechanical properties and also reduction of calorific value what directly influence the economics of blast furnace process. Besides acid character of coke causes increase in consumption of fusing agents in blast furnace what is connected with increase in heat consumption. Increase of ash content in coke exerts a negative impact on production capability of blast furnace and lowers its throughput.

Together with coke ash the other harmful components are introduced to blast furnace, which include: sulphur, alkalies, phosphorus and chlorine. Because coke is a meaningful source of alkalies supplied to blast furnace (about 35—45% of all alkalies) the requirements of the customers limit their level to 0.2—0.3% in recalculating for the sum of di-sodium and di-potassium oxides. Recently requirements occurred to also limit chlorine to the level of below 0.06%. Content of those components in coke is the resultant of their occurrence in mineral substance of feed coal. More thorough preparation of raw coal limiting content of ash also reduces the content of alkalies and chlorine.

Sulphur and phosphorous belong to especially harmful components of coking coal. During coking process most of coal sulphur remains in coke. The remaining part mainly in the form of hydrogen sulfide transfer to coking gas causing the necessity to remove sulphur from gas because of its transportation and further utilization. Sulphur content in coke influence the deterioration of the quality if pig iron and raw steel resulting in the so called hot-shortness. Necessity to run desulphurization process in blast furnace leads to increase in usage of fusing agents, increases in coke usage and consequently reduces the throughput of blast furnace.

Phosphorus is and undesirable component of blast furnace coke since getting into metal causes the so called cold-shortness. Content of phosphorus in coke depends exclusively on its content in coal mixture.

The above discussed quality parameters determining the volume of ballast in coal depend on exploited seams but to a large degree their level may be created in the process of coal preparation processes. Together with reduction of ash content also the content of harmful components is reduced (sulphur, phosphorus, chlorine, alkalies).

Indices: total moisture content W_t^r, ash content A^d and total sulphur content S_t^d are as a rule applied for settlement of prices between the supplier and the coal customer. The way and degree of influence of the aforementioned components in coal on the course of coking process and on quality and yield of blast furnace coke decide about selection of these parameters for assessment of the commercial value of coking coals.

On the basis of conducted analyses of the problem of influence of coking coals quality parameters on quality and yield of metallurgical coke and on economics of coking process for evaluation of commercial value of hard coal devoted for coking process two groups of factors were determined:

those characterizing its coking properties — carbonization degree measured by volatile matter content V^{daf} and sinterability the measure of which is the free swelling index *FSI*,

those characterizing content of selected ballast components — total moisture content W_t^r, ash content A^d, total sulphur content S_t^d.

2. Determination of reference coal parameters and coefficients correcting coal price with the change in values of quality parameters

2.1. Quality parameters of reference coal

The most often applied manner of coking coal valuations is the method of the so-called reference coal of determined quality parameters. With deflection of a given parameter as against the accepted reference value correction coefficients are introduced adjusting coal price.

Quality characteristics of Polish coking coals and the structure of their utilization in coking industry indicate that ortho-coking coal type 35.1 should be the reference coal with determined base level of quality parameters.

In the proposed method of usable value assessment of coking coals it was accepted that **ortho-coking coal type 35.1 with quality parameters at the level of: W_t^r — 8%, A^d— 7.5%, S_t^d — 0.8%, V^{daf} — 28,0% will be reference coal (standard) in a price formulae and the base price determined for it will be the reference point for valuation of other coking coals.**

The accepted values of quality parameters of reference coal are at the level determined for standard coal in the European Union. CIF price of the standard coal is determined on the basis of data on import of coking coals of hard type meant for the needs of steel industry of the member countries of the Community (Blaschke, Ozga-Blaschke 2000; Decyzja... 1993; Council... 2002). Production of coke in the countries of Western Europe is based mainly on imported coals, the price of standard coal (Coking Coal Guide Price) published in a quarterly communiqués of the Commission enables to monitor the relationship of coke price and coking coal prices in the countries of the EU. It is an essential phenomenon since Poland is the supplier of both coking coal and metallurgical coke to the market of the European Union. As comparable analyses indicated (Ozga-Blaschke 2003), average annual values of quality parameters of ortho-coking coals in the supplies to national coking pants were very close to the level determined for reference coal.

The most objective and easy for valuation are the properties of coal undergoing the rule of additivity in mixtures that is the parameter determining the content of: volatile matter, total moisture, ash and sulphur. Therefore for these parameters coefficients correcting coal price are determined.

2.2. Coefficients correcting coal price

The value of coefficients correcting the coal price with deflection of a given index by 1% as against the reference value is the measure of influence of ballast components in coal on its technological assessment.

In the process of transformation of coking mixture of coal two basic products are achieved: coke and the so-called raw coking gas (subjected next to cooling and scrubbing processes). The analysis of sale value of coking products indicates that coke (the yield of which is in the range of 73—77%), in the sale value of coking plant's products constitutes in total about 90% (Karcz, Kluz 1997; Program... 1999). Such structure of sales cost causes that all the financial effects resulting from change in quality of feed mixtures in the coking process should be referred to the final product that is blast furnace coke.

Ash and sulphur content in coke, determined by the volume of these elements in coal mixture, has a considerable impact upon the economics of blast furnace process.

The analysis of influence of changes in ash and sulphur content in feed coal upon the quality of produced coke and magnitude of its consumption in blast furnace process allowed for determination of the following dependencies (Ozga-Blaschke 2003):

- *1% increase in ash content in feed coal devoted for production of blast furnace coke results in financial effects (resulting from lowering of coke quality) in the value responding to about 2% of the price of this coal,*
- *0.1% increase in sulphur content in feed coal devoted for production of blast furnace coke results in financial effects (resulting from lowering of coke quality) in the value responding to about 0.59% of the price of this coal.*

Moisture content in coal has influence mainly on operation costs and throughput potential of the coking plant. The cost analysis of 1% moisture evaporation from 1 tons of feed coal and treatment of sewage waters generated from the process indicated that the cost constitutes about 0.3% of the price of feed coal. In order to calculate coefficient adjusting the coal price because of moisture content one can compare two tons of coal, different one from another by moisture content in the value of 1%. One ton of coal with higher moisture content has 10 kg more of water-free substance and about 10 kg of more water, which generates additional cost — *it therefore results that 1% of increase in moisture content in feed coal lowers its price by about o 1.4%* (Ozga-Blaschke 2003).

In the conducted tests on assessment of financial effects resulting from the change in coking coals quality coefficients of coal value assessment were obtained (with regard to its price) at the very approximate level to the coefficients applied in price calculation on CIF basis for standard coal in the EU (Council... 2002).

In the presented proposal for assessment of usage value of coking coals the value of coefficients were accepted for adjustment of coal price because of ash, sulphur and moisture content in conformity with the European Union principles of the standard coal price calculation (Coking Coal Guide Price) based on the following dependencies:

— change in ash content A^d by 1% as against the base value of 7.5% results in adjustment of price by 2%;

— change in sulphur content S_t^d by 0.1% as against the base value of 0.8% results in adjustment of the price by 0.5%;

— change in moisture content W_t^r by 1% as against base value of 8% results in adjustment of the price by 1%.

The accepted manner of determination of impact by selected coal quality parameters on its price is very similar to accounting used in trade contracts on international markets.

Introduction for the assessment of usage value of coking coal of the volatile matter content parameter requires determination of coefficient adjusting coal price depending on the value of these parameters, as compared to the level determined for the reference coal.

Volatile matter content in feed coal determines the yield of main products of coking process- with the increase of volatile matter content in feed mixture coking plant incurs losses resulting from lower yield of coke. In conformity with theoretical formula for coals with different volatile matter content by 1% (and unchanged other parameters), one can determine the yield of coke on working basis (Ozga-Blaschke 2003).

The obtained results of coking plant's loss assessment enabled to determine the dependence:

— *1% increase in content of volatile matter in feed coal meant for production of blast furnace coke causes financial effects in the value responding to about 1.19% of the price of this coal.*

In calculation applied for determination of the price of standard coal in the EU defection of the index V^d by 1% as against the base level $V^d = 26\%$ results in adjustment of the price by 0.3%. Bearing in mind, anyhow, the results of the analyses conducted for Polish coking plants [14, 17], in the suggested method of valuation of usage value of coking coals the adjustment coefficient's value was accepted amounting to 1% for each percent of the difference of V^{daf} as against the base value of reference coal — $V^{daf} = 28\%$.

In the production structure of Polish coking industry metallurgical coke dominates for generation of which a respective degree of carbonization of feed coal mixture is required. In the situation of limited supply of indigenous ortho-coking coals of type 35 (especially type 35.2), being the basic raw material for blast furnace coke production, the system of pricing should favor coal with higher metamorphism.

3. Issues of coals valuation of different coking properties

One of the elements of the modification of the system of coking coals' assessment is the way of approach to the problem of valuation of coals with regard to their coking properties Bearing in mind the classification used in trade on international markets one can divide also Polish coals into the types of hard and semi-soft coals and determine respective relations of process between them. These relations agreed upon between producers and coal customers should take into account the usage value of a given type of coal from the viewpoint of blast furnace coke production. In these determinations relations occurring in trade on international markets can be useful, especially that Poland is the exporter of coking coal for foreign markets.

Analyzing the quality of Polish coking coals from the viewpoint of commercial classification applied on international markets, the following division has been introduced:

— ***Class of hard coals*** — coals of type **35** (35.2, 35.1) characterized by average content of volatile matter V^{daf} 22%—30%, co-efficient of light reflection by vitrinite $R_o > 1$, good coking properties, high plasticity (especially coal of type 35.1) and sinterability — free swelling index *FSI* 7 — 9.

— ***Class of semi-soft coals*** — coals of type **34** (34.2, 34.1) with high content of volatile matter, V^{daf} above 30% and vitrinite light reflection coefficient of $R_o < 1$, having worse coking properties. In this group the free swelling index could be a distinguishing factor: $FSI > 6$ — type 34.2 (before: a semi-soft group) and $FSI < 6$ — coals of type 34.1 (before being typical semi — soft coals).

Valuation of coals with regard to coking properties characterizing the coals was suggested in two alternatives.

In variant I coals valuation was suggested with regard to hard or semi-soft class and basing on parameters of: volatile matter content V^{daf} and *FSI*.

Price of coals of hard type will be differentiated depending of real content of volatile matter (V^{daf} in the range of 22—30%), in conformity with the accepted co-efficient adjusting them by 1% for each percent of V^{daf} difference as against the reference value equal to 28%.

For the group of semi-soft coals with the volatile matter content above 30%, additional co-efficient were introduced reducing the price level: for coal with $FSI > 6$ co-efficient $k(FSI) = 0.95$ (coals of type 34.2); for coals with $FSI < 6$ co-efficient $k(FSI) = 0.90$ (coal type 34.1). The value of co-efficient *k(FSI)* has been selected in such a magnitude so that their influence was connected with the scale of coal's valuation with regard to the parameter of volatile matter content (as against the base level of V^{daf} — 28%). That placed the prices relations between the coals of hard and semi-soft type at the level similar to that occurring in trade on international markets. This method provides a possibility to differentiate coal prices with regard to coking properties within the range of a given coal type (Because of V^{daf} parameter) and increase the difference of prices levels between particular types of coal (influence of *k(FSI)* co-efficient and V^{daf}) (Ozga-Blaschke 2003, 1997b, 1999b).

In variant II it has been assumed that free swelling index *FSI* determining sintering properties of coal will, similarly as volatile matter content parameter, in a continuous manner valuate coals both in the type of hard and semi-soft coals. Basing on quality characteristics of coals type 35.1 it has been accepted that for standard coal (reference one) the value of FSI index will take the value of 8, and deflection of this parameter from the reference value by 0.5 point will result in price adjustment by 1%. Similarly as in alternative I this method provides a possibility for differentiation of coal with regard to coking properties within the same type range for hard coals by V^{daf} 22—30%, *FSI* —7,5—9, for semi-soft type 34 by V^{daf} 30—38%, *FSI* — 3—8, and increases the difference of prices levels between particular types of coals.

Influence of coal price adjustment coefficients because of quality parameters: V^{daf} and *FSI*, enables to valuate indigenous hard and semi-soft coals at the level close to relations occurring in trade on international markets.

4. Proposal of sale formulae valuating coking coal

Selected quality indices valuating coals with regard to their suitability for coking process will also be price creation parameters, building the structure of the formulae determining the price of coking coals. The structure will be the function of:

$$f\,(W_t^r,\ A^d,\ S_t^d,\ V^{daf},\ FSI$$

For the previously determined coefficients adjusting the prices, the partial elements of the structure of price formulae will take the form of:

— element adjusting the coal price with deflection of ash content A^d in coal by 1% as against the reference value accepted in the magnitude of 7.5%:

$$C_{wst} \cdot 0.02 \cdot (7.5 - A^d)$$

— element adjusting the coal price with deflection of sulphur content S_t^d in coal by 1% as against the reference value accepted in the magnitude of 0.8%:

$$C_{wst} \cdot 0.05 \cdot (0.8 - S_t^d)$$

— element adjusting the coal price with deflection of total moisture content W_t^r in coal by 1% as against the reference value accepted in the magnitude of 8%:

$$C_{wst} \cdot 0.01 \cdot (8 - W_t^r)$$

— element adjusting the coal price with deflection of volatile matter content V^{daf} in coal by 1% as against the reference value accepted in the magnitude of 28%:

$$C_{wst} \cdot 0.01 \cdot (28 - V^{daf})$$

— element (in variant II) adjusting the coal price with deflection of *FSI* index in coal by 1 point as against the reference value equal to 8:

$$C_{wst} \cdot 0.02 \cdot (FSI - 8)$$

where:

A^d, S_t^d, W_t^r, V^{daf}, FSI — value of quality parameters of evaluated coal;

C_{wst} — price of standard coal (reference coal type 35.1) with determined quality parameters: A^d — *7.5%*, S_t^d — *0.8%*, W_t^r — *8%*, V^{daf} — *28%*, *SI* — *8)*, PLN/Mg.

Thus the price of standard coal will be the measure of usage value of coal reduced or increased (depending on the value of quality parameters characterizing coal) by a value of elements adjusting the price.

On the basis of the above presented deliberations two sale formulas are proposed for coking coal F_1 and F_2 responding to presented variants.

Formulae F_1

$$C_w = C_{wst} \cdot [1 + (7.5 - A^d) \cdot 0.02 + (0.8 - S_t^d) \cdot 0.05 + (8 - W_t^r) \cdot 0.01 + (28 - V^{daf}) \cdot 0.01] \cdot k_{FSI}$$

This equation after transformation can be presented in the form of:

$$C_w = C_{wst} \cdot (1.55 - 0.02 \cdot A^d - 0.05 \cdot S_t^d - 0.01 \cdot W_t^r - 0.01\ V^{daf}) \cdot k_{FSI}$$

where:

C_w— coal price, PLN/Mg,

k_{FSI} = 0.95 — coefficient for semi-soft (soft) coals with $V^{daf} > 31\%$ and $FSI > 6$,

k_{FSI} = 0.90 — coefficient for semi-soft coals with $V^{daf} > 31\%$ and $FSI < 6$,

Remaining denotations as presented earlier.

Formulae F_2

$$C_w = C_{wst} \cdot [1+ (7.5 - A^d) \cdot 0.02 + (0.8 - S_t^d) \cdot 0.05 + (8 - W_t^r) \cdot 0.01 +$$

$$+ (28 - V^{daf}) \cdot 0.01 + (FSI - 8) \cdot 0.02]$$

This equation after transformation can be presented in the form of:

$$C_w = C_{wst} \cdot (1.39 - 0.02 \cdot A^d - 0.05 \cdot S_t^d - 0.01 \cdot W_t^r - 0.01 \cdot V^{daf} + 0.02 \cdot FSI)$$

Remaining denotations as presented earlier.

In the above formula F_1 and F_2 the elements in brackets describe structure of coking coal price formulae, created on the basis of selected quality parameters taken for the assessment of usage value of coal.

The level of coking colas prices depends on the value, which is accepted for standard (reference coal) — that is on C_{wst} value in the price formulae. In the literature one encounters ideas that the level of prices can be determined also by: cost of coal winning at particular producers, cost of mines closing the balance of demand for a determined type of coal or the cost of imports of coal of an equivalent quality.

Summary

One of the conditions of rational utilization of Polish coking coal reserves is proper price structure of these coals based on their usage value. In recent years the country's prices system accepted the principle to determine two levels of prices for ortho-coking coals type 35 and gas-coking coals type 34 with simultaneous reduction of influence of the quality of particular coals within the range of the same type on differentiation of their value. Besides high prices of gas-coking coals 34.1 (non adequate to their quality) resulted in the situation that differences of levels of very good coal prices and coals of poor coking properties did not reflect the evaluation of their utilization value.

Earlier elaborations (Ozga-Blaschke 2000b, 2001, 1999b; Mokrzycki, Ozga 1996), and also analyses included in the elaboration (Ozga-Blaschke 2003) permitted for presentation of proposals of introduction of a new coal price formulae. The presented equations describe the structure of the coking coal price formulae created on the basis of approximate dependencies between coal quality and its utilization value considered from the viewpoint of quality of metallurgical coke obtained.

Two variants were presented being different by the way of evaluation of coals with regard to their coking properties. Introduction to the price formulae of quality parameters characterizing carbonization degree (V^{daf}) and sinterability (index FSI), provides a possibility of valuation of coal within the range of a given type of coal not only because of ballast

elements content (ash, sulphur and moisture), but also because of coking properties. The assessment of coals based on these equations favors coals of higher degree of carbonization and better coking properties. The relations obtained between home market prices of hard and semi-soft coals respond to the relations encountered in trade of coking coals on international markets.

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URSZULA OZGA-BLASCHKE

OKREŚLENIE ZALEŻNOŚCI WIĄŻĄCEJ CENĘ WĘGLA KOKSOWEGO Z WYBRANYMI PARAMETRAMI JAKOŚCIOWYMI

Słowa kluczowe

Węgiel koksowy, parametry jakościowe, wartość użytkowa

Streszczenie

W referacie przedstawiono propozycję sposobu oceny wartości użytkowej węgla koksowego poprzez określenie zależności wiążącej cenę węgla z jego parametrami jakościowymi. O wartości technologicznej węgla decyduje zespół jago właściwości fizycznych, chemicznych i fizykochemicznych, tak więc wybór kilku najważniejszych parametrów oparto na kryterium wpływu jakości węgla na uzysk i jakość koksu metalurgicznego. Do parametrów określających jakość węgla, na podstawie których można prognozować o jakości koksu należą: wskaźniki charakteryzujące stopień uwęglenia (V^{daf}, R_o), właściwości koksotwórcze (spiekalność, plastyczność, dylatacja) oraz zawartość składników balastowych i szkodliwych (wilgoć, popiół, siarka, fosfor, alkalia).

Na podstawie przeprowadzonych analiz dokonano wyboru najistotniejszych parametrów jakościowych służących do oceny wartości użytkowej węgla oraz określono wielkości współczynników korygujących cenę węgla przy odchyleniach wartości wybranych parametrów jakościowych od poziomu przyjętego dla węgla wzorcowego. Zaproponowano dwa warianty algorytmu wartościującego węgiel koksowy w oparciu o wybrane parametry jakościowe, różniące się sposobem wartościowania węgli ze względu na ich właściwości koksotwórcze. Przyjmując, że cena węgla jest miarą jego wartości użytkowej, algorytmy te mogą służyć do kształtowania struktury formuł sprzedażnych wyznaczających cenę węgla koksowego.