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New technological classification of lignite as a basis for balanced energy management

Introduction

The rapid growth of prices of oil and natural gas, as well as temporary interruptions in the supply of natural gas from Russia, have increased concerns about energy security in the European Union. After many years of underestimation, coal came back into favor due to the lower price of energy produced per unit, balanced geopolitical distribution and far greater resources than oil and gas. In addition, turn in the direction of coal was enabled thanks to the progress of innovative and environmentally friendly technologies that use coal (clean coal technologies-CCT). If it would be possible to fully implement clean coal technologies, this would be a new opportunity for coal, which could reinforce its market position. However, in order to think about the competitiveness against oil and gas, certain efforts aimed at increasing the global resource reserves must be taken now. These reserves can be increased through: the development and implementation of improved technologies of search for coal deposits, technological improvement of existing underground and surface coal mining and the acceleration of research on "non-conventional" coal, such as underground coal gasification and the use of methane from mines (Kavalow and Peteves 2007).

The coal economy is – in large part – the energy, which consequently leads to sustainable energy development. According to WEC, balanced development is assessed in terms of three criteria, called the 3 A's (WEC 2004, 2007, 2009). The first is the continuous availability of energy of sufficient quantity and quality, while adapting to the changing needs of customers.

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Coal meets this condition because it is disposable and is able to meet rapidly growing demand for coal (Copley 2004; Borkowski 2004). The second criterion is the accessibility of energy, as economic costs of supply and further development of energy. Also, this condition is met by coal, which is available to more and more numerous people in the form of electricity. It is expected, that by 2030 coal will contribute to reducing by half the number of people without access to electricity, with 2 billion in the early twenty-first century (WEC 2001). The third criterion is the acceptability of energy relating to social and environmental concerns. Coal is acceptable, and this is supported by the estimates of WETO (2003), that by 2030 approximately 72% of electricity generated from coal will be produced using commercially viable clean technologies, while also drainage of both inactive and active mines and sequestration of carbon dioxide will be increasingly used (Wedig 2004).

Lignite is one of the major energy resources. World production of minerals, in the past decades, continued at a high level of about 835 Mt/year, while in 2006 exceeded 1000 Mt/year (IEA 2006). The major producers of brown coal are: Germany, USA, Australia, Turkey, Russian Federation, countries of former Yugoslavia and Poland. Approximately 79% of world extraction of this resource is used to produce energy by burning, 14% is used for the production of the synthesis gas in the gasification process, while the rest is used to produce fertilizers and in chemical industry (like active carbons). Given the fact that there are significant resources of this raw material in Poland, it should be noted, how important is its appropriate land use. Currently, balance resources of brown coal are over 14 billion tons, which allows utilizing coal at a similar level to today's for decades. In addition to these resources, we also have 35–41 billion tons of lignite resources in forecasting (Ney 2004). At present, four large lignite mines make it available to keep the maintenance of annual lignite mining in Poland at around 60 million tonnes by 2025. Figure 1 shows the location of the lignite deposits in Poland. It is expected that after 2020 there will be systematic decline in output in those mines. However, for 2025–2030 it is planned to start the preparation and operation of new deposits: "Legnica", "Gubin", as well as activation of satellite deposits of active mines, which – at current production – will be sufficient for many years, being both cheap and home-grown source of electricity (Program działań wykonawczych na lata 2009–2012; Turek 2005). This step will undoubtedly contribute to improving the country's energy security. Unused resources are located in the areas of: Legnica, Lubuskie, Wielkopolskie and Łódz. The stocks of brown coal, as well as the structure of their diagnosis and level of development are shown in Table 1. In the "Polish Energy Policy until 2030" (2009) the emphasis is put on the diversification of supply of raw materials and fuels, understood not only as a diversification of supply lines, but also the technology – largely consisting of obtaining liquid and gaseous fuels from domestic raw materials. Given the preliminary stage of development of nuclear program and few possibilities to run the reactors before 2020, there is a need to use ample opportunities to use coal as a source of cheap and modern energy, taking from both the natural wealth of resources and advanced scientific projects.

Fig. 1. Lignite deposits in Poland (Kasiński, Mazurek, Piwocki 2006, supplemented)

Rys. 1. Złoża węgla brunatnego w Polsce (Kasiński, Mazurek, Piwocki 2006, uzupełnione)

New ranking of lignite resources intended for soon use includes – first and foremost – such seams as Gubin, Legnica-Ścinawa, as well as enlargement of already exploited seams, such as Lignite mine Bełchatów (Szczerców, Złoczew and – in further perspective – Rogóźno) as well as satellite seams in energetic region of Konin-Adamów and Turów (Kasiński 2008; Kasiński et. al. 2006) (Fig. 1). In order to resolve this complex subject, there is an urgent need to evaluate again technological quality of domestic lignite – both actually exploited and located in seams intended for future use. One of the essential aims of new classification should be the assessment of domestic lignite for advanced technologies of modern technological processing (combustion, liquefaction and gasification). This topic is actually a subject for studies of research institutes in developed countries with own resources, that are encouraged by scientific and financial success of Sassol concern (South Africa). However, development and realization of these technologies demands precise technological and chemical research of used coal.

Despite the fact, that research on technological parameters of lignite has long tradition in Poland, current situation demands closer look at the topic of coal quality, especially considering its combustion with the lowest possible emission of toxic elements – mainly CO_2, what is related with the need for its sequestration. These restrictions are linked to greenhouse gas emission limits set to certain countries by European Union. Emitted amounts of sulfur and nitrogen oxides, as well as their disposal, should also be taken into consideration. New technological classification of low-rank coal (including bituminous coal) should also cover all those problems. Particular attention should be paid to quality parameters of coal evidenced on the basis of actual balance of resources in light of "The Polish Energy Policy until 2030" (Polityka… 2009) as well as "Green Paper: A European strategy for sustainable, competitive and secure energy". Currently used classification in polish standard PN-91/G-97051.01 „ Brown coal for energy purposes – Indicators code" was cancelled in 2007 by Polish Committee for Standardization. It was related to the fact, that in last years United Nations Economic Commission together with ICCP (International Committee for Coal and Organic Petrology) prepared classification of solid fuels (International Classification of Coal in Seam), while International Organization for Standardization (ISO) prepared on its basis ISO 11760 standard and introduced it to use. Currently in mines,

TABLE 1

Lignite deposits in Poland in bln tons according to Polish Geological Institute

TABELA 1

Bilans zasobów węgla brunatnego w Polsce według Państwowego Instytutu Geologicznego [mln ton]

Specification	Number of deposit	Reserves/resources				Economic reserves
		IER			potentially economic	
		total	economic	prospecting		
Total	**77**	**13 629.02**	**4 211.92**	**9 417.10**	**4 600.98**	**1 414.42**
Including reserves of exploited deposits						
Total	12	1 789.25	1 708.46	80.79	101.80	1 414.42
1. Exploration	11	912.56	844.26	68.30	87.79	794.58
2. Prospectiong	1	876.70	864.20	12.50	14.01	619.84
Including abandoned deposits						
Total	60	11 830.48	2 494.82	9 335.66	4 494.91	–
1. Deposits identified in detail	30	2 811.34	2 494.82	316.52	718.86	–
2. Deposits initially identified	30	9 019.14	–	9 019.14	3 776.05	–
Included – deposits, which discontinued exploited						
Total	5	9.28	8.64	0.64	4.27	–

in order to establish the quality of used coal, are used guidelines of Ministry of Economy which apply to balance criteria and coal prices. What is more, already withdrawn polish standard PN-91/G-97051.01 is still being used. In Polish literature, scientific principles of modern classification has been determined, inter alia, by Kwiecińska and Wagner (Kwiecińska and Wagner 1997, 2001; Wagner and Kwiecińska,1996), but these works need additions and modifications in light of present international documents and country's current energy situation.

New scheme of technological classification should be divided into two stages. First stage should be establishment of kind and type of coal in way relating to its origin, while second stage – more precise – is distinction of technological groups and classes in codification system. An outcome of such resolved problem would be technological classification of domestic low-rank coal in a way fully matching the needs of technical legislation, both domestic and international.

1. Technological classifications of lignite

Under „coal rank" term we understand its grade of coalification, which is set thanks to parameters precisely setting this state (gross calorific value, vitrinite and huminite reflectance) (Fig. 2), while quality features are describing ways of its use (such as combustion, gasification, liquefaction). We also distinguish subcategories such as groups and classes, which are used to evaluation of coal quality in certain technology (Kwiecińska and Wagner 2001, 1997).

Lignite (low rank) coal in International Classification of in-Seam Coals (ECE UN, 2004) and American Standard Classification of Coals by Rank (ASTM D 388) is a coal, which gross calorific value (GCV^{maf}), recalculated to moist, ash free basis, is lower than 24 MJ/kg.

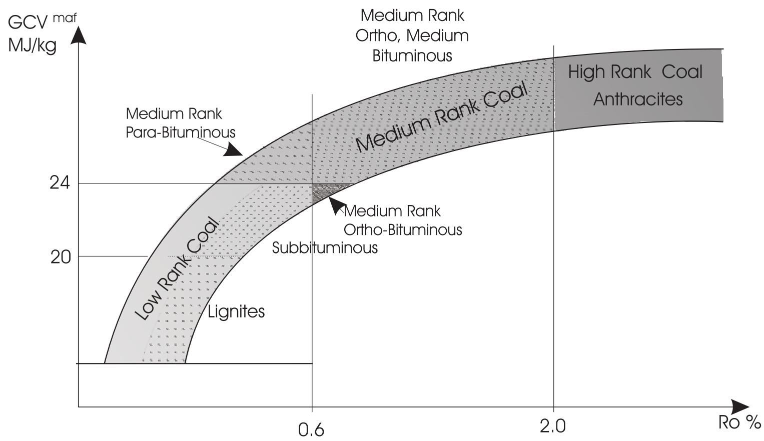

Fig. 2. UN/ECE coal classification (Lemos de Sousa, Pinheiro 1994, simplified)

Rys. 2. UN/ECE klasyfikacja węgla (Lemos de Sousa, Pinheiro 1994, uproszczona)

This parameter sets the coal distinction into three classes related to the grade of its coalification: Ortho-lignite, Meta-lignite and Subbituminous Coal, what in Polish classification is equal to terms: “soft brown coal” (węgiel brunatny miękki), “dull hard brown coal” (brunatny twardy matowy) and “bright hard brown coal” (brunatny twardy błyszczący). On the basis of maceral composoition we separate humic and sapropelic coal. On the other hand, in order to set the amount of impurities, ash content recalculated to dry basis is being used, while this parameter divides the coal into very low grade, low grade, medium grade and high grade coal.

Consequently, in PN-ISO 11760 standard, low rank coal (lignite and subbituminous) has to have random reflectance (measured on collotelinite) lower than 0.5%. The border between lignite and a sub-bituminous coal has been set as vitrinite random reflectance equal to 0.4%, meanwhile – total coal moisture recalculated to ash-free basis and equal to 35% divides lignite into lignite C and lignite B. Classification within this standard uses also vitrinite percentage, as well as ash content in mineral matter free basis. On Polish modern technological classification of coal already worked, inter alia, Kwiecińska and Wagner (1996, 2001). Wagner in his article (Wagner 1996) suggests changing the term „sapropelic coal” (węgiel sapropelowy) into „ bituminiferous lignite” (węgiel bitumiczny) in Polish classification. There also have been attempts to characterize lignite on the basis of reflectance (Kwiecińska and Wagner 1997, 2000; Wagner and Kwiecińska 1996). Similar concerns are also engaged in countries, where lignite mining is one of the main branches of the industry, such as Germany, Russia, China, India and Serbia. Particularly interesting are solutions proposed by Ercegovac, Źivotić and Kostić (2006), who prepared genetic-industrial classification of brown coals in Serbia. In first stage of this classification they propose setting the rank of coal through setting the huminite/vitrinite reflectance, while in the second stage – coal quality. The border between soft (low rank C) and dull brown coal (low-rank B) is set at huminite random reflectance equal to 0.3%, while between dull and bright brown coal (low-rank A) at 0.4%. Border between bright brown coal and bituminous coal is 0.5%, what is analogical with ISO 11760 standard. Technological quality of tested coal is presented in form of diagram together with codification system based on total moisture, sum of gelified macerals and inertinite, tar yield, as well as ash content. Similar idea for coal classification was presented by Jeremin and Bronowjec (1997), who proposed Russian technological classification for all coals. Similarly to International Classification of In-Seam Coals and American Standard Classification of Coals by Rank ASTM D388, lignite is a coal, which gross calorific value, recalculated to moist, ash free basis, is lower than 24 MJ/kg. In addition, in order to distinguish the type of coal, tar yield has been used. Russian classification pays special attention to petrographic composition of tested material, which is presented at triangle diagram. At the same time such solution allows easy setting of areas that describe the quality of tested coal. Work on integration of already used coal classifications has also been done in China (Peng 2000). In coding system being used in China (GB 16772–1997), in order to classify low-rank coal, gross calorific value recalculated to moisture ash free basis (Q_s^{maf}), volatile matter (V^{daf}), total moisture, tar yield (T^{daf}), ash content (A^d) and sulfur total content (S_t^d) has been used. Szwed-Lorenz investigated the link between petrographic composition and chemical-technological properties of polish lignite (1991). Her studies have shown important impact of lignite's petrographic composition on possibility of its use, mainly: briquetting and carbonization.

2. Parameters of new technological classification

First stage – graphic – relies on setting the rank of coal, expressing its coalification, as well as genetic type (litological) and chemical-technological traits set on the basis of parameters important in assessing basic technological quality. This part of classification ought to be based on modified polish standard PN-G-97051-00 standard and newer polish standard PN-ISO 11760, what would enable – already at the stage of documentation of deposit – presenting the way of utilization of the coal. It is proposed to change "gross calorific value" term into huminite/vitrinite random reflectance, in order to separate lignite C (low-rank C) from lignite B (low-rank B) and subbituminous coal (low-rank A). This might be quite difficult, because of the fact, that gross calorific value relates to the whole sample of coal of variable petrographic composition, while random reflectance is measured on single maceral (huminite/vitrinite). Therefore, in order to correlate aforementioned parameters, research on maceral and petrographic composition of Polish low-rank coal and their influence on gross calorific value is needed. In final version, similarly to coal with higher rank, the single parameter needed to setting the rank is random reflectrance. Threshold of random reflectance for lignite C is set by some of the researchers at 0,30% and seems to be – in case of Polish coals – too low, therefore, in Polish classification it is proposed to set it at 0,35%. In order to set technological type, it is proposed to use petrographic composition related to maceral groups, with particular underlining of macerals from liptinite group, in order to evaluate coal lithological types (whether is it bituminiferous coal), which are related to carbonization and extraction (Fig. 3).

Second stage of classification – presented in codification system – is based on distinguishing classes and groups in already defined types of coal. Classes and groups are more detailed terms defined with use of so-called basic and supplementary parameters (inter alia Kwiecińska and Wagner 1996). Supplementary parameters are understood as such attributes of coal, that are important for certain technological processes. Different tested types of coal would get identification numbers ranging from 21 to 26 (Kwiecińska and Wagner 1997) which would correspond to historical classification of solid fuels by Laskowski and Roga (1949), who proposed that first number of distinguishing feature for low-rank coal should be 2. Main types of lignite and subbituminous coal, that are currently proposed and have economic importance, include: energetic coal (type 21), briquette coal (22), coal for carbonization (23), coal for extraction (24), coal for gasification (25) as well as coal for liquefication and hydrogenation (26).

Main parameters describing crucial attributes of tested coal, its type and, particularly, setting aforementioned identification numbers, should also include: ash content, calorific value, sulfur total content, tar yield, as well as petrographic parameters, which altogether

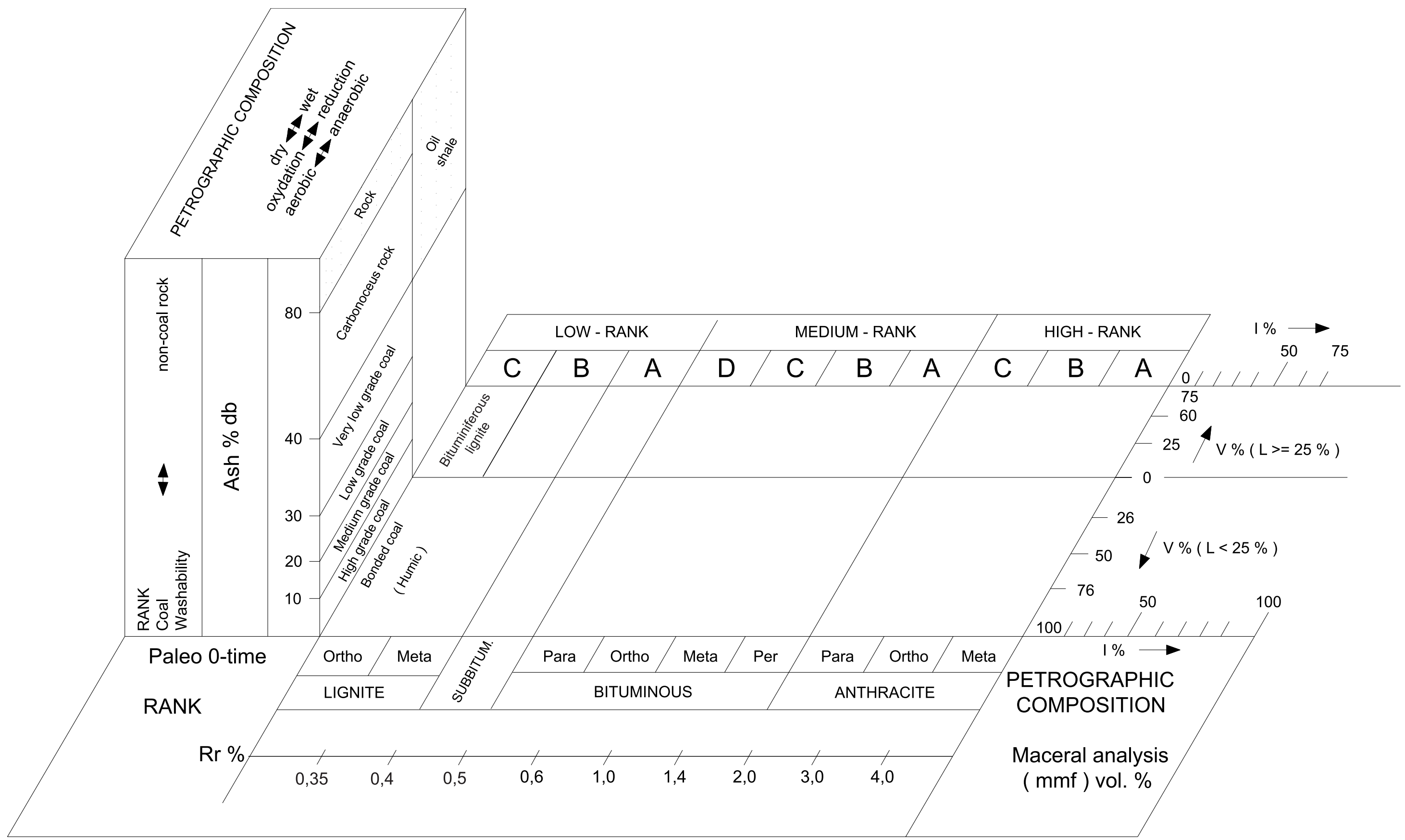

Fig. 3. Changed International Classification of in-Seam Coals

Rys. 3. Zmieniona międzynarodowa klasyfikacja węgla w pokładzie ECE-UN would result in main code of tested coal. Second part of the code, characteristic for specified subtypes of coal would be described by supplementary parameters.

Currently, combustion of coal is done mainly in pulverized and fluiduised beds, as well as – less popular – in form of grate firing. However, to match the needs of environmental protection, mainly sulfur and nitrogen oxide, as well as mercury and dust emission limits (Clean Air Interstate Rule 2010), there is an urgent need to introduce more and more better, cleaner technologies. In order to asses humic lignite type 21, intended for combustion, particularly important is setting its gross calorific value in total moisture, which should be at least 6200kJ/kg (1500 kcal/kg) and ash content recalculated to dry basis, which should be lower than 40%. Supplementary parameters, which also should be included, are sulfur, alkali, sand and xylite content. What is more, ash melting point, as well as amount of toxic and radioactive elements inside the coal and ash, should also be set.

One of the most active branches currently developing in energetic is IGCC technology (Integrated Gasification Combined Cycle) (Collot 2006), in which coal is changed into high-calorie syngas, which structure depends on used technique. Syngas, after cleaning from carbon dioxide and toxic elements is directed to combustion turbine. In addition, sulfur and hydrogen is emitted from syngas just before entering gas and steam turbine – and they are being used in order to produce chemical compounds, such as chemical fertilizers, ammonia or methanol. Fumes from heat and gas turbine are directed into steam turbine to produce additional energy (Coal Utilization Research Council, 2006).

Briquette coal (type 22) has to have set pertographic composition, net calorific value of 8300 kJ/kg (2000 kcal/kg) and ash content below 15% recalculated to dry basis. Therefore, in supplementary code of this coal, special attention should be put to the sum of macerals needed and unneeded in briquette process.

In case of coal for carbonization (type 23) main needed parameter is tar yield, but also low ash content. However, during carbonization, proper grindability is very important, what requires testing xylite content, as well as Hardgrove Grindability Index.

In order to use coal in extraction process (type 24), it is necessary for it to have proper efficiency of bitumen extraction – set as main parameter, but – similarly to coal for carbonization – has to have good Hardgrove Grindability Index. Therefore, supplementary code should include this parameter too.

Gasification is crucial technology for energy production from coal, which at the same time is environment friendly (Hutchinson 2006). Great amount of possible ways of gasification form enable production of large variety of products, including liquid fuels, chemicals, gas fuels and many others (Richter 2001; Hycnar 2007; Dreszer and Więcław-Solny 2007). Currently, there are around 150 coal gasification facilities around the world, while more and more are being produced. Gasification reactors could be divided into three groups (King 1981; Collot 2006; Higman and van der Burgt 2008; Chmielniak, Ściążko 2008):

— moving bed,
— fluidised bed,
— entrained flow.

Additionally, there are works on gasification inside bubbling bed reactor (Collot 2002, 2006). Gasification may also be a part of production in integrated cycles (Co-gasification). Production of fuel from hydrogen is more and more popular, because it is easy and environment friendly. Research on this topic is made in various countries, including USA, China, Japan (HYCOL) and France (Chmielniak et. al. 2009, Zarębska and Pernak-Misko 2007; Higman and van der Burgt 2003; Collot 2006). In Poland, research on usefulness of coal to production of hydrogen from „Legnica" deposit was undertaken by Chmielniak and Ściążko (2007). They proved, that this material is perfect for hydrogen production through gasification. Lignite, both humic and sapprophelic, can be used to gasification (type 25) in two forms: as briquettes or culm. In both cases, analyze of pethrographic composition is needed. In gasification of briquettes, special attention has to be put to petrographic criteria for non-binder briquetting. Reactivity and ash melting point are very important parameters in gasification, which should make their way into main code of coal of this type. Because of different gasification processes it is not possible to answer beyond question, whether certain coal is available to gasification or not. Ash content of coal could serve as example, because it is not limited in moving bed gasification reactors. Currently developing gasification technologies are so universal, that they can use any kind of fuel.

Main aim of coal liquefaction (type 26) to liquid fuels is enlargement of content of hydrogen in carbon skeleton, what allows using it as fuel or chemicals. There is a few methods to obtain liquid fuels from coal: direct through hydrogenation, hydrocracking or coal methanation; indirect, as result of Fisher-Tropsh synthesis and pyrolysis. Direct method relies on destructive effect of hydrogen on coal under influence of high pressure and appropriate temperature – what enables us to obtain diesel, gear and fuel oils. Consequently, indirect method relies on coal gasification, and then – from gasification products (syngas) – liquid hydrocarbons are created. Technology development leads into direction of hybrid process, which integrates processes of direct and indirect coal liquefaction. Supplementary parameters for coal intended to liquefaction or hydrogenation, are mainly content of Carbon and Hydrogen recalculated to dry, ash-free basis and ash content. Another very important factor is petrographic composition. The most important is the lowest possible content of macerals from inertinite group, while – at the same time – the biggest role of macerals from huminite and liptinite group (hydrogen source). For the process of liquefaction alone, a great importance comes also from amount of pyritic sulfur, which acts as catalysis.

Summary

Currently, many countries do research on modern technological classifications of coal. From Table 2, presenting selected parameters used in various classifications of lignite, it is clear, that those classifications lack the needed determination of the possible use of tested coal, especially in relation to global tendencies. During the development of modern

TABLE 2

List of selected parameters for the various classifications of lignite

TABELA 2

Zestawienie wybranych parametrów stosowanych w różnych klasyfikacjach węgla brunatnego

Classification	International classification of inseam coals	ISO 11760	ASTM D 388	Polish proposition Kwiecińska, Wagner (1997)	Serbian: Ercegonac, Źivotić, Kostić (2006)	Russian: Jeremin, Boronowiec (1997)	Chines GB 16772-1997	Polish PN-91/G-97051
Parameter								
Gross Calorific Value	✓		✓			✓	✓	
Net Calorific Value				✓				✓
Random Reflectance R^o		✓			✓		✓	
Ash Content A^d	✓	✓		✓	✓		✓	✓
Total Sulphur Content S_t^d				✓			✓	✓
Tar Yeld T^{daf}				✓	✓	✓	✓	
Maceral Composition	✓	✓		✓	✓	✓	✓	✓
Snad Content								✓
Volatile matter V^{daf}						✓	✓	
Total Moisture W^r		✓			✓		✓	
Ash Melting Point								✓

technological classification of low-rank coal, it is important to rely on existing international standards, but with taking into account individual characteristics of national brown coal. The solutions presented in this work are preliminary proposals, which may be a subject to further discussion on creation – and introducing into widespread use – of modern, based on advanced technologies, classification of low-rank coal.

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NOWA TECHNOLOGICZNA KLASYFIKACJA WĘGLA BRUNATNEGO PODSTAWĄ ZRÓWNOWAŻONEJ GOSPODARKI ENERGETYCZNEJ

Słowa kluczowe

Węgiel brunatny, klasyfikacja węgla brunatnego, zasoby węgla brunatnego, czyste technologie węglowe

Streszczenie

Znajdujemy się obecnie w dobie poszukiwania coraz tańszych źródeł energii, a to właśnie węgiel brunatny jest jednym z najtańszych surowców energetycznych. Biorąc pod uwagę znaczące zasoby tej kopaliny w Polsce, należy zwrócić uwagę, jak ważne jest jej odpowiednie zagospodarowanie. Obecnie zasoby bilansowe węgla brunatnego to przeszło 14 mld ton, co pozwala użytkować węgiel na podobnym poziomie do dzisiejszego jeszcze przez kilkadziesiąt lat. Chociaż badania właściwości technologicznych węgla brunatnego mają w Polsce swoją długą historię, uzasadnione wydaje się nowe spojrzenie na zagadnienie jakości węgla, przede wszystkim pod kątem jego spalania z jak najniższym wydzielaniem związków toksycznych (głównie CO_2) oraz koniecznością jego sekwestracji. Należy wziąć także pod uwagę możliwości chemicznej przeróbki węgla, takie jak zgazowanie i upłynnianie. Do rozwiązania tych kwestii pilnie potrzebna jest nowa klasyfikacja technologiczna węgla brunatnego. Obecnie w kraju nie obowiązuje żaden dokument klasyfikujący węgiel brunatny ze względu na możliwość jego zastosowania. Nowy schemat klasyfikacji technologicznej powinien mieć charakter dwustopniowy. Pierwszy stopień ma stanowić określenie rodzaju i typu węgla w sposób nawiązujący do jego genezy, podczas gdy drugi stopień – bardziej szczegółowy – to wyróżnienie klas i grup technologicznych w systemie kodowym. Efektem tak rozwiązanego problemu będzie zaklasyfikowanie technologiczne krajowego niskouwęglonego węgla w sposób w pełni spełniający potrzeby ustawodawstwa technicznego zarówno polskiego, jak i międzynarodowego. Obecnie w wielu krajach są prowadzone badania nad wprowadzeniem nowoczesnych technologicznych klasyfikacji węgla. Z porównania i zestawienia różnych klasyfikacji węgla brunatnego wyraźnie widać, iż brakuje w nich określenia możliwości użytkowania badanego węgla. Istotne jest, aby – w nawiązaniu do tendencji światowych przy tworzeniu nowoczesnej klasyfikacji technologicznej węgla niskouwęglonego – opierać się na istniejących normach międzynarodowych, jednak z wyraźnym uwzględnieniem specyfiki krajowego węgla brunatnego.

NEW TECHNOLOGICAL CLASSIFICATION OF LIGNITE AS A BASIS FOR BALANCED ENERGY MANAGEMENT

Key words

Lignite, lignite classification, lignite reserves, clean coal technology

Abstract

At the present time, we are in search of the cheapest energy source. There is a chance, that the appropriate use of brown coal may result in one of the cheapest energy sources. Knowing about significant amounts of that resource in Poland, it should be noted, that its appropriate usage is very important. Currently, resources of brown coal are over 14 billion tons, which allows us to utilize coal at a similar level to today's for decades. Although the study of technological properties of brown coal in Poland has a long history, it seems reasonable to take another look at the issue of quality of coal, primarily in terms of its combustion with lower emissions of toxic compounds (mainly CO_2) and the need for its sequestration. What is more, the possibility of chemical processing of coal, such as gasification and liquefaction, also should be considered. To resolve these issues, there is an urgent need for a new technological classification of brown coal. Currently, the country does not apply to any document classifying lignite in terms of possibility of its use. New scheme of technology classification should have a two-stage character.

The first step is an indication of the rank and type of coal in referring to its origins, while the second step – more precise – is the distinction of classes and technological groups in the codification system. Such approach will result in technological classification of national low-rank coal in a way that fully meets the needs of technical legislation of both Polish and international law. Currently, many countries work on introduction of modern technological classification of coal. A comparison and ranking of the various classifications of lignite leads to clear afterthought, that they lack the needed determination of the possible use of tested coal. It is important, to – in response to global trends during the development of modern technological classification of low-rank coal – base on existing international standards, but with taking into account individual characteristics of national brown coal.