Abstract 1

Preliminary assessment of the usefulness of the Polish lignite in the gasification process according to its petrographic composition

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The study has been conducted on the lignite samples from 12 currently exploited, perspective and abandoned Polish deposits. Lignite is common in the Polish Lowland and is derived from the Paleogene and Neogene.

Coal gasification is carried out to produce syngas, which is used as a substitute for natural gas or to produce a synthesis of liquid fuels using the Fischer-Tropsch process. The process of coal gasification is influenced by many factors. Higman and van der Burgt (2003, 2008) claim that the most important parameters include the particle size, surface and internal structure of coal intended for gasification and the type of gasifier. Similarly, van Heek and Muhlen (1986) suggest that the efficiency of gasification depends on the construction of the gasifier and the coal type, particularly its elemental composition (mineral matter and organic matter), moisture, physical properties, porosity and reactivity. According to Zhuo et. al. (2000) petrographic composition has a major impact on the gasification of coal. However, it should be noted that lignite is a mixture of organic matter represented by the macerals and mineral matter.

However, according to many studies the most important parameter in the process of gasification is the reactivity if coal (Smoliński et. al., 2006). A universal method for the determination of this parameter has not yet been determined. According to many researchers, this parameter is influenced by many coal properties; according to some of them, petrographic composition and particle size are among the most important properties. This uncertainty is due to the fact that different macerals have differing reactivity. The highest reactivity is typical for macerals of vitrinite / huminite group, then liptinite group. The least reactive are the macerals of inertinite group, but their gasification starts at higher temperatures, which makes the process longer.

In order to determine the suitability for gasification based on the petrographic composition, the diagram shown in figure 1 has been used. To be suitable for gasification, the lignite should contain at least 80% of the macerals of the huminite and liptinite groups ($H + L^{mmf}$) and less than 20% of the macerals of the inertinite group in mineral matter free basis (I^{mmf}). The suitability for this process is problematic when the inertinite group content varies between 20 and 50% (Fig1.) (Bielowicz, 2012).

Within the analyzed samples of lignite, content of the huminite group varies with low variability (7.48%) from 62 to 100%, with an average of 89% (Table 1).

Macerals of liptinite group are up to 8% of organic material in the studied lignite, while the macerals of inertinite group are up to 3%.

The petrographic composition of lignite from various deposits is dominated by the huminite group. The average content in mineral matter free basis in the deposits varies from 87% in Drzewce

deposit up to 95% in Adamów and Sieniawa deposits (Fig. 2). Overall, macerals from huminite and liptinite groups within all studied deposits are over 90%. This indicates that the lignite from Polish deposits meet the criterion for petrographic coal for gasification. It should be noted, however, that the problem of petrographic composition of coal for gasification in various types of generators requires further studies.

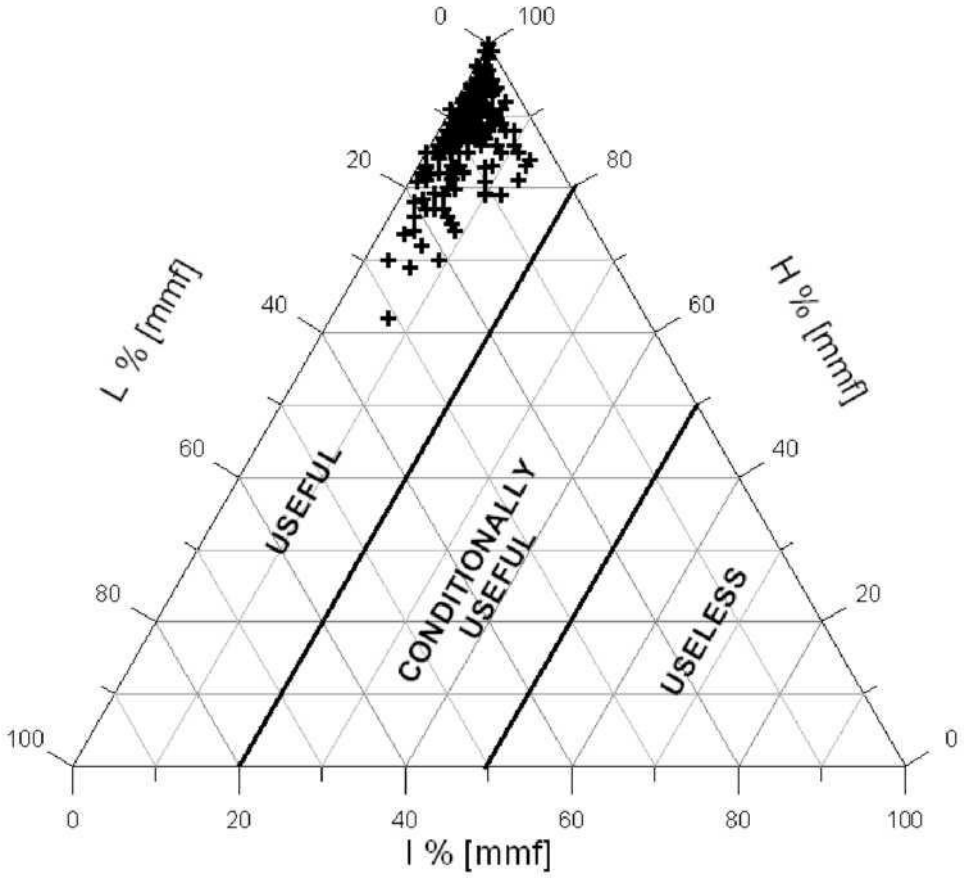

Fig. 1. Evaluation of the applicability of analyzed lignite for gasification based on the petrographic composition recalculated to mineral matter free basis (explanations: H [mmf] - huminite group content recalculated to mineral matter free basis, L [mmf] - liptinite group content recalculated to mineral matter free basis, I [mmf] - inertinite group content recalculated to mineral matter free basis).

Table 1 Basic statistics of the petrographic composition of Polish lignite

Variable	Sample size	Average	Minimum	Maximum	Standard deviation	Coefficient of variation [%]
H [%, mmf]	247	89	62	100	6,65	7,48
L [%, mmf]	247	8	0	31	5,63	72,25
I [%, mmf]	247	3	0	13	2,61	81,50

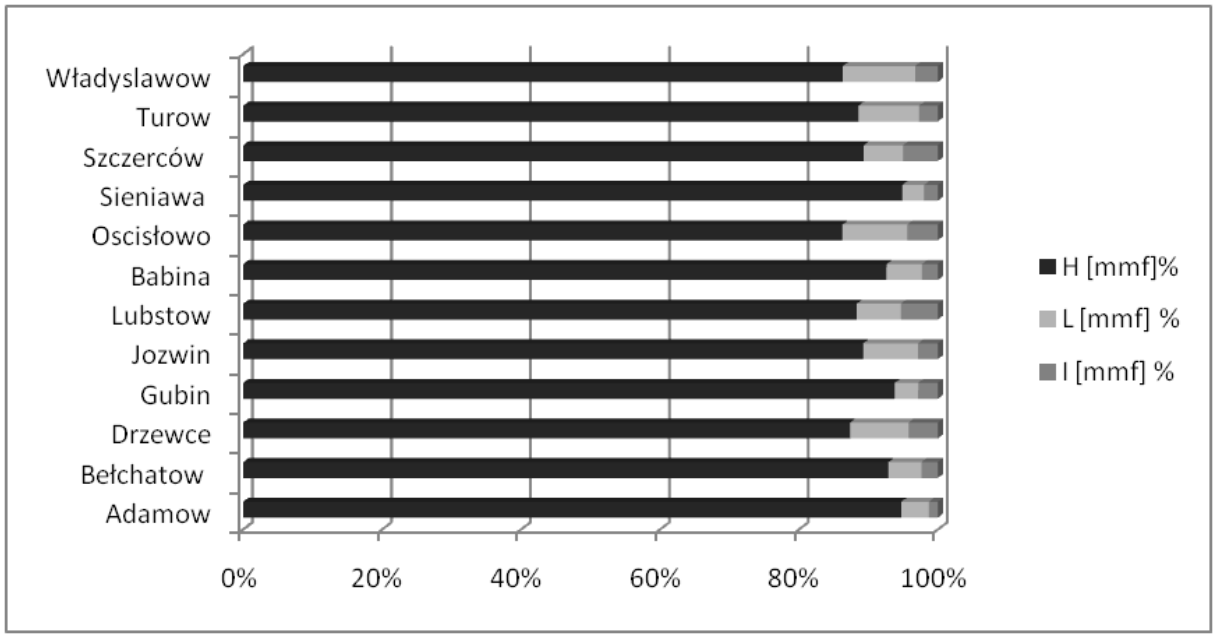

Fig. 2. Petrographic composition of Polish lignite deposits. (explanations: H [mmf] - huminite group content recalculated to mineral matter free basis, L [mmf] - liptinite group content recalculated to mineral matter free basis, I [mmf] - inertinite group content recalculated to mineral matter free basis).

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