PETROGRAPHIC COMPOSITION OF CHAR FROM THE GASIFICATION OF COAL FROM THE WIECZOREK MINE AFTER COMBUSTION

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Introduction

Gasification is a modern coal processing technology that can be used to replace direct coal combustion with cleaner energy. Gasification enables more environmentally friendly energy generation and is a very flexible technology in terms of the fuels used. The aim of the paper was to investigate the impact of petrographic composition of bituminous coal from the Wieczorek mine on the gasification process and petrographic composition of the resulting char.

Samples and methods

The starting material, which was subjected to the gasification process, was bituminous coal from the Wieczorek mine. The coal was subjected to gasification in a fluidized bed reactor at a temperature of about 900°C and in an atmosphere of oxygen and CO_2. The char was burned and the resulting bottom and fly ashes were subjected to petrographic analysis.

Results

In the case of bituminous coal, petrographic composition was dominated by macerals of the vitrinite group (54.8% vol.) followed by macerals of the inertinite group (23.4%). The liptinite group constituted 16.2% of the examined coal volume, while the mineral matter - 5.6%. Petrographic composition of gasification char, fly ashes from bituminous coal and char combustion, and bottom ashes from the combustion of bituminous coal and char are presented in table 1.

Table 1 Petrographic composition of gasification char, fly ashes, and bottom ashes.

Char type	Gasification char	Bottom ash from the combustion of bituminous coal	Bottom ash from the combustion of char	Fly ash from bituminous coal combustion	Fly ash from char combustion
Mineroid	5.1	82.5	81.9	36.0	44.0
Solid / Fusinoid	11.3	1.6	3.3	0.0	0.0
Inertoid	41.2	7.1	5.5	42.1	50.3
Mixed dense	10.9	4.5	4.1	2.7	0.9
Mixed porous	13.5	3.2	4.1	4.0	0.7
Crassinetwork	8.7	1.0	1.1	2.7	1.1
Tenuinetwork	1.6	0.0	0.0	2.2	0.2
Crassisphere	4.8	0.0	0.0	4.0	1.6
Tenuisphere	2.9	0.0	0.0	6.3	1.1

Conclusions

The conducted experiment has shown that coal from the Wieczorek mine is suitable for fluidized bed gasification in carbon dioxide atmosphere. The inertinite group accounts for almost 23%, of which around 8% is semifusinite. The share of non-reactive macerals is relatively high (around 20%). When it comes to the petrographic composition of char, only a small part has not reacted and took the form of solid / fusinoid. The char, dominated by inertoids, was formed during the fluidized bed gasification of bituminous coal from the Wieczorek mine. There are very few porous particles. Such a composition is associated with a fairly low temperature of the gasification process and the petrographic composition of the gasified coal. The combustion of bituminous coal and gasification char led to formation of bottom and fly ashes with similar petrographic composition. However, it has been found that fly ash from the combustion of char contained more mineroids and less porous chars, which suggest a better burnout. This may in turn suggest that the combustion of char remaining after gasification may be economically justified.

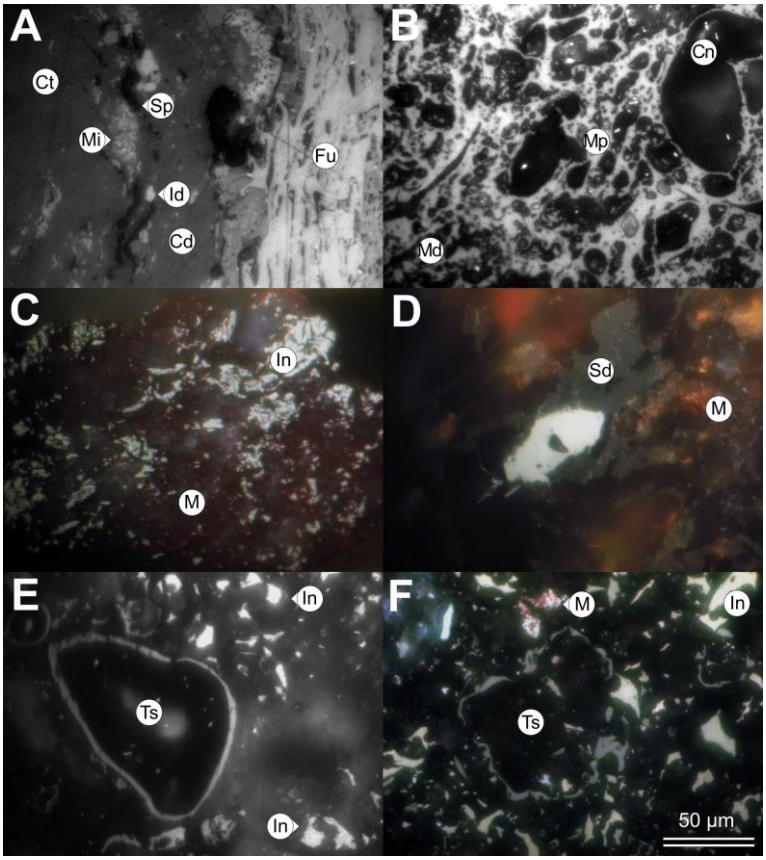

Figure 1. *Micropgraphs of the samples: A – bituminous coal, B – char, C – bottom ash from coal combustion, D – bottom ash from char combustion, E – fly ash from coal combustion, F – fly ash from char combustion. Abbreviations – coal macerals (A): Cd – collodetrinite, Ct – collotelinite, Fu – fusinite, Id – inertodetrinite, Mi – micrinite, Sp – sporinite; char morphotypes (B, C, D, E, F): Cn – crassinetwork, In – inertoid, Md – mixed dense, Mp – mixed porous, Sd – solid, Ts – tenuisphere, M – mineroid.*

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