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## **THE COALY MATTER IN FLY ASH FROM KATOWICE STEEL WORK POWER STATION**

### INTRODUCTION

Throughout the twentieth century a rapid industrial development has stimulated a growing demand for coal supply. The proper utilization of coal depends on both technological conditions and the natural properties of this complex organic rock. This was the reason for intense investigations of coal, its products' and byproducts' chemical and petrological properties.

In case of coal combustion the burning of coal in dust furnaces influences the atmospheric, soil and water pollution causing health hazard for the wide spread vegetation as well as for human and animal population. This in turn has induced scientists to undertake a deep insight into combustion processes as to find solution for diminishing their impact on the environment.

This paper presents results of investigations on the coaly matter in fly ash from Katowice Steel Work Power Station which has derived from the not fully combusted reactive macerals .

The aim of the work was to detect the ways of behavior of the reactive macerals in coal during combustion process.

### SAMPLING AND METHODS OF INVESTIGATIONS

"Katowice" employees have taken fly ash samples for petrography straight from section No 6 of the ash hopper belonging to electro filter each month from February till November 1998. Altogether 10 samples were supplied. Mrs. Danielowska provided the feed coal sample together with the names of collieries, which were supplying coal for the power station. These were: Niwka Modrzejow, Kazimierz Juliusz, Sosnowiec, Myslowice, (private communication).

The petrographic analyses of the feed coal as well as of the ash samples were carried out in reflected light using Zeiss Axioplan 2 microscope combined with the point counter "Swift". According to the ISO Standard. Maceral analysis and vitrinite reflectance were completed on the coal sample in accordance with the ISO standards.

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The ash samples were analyzed in the reflected light using dry objective and magnification 200 times. Coaly particles were identified in 500 points, each time when the cross point coincided with the organic matter visible on the surface of the polished block.

Chemical analyses of the char and ash content were completed in Analytical Chemistry Laboratory, a part of the Center for Research and Development of Energy Management in Katowice. They were carried out in accordance with the polish standard PN – 80/G – 04512.

## DISCUSSION ON RESULTS

The content of morphological forms of unburned organic matter as well carbon content shows some diversity (Table 1).

Detritus is dominating over other forms with two exceptions (samples 4 and 8). It has probably derived from the cracked parts of other morphological forms and/or from soot flakes. The range of its particle diameters (< 10 to <20  $\mu\text{m}$ ).

Could be connected with burning conditions. The smallest particles are connected with very effective combustion of reactive constituents of coal whereas larger grains derive mainly from inert macerals. The latter ones are usually solid and do not display porosity. However the shape of some of them indicates that they could derive from crumbled char forms such as cenospheres or laces.

Laces form another morphological group, which usually occurs in abundance (with the exception of samples 6 and 7). They probably derived from combusted vitrinertite and clarodurite, but one could not exclude also involvement of vitrinite (collotelinte), which was affected by somehow lower temperatures in the peripheral areas of the burner. Laces' walls could be thick, massive and porous, or thin, broken and crumbled. This diversity of forms is connected with burning conditions as well as with the proportions of different microlithotypes in the feed coal. According to Misz (1999) the thick walled laces were probably generated from inertinite- rich vitrinertite, whereas the thin walled ones from vitrinite-rich vitrinertite and duroclarite. High content of volatile matter is responsible for higher plasticity of combusted coal particles and formation of thinner walls in the discussed forms. The centric distribution of pores within the specimen's wall seems to be a result of the rotation movement of the burning particle.

Thick-walled cenospheres which are a product of combusted vitrinite, were also common in the analyzed fly ash, with exception of sample 9 that lacks this form and sample 4 where only few specimens were found. However it is to be stressed that in spite of abundance of vitrinite-derived forms in analyzed fly ash samples, their content was always significantly lower than that of vitrinite in the feed coal.

Thin-walled cenospheres are most likely a product of combusted clarite. Their thin walls were formed during intensive devolatilization process. Usually they occur in minor amounts, and in samples 7, 8 and 9 they do not occur at all.

Honey combs have probably derived from semi- inert inertinite. They occur in amounts ranging from 0.2 to 9,8 % and were identified in all analyzed samples.

Altered inertinite is most probably a remainder of degrado-inertinite such as degrado (oxy)- semifusinite, macrinite etc of reflectance indicating higher than semi –inert oxidation. Its characteristic features such as: rounded edges, small pores and cracks visible on the grain surfaces, indicate that it has responded (up to some extent) to high temperatures in the boiler. This form has been found in all samples.

Unaltered inertinite has derived from pyro-fusinite and pyro-semifusinite. It does not display any visible changes of appearance as compared with forms identified in the raw coal. It occurs in traces in most of samples and in samples 6, 7, 8 and 9 was not identified at all.

## CONCLUSIONS

- The analyzed fly ash samples were free of liptinite reminders. This suggests that macerals belonging to this group have been completely combusted.
- Visibly smaller amount of the vitrinite group reminders as compared with the vitrinite content in the feed coal, indicates that the significant part of macerals belonging to this group have been completely burned in electricity boilers.
- Not completely combusted vitrinite forming matrix in vitrinerite and clarodurite occur in ash in a form of thick-walled laces, whereas non-burned part of vitrite (mostly collotelinite) was found in ash as thick-walled censpheres.
- Clarite reminders (mainly in a form of telinite with resinite cell fillings) have occurred in form of thin-walled cenospheres. Their rare occurrence in analyzed samples could be explained by small amounts of telinite in the raw coal. Thin walls of censpheres could easily be crumbled and became a part of detritus.
- High content of detritus and low carbon content in samples 2, 5, 6, 7 and 9 could be a proof of the highly effective combustion processes of coals represented by these samples.

## REFERENCES

- MISZ, M., 1999, Organic matter in slag and fly ash as derived from coal combustion processes in power station “Bedzin “S.A. PhD thesis. Sosnowiec.
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