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THERMAL ANALYSIS OF COALS USED FOR LIQUEFACTION

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ABSTRACT

With the aim of better understanding and, if possible, of prediction of the behaviour of various coals during liquefaction by catalytic hydrogenation, thermogravimetry and differential thermal analysis have been performed in oxidative, inert and reductive atmospheres.

Samples of domestic lignite and brown coals have been investigated. The results obtained indicated some differences in the reactivity of coals which may be correlated with the convenience of using the coals as the source of liquid fuels.

INTRODUCTION

The determination of the possibility of using a certain type of coal as a source of liquid fuels requires a long termed and complex investigations. Thermal analysis of coals may provide data about the thermal stability and reactivity of coals which may be correlated with their behaviour in liquefaction. Experimental banch scale liquefaction of some yugoslav coals by catalytic hydrogenation being developed in our laboratory, an attempt was made to study the usefulness of the thermal analysis of coals in various atmospheres to predict or determine the reactivity of coals in the liquefaction process.

EXPERIMENTAL

Samples of the yugoslav brown coals from deposits "Aleksinac", "Banovići" and the lignite "Kolubara" were chosen for thermal analysis, and noted by A, B and K, respectively. Properties of the samples, relevant to the liquefaction are given in table 1.

Differential thermal analysis and thermogravimetric analysis were performed with Linseis L 81/22 thermobalance, in the stationary atmosphere of air, and in streems of nitrogen or hydrogen dried and catalyticaly purified from oxygen.

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Table 1. Chemical analysis of coals (wt %)

coal	moisture	ash (mf)	volatiles (maf)	C fix	S
A	15,6	8,9	46,4	53,62	5,66
B	10,3	16,1	46,0	53,96	1,97
K	14,6	27,4	58,2	41,79	0,67

Measurements were made with the heating rate of 10°C/min up to 800°C. Liquefaction of coals was performed by the procedure described elsewhere (1).

RESULTS AND DISCUSSION

Data obtained by the applied thermal analysis may be used to consider various properties of coals. Content of the moisture and ash calculated on the base of the thermal analysis performed in air confirmed the possibility of using this method instead of chemical analysis. The appropriate contents of volatiles were calculated combining the data obtained in air and nitrogen.

Thermal behaviour of our coals corresponds to the published data for similar type of coals (2). In air, moisture evaporation and oxydation of coals were detected, only. There were no significant differences between various type of coals in temperatures of the beginning of the oxydation but the maximum and the end of the process were shifted toward the lower temperatures for the lignite K, as it was expected for a lower rank coal (3).

Results of the analysis in the inert atmosphere are shown on figure 1. The main conclusions concerning the reactivity of coals are drawn from the derivated thermogravimetric curves, especially from the second peak corresponding to the removal of volatiles. The lower temperatures of the beginning of this effect in coals A and K compared to the coal B may not be explained by the data of their elemental analysis or their degree of metamorphysm, but they are in accordance with the statement (4) that coals from the same petrographic class may have a different reactivity. They may correlate also, to our results of the laboratory coal liquefactions, listed in table 2.

Low rank coals, like lignite K, give much more gases and less liquid products than brown coals while inside the same class of coal, a sample with the narrower second DTG peak in the inert

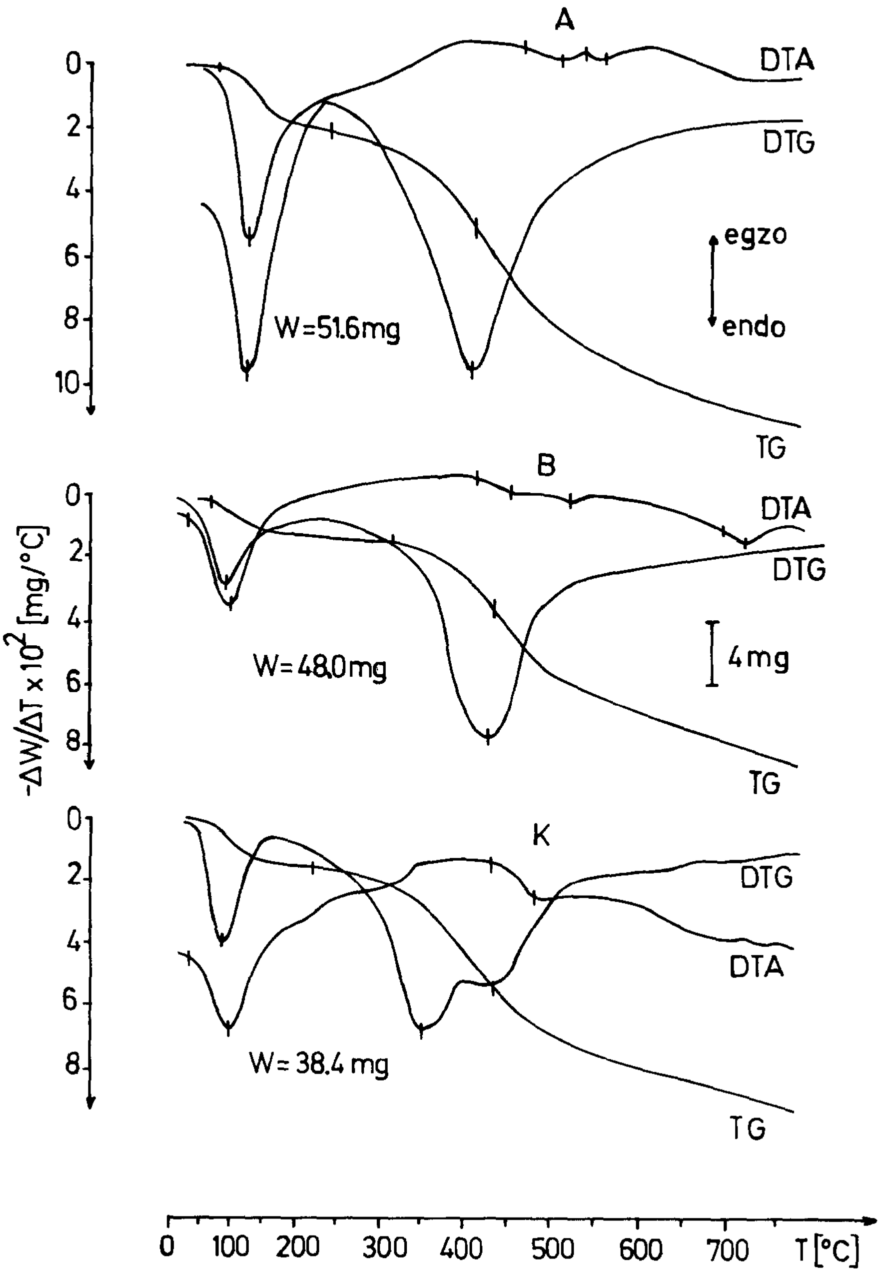

Figure 1. Thermal analysis of coals in nitrogen

Table 2. Results of the liquefaction of coals

coal	products of the liquefaction, wt %, on coal (a.r.)		
	oil fraction	asphaltenes	solid residue (on carbon)
A	56,9	0,7	30,23
B	75,2	0,4	15,50
K	50,1	1,4	26,64

atmosphere was more reactive in liquefaction (4). During the thermal analysis in hydrogen, the higher loss of weight observed in all the samples indicated the interraction of hydrogen with some constituents of the coal (sulphur, oxygen) but the thermal effects corresponding to the reduction or hydrogenation of coal were not observed .

CONCLUSION

Thermal analysis of coals may provide usefull data concerning the chemical properties and the reactivity of coals as a source of liquid fuels. Combination of the results obtained in oxidative, inert and reductive atmospheres reveales the differences between various coals even of the same rank, relevant for their behaviour in the process of catalytic hydrogenation.

REFERENCES

1. B.R. Aleksić, B.D. Aleksić and D.Vitorović, Fuels and Lubricants , Zagreb, 18, 187 (1979).
2. O.E. Ivancev, V.P.Stasov and G.O. Uzhenkov, Geol. Geohim. Gorjutch. Iskop., 36, 83 (1973).
3. D.Rustschev and K.Jetschewa, In Thermal Analysis, 2, eds. R.F. Schwenker and D.Garn, Acad. Press, N.Y. 1969.
4. Z.S. Smutkina et al., Himia tv. topliva, 1, 59 (1982).