

THERMAL ANALYSIS OF LIGNITE COAL'S CHARs WITH ADDITIONS
OF ALKALINE CARBONATES

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S U M M A R Y

Chars of lignite coal obtained at 300, 400, 500 and 600°C is demineralized and subjected to differentially thermic and thermogravimetric analysis. There has been investigated the effect of additions of 10% of lithium and sodium carbonate. There has been calculated the energy of activation of the thermal destruction.

I N T R O D U C T I O N

Pyrolysis, which is the initial stage of all thermic processes in processing hard fuels (carbonization, gasification, liquefaction etc.) can be investigated with the aid of various methods. Franklin and co-workers [1] investigate the effect of the natural mineral admixtures of coal in their rapid pyrolysis. Investigators from CSIRO in Australia clarify the mechanism along which act the inorganic substances during pyrolysis [2, 3]. During the latest years there appeared interesting works on the catalytic gasification of coal with alkaline additions. Wood and coworkers [4], as well as Sams and Shadman [5] study the effect of potassium carbonate in gasification of chars from coal. Oya and Marsh [6] turn into coke mixtures of coal and potassium carbonate and analyze the structure of the obtained coke with the aid of an optical and scanning electron microscopy, while Sarkar [7] studies the effect of KOH on the coking and the baking ability of coal. Afler, Hüttinger and Minges [8] proved the poisonous effect of sulphur in catalytic gasification.

M E T H O D S

The initial lignite coal, used in these investigations, at characterized as follows: moisture W^a - 9,0%, ashes A^d - 22,3%, common sulphur S_t - 7,22%, volatile substances V^{daf} - 61,1%, carbon C^{daf} - 54,7% and hydrogen H^{daf} - 6,6%. The are subjected to thermal destruction at 300, 400, 500 and 600°C. In Table 1 are gi-

Table 1. Characteristics of chars

| Yield and indices of the obtained chars | Temperature, °C | | | |
|--|-----------------|------|------|-------|
| | 300 | 400 | 500 | 600 |
| Yield, % | 77,5 | 63,6 | 58,9 | 52,4 |
| Humidity VV^a , % | 2,2 | 2,0 | 1,9 | 1,5 |
| Ashes A^d , % | 23,4 | 27,8 | 32,3 | 36,9 |
| Volatile substances V^{daf} , % | 52,4 | 44,8 | 30,7 | 26,0 |
| Common sulphur S_t , % | 8,95 | 9,70 | 9,88 | 10,80 |
| Carbon C^{daf} , % | 59,8 | 64,3 | 77,3 | 77,5 |
| Hydrogen H^{daf} , % | 6,2 | 5,1 | 3,4 | 2,1 |

ven the yields of the obtained hard residue (chars) and its most important indices. The chars is demineralized, first when processing with 10% of hydrochloric acid, and then with fluorohydric acid at room temperature at which its ashes decrease considerably (A^d 3,3 to 8,4%).

To impregnate the char with lithium or sodium carbonate has been used class 0,5-1 mm, to which, at constant stirring are added 10% of the outpointed carbonates under the form of an aqueous solution. The allocation of the additions on the surface of the char is observed by means of an optical electron microscopy M 301 G. Philips.

Thermal and thermogravimetric analysis is carried out with a derivatograph from the firm "MOM"-type Paulic - Paulik - Erday GD-102 under the following conditions: quantity of the sample 300 to 400 mg., speed of heating 10°C/min. inert substance Al_2O_3 and uncontrolled air atmosphere. The activation energy is calculated by the method of Broido [9] wherein are used the curves-TG.

RESULTS AND DISCUSSION

On figures 1 and 2 are presented DTA-, respectively TG-curves of the initial lignite coal and the chars obtained from it at 300, 400, 500 and 600°C, which, as it is clear from the data on Table No 1, has a various amount of volatile substances (from 52,4 to 26,0%). The DTA curve of the initial coal /Fig. 1,a/ begins with two typical for the separation of humidity /9,0%/ endothermic effects at 130 and 160°C which are more slightly expressed with the chars

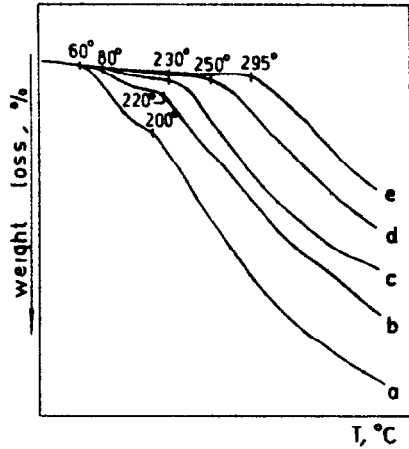
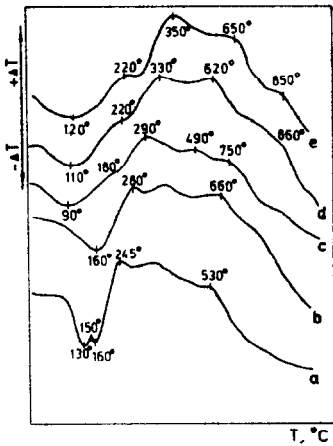


Fig. 1

TG - Curves

- a - Initial lignite coal; b - char at 300°C;
- c - char at 400°C; d - char at 500°C;
- e - char at 600°C.

Fig. 2

DTA - Curves

(Fig. 1, curves b, c, d and e) which have considerably less humidity (2,2, 2, 0, 1,9 relatively 1,5%). The maximum of the first exothermic effect from 245°C for coal moves up at 280, 290, 330 respectively 350°C parallel with the increase of temperature at which this char is obtained.

The TG curves, which considerably differ among themselves, are much more characteristic. The decrease of the mass of the initial coal begins even at 60°C, but after 200°C it becomes specially intensive (Fig. 2, curve a). For chars obtained at 300 and 400°C this temperature is slightly higher - 80°C, while for those at 500°C and 600°C it reaches 250°C respectively 295°C. The activation energy of thermic destruction of the initial coal (51.1 kJ/mol) does not differ from the one of the obtained kinds of coke (49, up to 52,0 kJ/mol), despite the great difference in the yield of volatile substances during the thermal destruction of these products /Table No 1/.

In figure 3 are compared DTA - the curves of the chars, obtained at 400°C, impregnated with 10% Li_2CO_3 and of the pure lithium carbonate. According to literary data, the melting point of the pure Li_2CO_3 is 732°C [10], but due to the presence of some impurities, determined by the endothermic effect of DTA - curve, the melting point is lower - 700°C. The same effect, but of lower intensity, is observed also at the thermic analysis of char impregnated with 10% of lithium carbonate = Fig. 3, curve a./

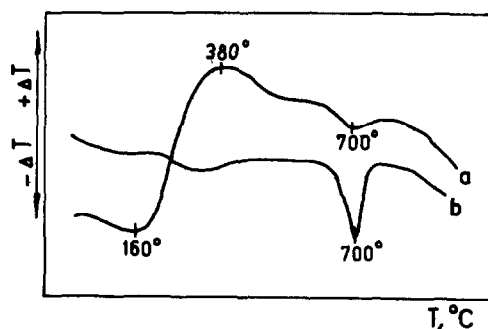


Fig. 3. DTA - curves char with 10% Li_2CO_3

C O N C L U S I O N

1. There have been carried out differential-thermal and thermogravimetric investigations of lignite coal and its char obtained at 300, 400, 500 and 600°C with an addition of 10% of lithium carbonate.

2. The char has an endothermic effect in the temperature interval 130-160°C determined in the separation of humidity and characteristic exothermic effect, whose maximum is moved to higher temperatures with the increase of the temperature at which the char was obtained. Parallel with it is also increased the temperature at which the mass of the char begins to decrease, due to the separation of the volatile products by its thermal destruction.

3. An endothermic effect at 700°C appears in DTA-curve of char, impregnated with 10% of lithium carbonate. It is due to the melting of the carbonate, intimately filling its pores.

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