

A DEVOLATILIZATION PROCESS OF BROWN COAL DURING HEATING UNDER DIFFERENT CONDITIONS

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The devolatilization process is referred to the release of gaseous fuel components during heating of solid fuels. This process is a key characteristic of the combustion of solid fuels [1]. The volatiles burn much more rapidly than the remaining char particles and therefore are important for flame ignition and stability and play an important role in gas pollution formation. On the other hand, at the same time the water evaporation occurs that can delay the ignition of solid fuel [2]. Moreover, the devolatilization process determines how much char remains to be burned as well as the physical characteristics of the resulting char, with subsequent impacts on the char combustion properties [1]. In this work, the methods of infrared spectroscopy of disturbed total internal reflection were used to study the change in the chemical structure of fine particles of brown coal during heat treatment in an air atmosphere and with a limited presence of air. Deconvolution methods for the IR spectra of samples made it possible to clarify information on the structure and chemical bonds in brown coal, including in the range of O–H vibrations.

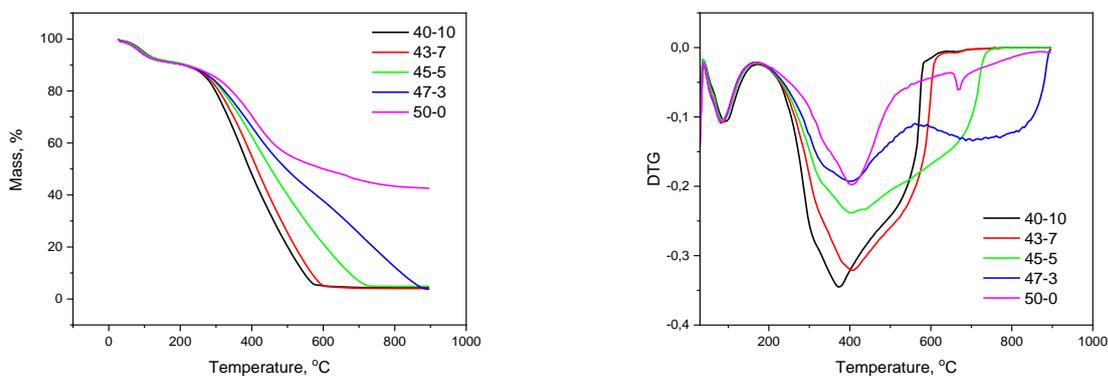


Fig. 1. TG and DTG curves of brown coal samples in nitrogen-oxygen atmosphere (Numbers indicate the nitrogen/oxygen flow rates.).

Non-isothermal thermogravimetry (TG) was applied for determining chemical kinetic parameters in coal combustion. Activation energy and the pre-exponential factor were determined considering first order Arrhenius' kinetics. The pyrolysis experiments for coal samples were performed on Thermo-Gravimetric Analyzer (TG 209 F1 Libra, NETZSCH). In a typical run, 5 ± 0.2 mg samples were used to carry out experiments at the heating rates of 10, 15, 20 K/min in the temperature range of 25°C to 900°C in a N₂ atmosphere (99.99% pure) at a constant flow rate of 50 mL/min. Before each experiment, the sample was further ground to a smaller size to eliminate the influence of thermal effects on the TG measurements. In the combustion experiments synthetic air atmospheres were used. To investigate the oxidation process, measurements were carried out in an air atmosphere with different oxygen contents (0, 6, 10, 14, and 20%) at a heating rate of 10 K/min and at a constant flow rate of 50 mL/min.

The study of changes in the chemical composition of coal particles during heat treatment is relevant and interesting for mathematical models' development to describe the combustion of organic solid-phase fuels and multifuels systems. Moreover, it could be useful for a deeper understanding of the conditions for fabricating coal-based sorbents with improved properties.

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