Table 3. Coking products of coking tar fractions with t_{bo} > 280°C

Sample	Parameters				Product yield, wt %	
	holding temperature, °C	holding time, h	final temperature, °C	maximum pressure, MPa	coke	gas + losses
1	500	4	520	1.5	32.8	67.2
2	500	4	520	2.0	47.5	52.5

Table 4. Characteristics of coke produced from fraction with t_{bo} = 280°C

Sample	Actual density, kg/m^3	Ash content, %	Yield of volatiles, %
1	2068	0.3	7.0
2	2025	0.2	8.2

Table 5. Elemental composition of coke

Sample	Elemental composition, wt %				
	O	H	C	N	S
1	2.15	2.93	93.1	1.62	0.24
2	1.64	1.89	96.1	1.12	0.12

in Table 2, after hydrogenation of tar in the presence of Ni-bearing catalyst, the yield of the fraction with t_{bo} = 180–300°C is 37.0 wt %, as against 19.0 wt % in the initial tar. The yield of fractions boiling above 330°C is 60.8%.

Subsequently, the hydrogenated tar obtained in the presence of Ni-bearing catalyst is filtered at 180°C and 1.0 MPa through belting fabric, with two layers of filter paper, at a filtration rate of 14–15 kg/min m^2. The filtrate yield is 90.5%. The distilled tar fraction boiling above 280°C is coked in a high-pressure laboratory system. Table 3 presents the results of coking.

The coke yield is 47.5 wt % at a pressure of 2 MPa (Table 3). In the experiment, we find that, with decrease in pressure from 2.0 to 1.5 MPa, the coke yield decreases from 47.5 to 32.8 wt %. In the course of the process, most of the light hydrocarbons are removed from the reaction zone. Analysis of the basic characteristics of the coke produced reveals three main characteristics. The composition of the coke is determined by technical analysis (Table 4).

Thanks to the decrease in density of sample 2 relative to sample 1 and the increase in the yield of volatiles, the specific surface of the pores is increased, and cross-linked structures are formed in coking [8].

An important criterion in assessing the quality of coking products is the elemental composition. The elemental composition of coke is determined by means of a TESCAN VEGA (Czech Republic) scanning electron microscope. Table 5 presents the elemental composition of the coke samples produced.

The carbon content is 96.1 wt % in sample 2 and 93.1 wt % in sample 1. In thermal cracking at high temperature and pressure, high-molecular condensed aromatic compounds are formed. That corresponds to high carbon content in the coke. The sulfur content in sample 2 is 0.12 wt %, as against 0.24 wt % in sample 1. That is associated with decrease in the content of heterocyclic compounds in the coke samples on coking at 500°C and 2 MPa, as a result of hydraulic cracking of the heterocyclic compounds in the tar fractions.

Thus, we have proposed a method of producing coke from the distilled tar fraction at t_{bo} > 280°C: preliminary hydrogenation of the coal tar, followed by fractionation and heat treatment of the selected distilled fraction.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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