ISSN 1068-364X, Coke and Chemistry, 2021, Vol. 64, No. 8, pp. 369–371. © Allerton Press, Inc., 2021.
Russian Text © The Author(s), 2021, published in Koks i Khimiya, 2021, No. 8, pp. 29–32.

COKE

Bitumen Production from Shubarkol Coal (Kazakhstan)

Zh. K. Kairbekov[a, b, *], N. T. Smagulova[a, b, **], and N. A. Abik[a, *]**

[a] *Al-Farabi Kazakh National University, Almaty, Kazakhstan*

[b] *Research Institute of New Chemical Technologies and Materials, Almaty, Kazakhstan*

**e-mail: zh_kairbekov@gmail.com*

***e-mail: nazym2011@inbox.ru*

****e-mail: nariman.abik@gmail.com*

Received May 14, 2021; revised May 14, 2021; accepted June 17, 2021

Abstract—Viscous bitumen for highway use, which matches all the physicomechanical properties of BND 60/90 bitumen (in other words, those required by the standard for bitumen), may be produced by modifying the organic component of hydrogenated coal with sulfur. The new bitumen may be used as a road surface operating at mean monthly temperatures between −10 and −20°C. On adding sulfur, the content of monocyclic, bicyclic, and condensed aromatic hydrocarbons in BND 60/90 bitumen is decreased, while the content of asphaltenes and tars is increased. That may be explained by the reaction of sulfur with aromatic compounds.

Keywords: coal, bitumen, modifiers, hydrogenated derivatives, elemental sulfur, roads, low working temperatures

DOI: 10.3103/S1068364X21080044

Recently, the demand for sulfurous bitumen material in the oil industry has been growing because of the traditional need for high-sulfur compounds. If the sulfur content in oxidized bitumen for road use is 20 wt %, sulfur in such quantities dissolved at 120–150°C [1]. The dissolved sulfur in the hydrocarbon components of bitumen serves as a plasticizer, a filler, and a supplementary reagent. The structure of sulfur-modified bitumen depends on the quantity of sulfur employed and the temperature at which the sulfur–bitumen mixture is prepared. On adding up to 20% sulfur to bitumen, the type of reaction in the mixture depends on its final temperature.

Depending on the ratio of bitumen and sulfur, the duration of mixture heating, and the final temperature, the sulfur may penetrate in the bitumen molecule, and dehydrogenation may occur, with the liberation of hydrogen sulfide. When the mixture is heated to 140°C, the sulfur forms polysulfides, in which the unreacted sulfur dissolves. The system of unreacted polysulfides soluble in elemental sulfur, such as asphaltenes, forms the basic lattice structure.

Asphaltenes, paraffins, disperse sulfur, tars, and hydrocarbons are dispersed in this lattice. If the mixture of sulfur and bitumen is heated above 140°C, the structure of linear polysulfides may be converted to stable sulfides of thiophene type, on account of dehydrogenation of the saturated bitumen components. With increase in temperature, the highly reactive asphaltenes and tar, as well as aromatic naphthene compounds, react with sulfur to form C–S bonds. We also know that, at 240°C, sulfur reacts with aromatic

Table 1. Results of hydrogenating Shubarkol coal in a 1 : 1 mixture with petroleum at 5.0 MPa for $\tau = 15$ min

Process	Temperature, °C	Total yield of hydrogenated coal, %	Gas + H_2O, wt %	Losses, wt %
With no catalyst	300	26.0	39.0	35.0
	350	29.7	38.1	32.2
	400	35.1	30.5	34.1
With 0.05% Mo	300	47.8	36.0	16.2
	350	51.7	28.1	10.2
	400	65.1	17.8	17.1