Available online at www.sciencedirect.com

ScienceDirect

Procedia Chemistry 10 (2014) 326 – 331

Procedia Chemistry

XV International Scientific Conference "Chemistry and Chemical Engineering in XXI century" dedicated to Professor L.P. Kulyov

Composition of Initiated Cracking Products of High-Sulfur Natural Bitumen

N.N. Sviridenko[a] *, E.B. Krivtsov[a], A.K. Golovko[a], A.S. Dombrovskaya[a] N.I. Krivtsova[b]

[a]*Institute of Petroleum Chemistry, Siberian Branch of the Russian Academy of Sciences, Academicheskii ave. 4, Tomsk, Russia*
[b]*National Research Tomsk Polytechnic University, Lenina ave., 30, Tomsk, Russia.*

Abstract

The analysis of the cracking products of bitumen Karmalskoye deposits (the content of fractions boiling up to 200 ºC 6,7 % wt.) has been performed. The influence of power plant coal ash microspheres on orientation of cracking bitumen components is stated. Bitumen cracking leads to significant yields of gas and coke for more than 20 % wt. and destructions of all components. The initiated bitumen cracking in the presence of 10 % microspheres at cracking temperature 450 °C leads to reduction of gas and coke yields and increase in fractions of ibp (initial boiling point) –360 °C at 10 % wt. in comparison with products of the thermal bitumen cracking. The analysis of composition and amount of sulfur compounds in initial bitumen and the cracking products in the various conditions has shown that the thermal cracking leads to increased homologues benzothiophene contents due to partial destruction of resins, and to decrease in the content of homologues dibenzothiophene.

Peer-review under responsibility of Tomsk Polytechnic University

Keywords: Natural bitumen, cracking, microspheres, resins, asphaltenes.

1. Introduction

The decline in reserves growth of low viscosity, the so-called "light" oils in many oil producing regions of the world, including Russia, forms the demand for involvement of unconventional - new refinery hydrocarbon sources, primarily heavy and extra-heavy oil and natural bitumen in the economic turnover[1]. Russia is ranked as the third country after Canada and Venezuela in terms of heavy hydrocarbon reserves. According to various estimates, the reserves of heavy oil in the RF range from 6.3 to 3.4 billion tons. In modern refining industry

* Corresponding author name. Tel.: +7-913-808-4061
E-mail address: dark_elf26@mail.ru

Peer-review under responsibility of Tomsk Polytechnic University
doi:10.1016/j.proche.2014.10.055

catalytic processes of deep oil processing are widespread, but still they do not provide sufficiently attractive technical and economic performance in the processing of heavy hydrocarbons.

One of the main problems associated with the processing of natural bitumen is the high content of high-molecular compounds - resin and asphaltene molecules, which concentrates most of the heteroatoms present in the feedstock. Amount of resins and asphaltenes defines bitumen properties of both dispersion medium and dispersed phase, as well as natural bitumen aggregate stability of in the thermolysis conditions[2-7]. These compounds have high molecular weight, tend to condense and coke formation during processing, and deactivate catalysts[8-10]. Development of deep destruction methods for heavy oil and natural bitumen to resin-asphaltene components will solve the problem of heavy hydrocarbons refinery and reduce the shortage of hydrocarbon fuels in future.

The purpose of this paper is to identify the main directions of transformation of hydrocarbons and sulphur compounds of the bitumen oils during thermal cracking initiated.

2. Experemental

2.1 Sample

The object of the study is natural bitumen deposits of the Mordovo-Karmalskoye oil field in Tatarstan.

Table 1 Characteristic of bitumen

Sample	Contents % wt.										
	C	H	N	S	O difference	Oils	Resins	Asphaltenes	ibp–200	200–360	>360
	81.5	11.6	1.1	3.7	2.1	70.3	24.5	5.2	6.7	34.6	58.7

As an additive initiating cracking MS (microspheres) was used, the size of which is 0.2 – 0.4 mm (Table 2). Microspheres were isolated from fly ash produced from coal combustion by the separation processes of hydrodynamic and granulometric classification[11]. The basis of the microsphere chemical composition is formed by iron oxides[11]. In bitumen cracking microspheres were not active, therefore, they had been previously calcined at 800 °C for 120 minutes. The addition of the microspheres was 10 % wt. of the bitumen sample.

Table 2 – Composition of microspheres

Composition, % wt.									
SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Na_2O	K_2O	TiO_2	FeO
3.45	1.64	73.39	7.49	0.86	0.22	0.22	0.06	0.16	12.53

2.2 Elemental analyses

Elemental analysis of the whole vacuum residues was performed by the microanalytical method using CHNS Vario EL Cube analyzer, O was defined by differences (Table 1).

2.3 Fractionation methods

Material composition. Group composition of the original oil and cracking products was determined using the traditional pattern: first, the content of asphaltenes was defined in the sample by the Golde's "cold" method. Then, the concentration of resins in produced maltenes was determined by the adsorption method covering the