PHYSICAL AND CHEMICAL PROPERTIES OIL BITUMINOUS ROCKS OF KAZAKHSTAN DEPOSITS IMAN- KARA AND MORTUK

Bishimbayev VK, Bishimbayev KV, Issayeva AU*

M.Auezov South Kazakhstan State University, Shymkent, Kazakhstan
**E-mail of the corresponding author: akissayeva@mail.ru*

Abstract
Studies have been conducted physical and chemical properties of oil bituminous rocks Kazakhstan fields Iman –Kara and Mortuk. Based on these studies it can be concluded that the organic part of the oil bituminous rocks of Iman-Kara and Mortuk by its physical and chemical properties and structural-group composition is close to the conventional petroleum bitumen and mineral sands part- to the sand-dune type. The content of the bitumen in rocks of deposit Iman-Kara is 17.2%, deposit Mortuk-15.7%, with high values of acid number of bitumen 11.21 and 4.2 mg KOH / g, respectively. The group composition of bitumen fraction oils presented paraffin-naphthenic components, and the bitumen is characterized by a high content of tar fractions.

Keywords: oil bituminous rocks, bitumen, fractional composition.

1. Introduction

At present, the questions become particularly acute environmental improvements oil-producing regions, as contaminated soil, accidental releases and oil spills, barn oil, sediment remaining after oil extraction, waste or wastewater occupy huge areas and harmful to the environment because they are not processed and this problem becomes more and more threatening (Prokoph A. & Agterberg F, 2000, Magnier C et al, 2004, Al-Ameri TK, 2011, Barry B and Klima MS, 2013). Kazakhstan has huge reserves oil bituminous rocks (OBR) (950-1000 million tons), Containing in its composition natural bitumen, which can be used in various sectors of the construction industry and road construction as a binding framework for the production of tiles, bricks, hydrophobic additives, pavements anticorrosion, heat and waterproofing mastic (Charlton TR, 2004, Langrock V and Stein R, 2004, Saleh HM, 2012). These OBR also occupy large areas.

Bitumens are widely use in many sectors of the economy, due to their high technological, operational and economic performance, the most important of which are: increase in ductility when heated, a rapid increase in viscosity during cooling, high adhesion to the stone, wood, metal; hydrophobicity; watertight; resistance to acids, alkalis, corrosive liquids and gases; electricity and sound transmission; low density; low thermal conductivity; weather resistance and low cost (Shon JS et al, 2001, Ohm S and Karlsen D, 2007). In the building materials industry bitumens are widely used for construction and repair of road and airfield pavements and foundations, floors of industrial buildings; soil stabilization; corrosion protection of metal and concrete; the manufacture of roofing, waterproofing, thermal and vapor barrier, materials and products, radiation protection; in the manufacture of paints.

However, the low stability of bitumen to sudden temperature fluctuations limits its widespread use. Earlier studies thermomechanical roofing mastics and adhesives shown that the

bitumen softens at 0C, at + 20C becomes viscous flowable state and 100% destruction is achieved at 40, i.e. rubbery deformation region is absent. Roofing material begins to soften at -40 ° C, the area of rubbery deformation ranges from -30 ° C to + 30 ° C and becomes viscous fluid state from 35 to 60 ° C and is completely destroyed at + 60 ° C.

2. Material and methods of researches

2.1 *The objects of researches*. The objects of researches were oil bituminous rocks deposits Iman-Kara and Mortuk of Western Kazakhstan.

2.1.1 Deposit Iman-Kara: timed to brahianti-clinal salt-dome structure, broken meridian system discharges. Total mineral reserves account for more than 1.0 million tons. Mining and technical conditions of the field do not differ considerable complexity. Overburden distributed almost throughout and presented sandy loam and loam with lenses of sand and the inclusion of small fragments of sandstone. Their thickness varies from 0 to 12.0 m, making on average on various sides of 1.92-6.03 m. Oil bituminous rock deposits at this bitumen content of 1.0 to 10.0% have a brown color. Further increase in bitumen content of 10-20% results in a color change from dark gray to black, thus, marked increase in viscosity.

2.1.2 Field Mortuk: 1 deposit, which contains the bulk of the OBR reserves. The deposit is confined to the roof of deposits Aptian stage represented flat-lying strata of sand with lenses and layers of sandy clay and silt. Host rocks are natural bitumen inequigranular Sands having different porosity. Average power zalezhi10-12 m. Saturation bitumen deposits uneven, the content of the organic part ranges from 0.01 to 22.0%. OBR reserves are estimated at 40-45 million tons. 2 deposit is confined to the sole of the Aptian and roof barem tiers. Holds reservoir rocks are loamy sands bitumen, alternating with layers of clay and sandy clays. OBR reserves are estimated at 3 million tons.

2.2 *Research Methods*

2.2.1 Extraction of bitumen from the OBR. OBR was extracted with ethanol: benzene (1: 1) in Soxhlet until complete bleaching of the extractant. Fine clay particles were separated by centrifugation. Then, the solvent was distilled bitumen and dried at 313-3230 K under vacuum (2660 Pa) to constant weight. The test was performed according to standard bitumen methods

UV-IR spectroscopic analysis of the organic part of the OBR carried out on spectrometers with a prism at wavelengths from 700 to 3800 cm-1 according to the procedure (Interstate standard SST 11955-82, M-02-505-72-00).

2.2.2 Density of bitumen was determined according to State standart SST 51069-97.

2.2.3 Fractional composition was determined according to SST 11011-85, 10120-71.

2.2.4 Mechanical impurities were determined according to SST 10577-78. Mass concentration of metals in the samples was determined by the method M-02-505-99-02.

2.2.5 The refractive index was determined by refractometer IRF-23 at a temperature of 293^0 K with an accuracy of 0.0001 hearth wave solution (SST 11244-76, SST R 55413-2013, SST R 53717-2009).

2.2.6 Petrographic and X-ray analysis of the mineral part of the OBR conducted on Tayuda microscope (Japan) and DRON-2.

3. Results of researches and discussion

A study of the physicochemical properties of the organic part oil bituminous rocks found that the content of the bitumen deposits in rocks of Iman-Kara is 17.2% and deposit Mortuk - 15.7% (Table 1). The density of the organic part of the OBR ranges 987.8-1038.4 kg / m3, which is explained by the different fractional composition of bitumen. The softening temperature varies slightly, ranging from 293 to 295^0K. Extensibility of bitumen deposit Iman-Kara high, in

contrast to the field Mortuk, it depends on various tar. Significant oil content affecting the high penetration bitumen.

The elemental composition shows that the organic part OBR more than 82.1% is composed of carbon, while the hydrogen concentration in the range 11.0-13.4% oxygen, nitrogen and sulfur -more than 3.0%.

Contents kerosene- gas oil fractions boiling at temperatures 573-623^{0}K is 7.8-15.7%. They are characterized by a high density value and can be a source of organic sulfur compounds and oxygenates, naphthene-aromatic nature.

Oil products boiling at 623-673^{0}K are 6.9-8.7%. Their feature is the low pour point because of the small content of paraffins. Products boiling at temperatures above 673^{0}K are 75.6-82.4%. They are characterized by a high content of sulfur and can serve as the raw material of destructive processes. Gasoline, kerosene and light fractions in the OBR absent.

It should be noted the high values of the acid number of bitumen deposits OBR Iman-Kara and Mortuk that are equal to 11.21 and 4.2 mg KOH / g, respectively. This indicates a significant concentration of anionic compounds and their high adhesion to the mineral material and primary alkali compositions compared with acidic silicates. This is due to the fact that the natural bitumen anionic group in the contact zone with the major alkaline and mineral form a chemisorption compound insoluble in water. As a result of the processes on the surface of carbonate material formed water-resistant bituminous layers.

The group composition of bitumen of deposits OBR Iman-Kara and Mortuk oil fraction presented paraffin-naphthenic components, and the bitumen is characterized by a high content of tar fractions (Table 2**).** The number of alcohol-benzene resins for all the samples to 1.2-2.1 times higher than that of benzene-light petroleum. The asphaltenes content in the range 2.0-12.5%, they are highly polar and contain oxygen in the form of esters, acids, and phenols.

UV spectra are similar investigated bitumen. They are characterized by intense absorption maximum at about 240-250 nm, due to the presence in the molecules of aromatic nuclei containing fused benzene rings 1-4. The absorption at long wavelengths indicates the presence of a small number of large polycondensed structures.

Analysis of IR spectra showed the presence of bitumen CH groups, aliphatic compounds, aromatic structures and oxygen groups (Figure 1, Table 3).

The samples studied OBR are finely sandy, sandy-loam and clay mineral component, in which coarse-sand and gravel and grit particles are very rare. Mineral part is fine sands, sandy loams, loams, clays size of 0.071-0.25 mm. The chemical composition of the mineral is presented in Table 4.

Petrographic analysis of the studied mineral part deposits OBR showed the prevalence of β-quartz, feldspars, the presence of crystals of hematite (refractive index 2.70), goethite (refractive index 2.28-2.41), fluorite (refractive index 1.43), quicklime (refractive index 1.83), slaked lime (the refractive index of 1.54-1.57), calcite (refractive index 1.49-1.66), clay material (refractive index 1.55-1.60). The data obtained confirmed by X-ray analysis, which further indicate the presence of glauconite and montmorillite in mineral deposits of the OBR Mortuk (Figure 2).

4. Conclusion

Based on these studies it can be concluded that the organic part of the oil bituminous rocks of Iman-Kara and Mortuk by its physical and chemical properties and structural-group composition is close to the conventional petroleum bitumen and mineral sands part- to the sand-dune type. The content of the bitumen in rocks of deposit Iman-Kara is 17.2% ,deposit Mortuk-15.7%, with high values of acid number of bitumen 11.21 and 4.2 mg KOH / g, respectively. The group composition of bitumen fraction oils presented paraffin-naphthenic components, and the bitumen is characterized by a high content of tar fractions.

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15. SST 11011-85 - Oil and oil products. Method for determination of fractional composition of the machine APH-2
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19. SST 51069-97 - Oil and oil products. Method for determination of density, relative density and API gravity hydrometer

Table 1: Physico-chemical characteristics of the organic oil bituminous rocks

Indicators	Iman-Kara	Mortuk
Exit bitumen rock, mass. %	17.2	15.7
Density, kg / m3 × 10^3	1.0384	0.9878
Molecular mass	705.0	603.0
Coking, Mass. %	29.8	6.0
Penetration, mm at 293^0K	23.0	36.0

Extensibility, sm	37.4	25.0
Element composition, mass. %:C	84.03	82.88
H	11.80	13.40
S	1.20	1.36
O	2.97	1.86
N	0.80	0.50
Fraction *573-623^{0}K*		
Exit bitumen rock, mass. %	7.80	15.70
Refraction coefficient	1.4916	1.4865
Density, kg / m3 × 10^3	0.9065	0.9488
Molecular mass	307	304
Fraction *623-673^{0}K*		
Exit bitumen rock, mass. %	6.9	8.7
Refraction coefficient	1.4984	1.4850
Density, kg / m3 × 10^3	0.9234	0.9188
Kinematic viscosity at 293 K mm2 / s	32.16	19.36
Pour point, K	255	253
Diesel index	32.0	32.0
Balance more 673^{0}K		
Exit bitumen rock, mass. %	82.4	75.6
Density, kg / m3 × 10^3	1.0534	0.9488
Penetration, mm at 593^{0}K	16.0	7.0
Extensibility, sm	35.0	70.0
Kinematic viscosity at 323 K mm2 / s	30.4	30.4
at 373 K, mm2 / s	5.24	5.18

Table 2: Group composition of oil bituminous rocks

Components	Component content (mass.%) in the OBR deposits:	
	Iman-Kara	Mortuk
Oils including:	51.1	68.7
Paraffinic, naphthenic hydrocarbons	30.5	43.2
Monocycloaromatic hydrocarbons	13.3	15.4
Bicycloaromatic hydrocarbons	7.3	10.1
Resins including:	36.4	29.3
Petroleum-benzene	14.0	13.3
Alcohol-benzene	22.4	16.0
asphaltenes	12.5	2.0

Table 3: Spectroscopic characterization of bitumen

Depo sit	Spectral characteristics of bonds					
	Oxidation of the C = O	aromatizing C = C	C H_2 7	Naphthenes 970 cm-1	C=O 129	The degree of branching

	1700 cm-1	1600 cm-1	20 cm^{-1}		0 $см^{-1}$	of the paraffins 1380-1600 cm-1
Iman-Kara	0.37	0.10	0.08	0.08	-	0.60
Mortuk	0.57	0.22	0.11	0.15	0.31	0.66

Table 4: The chemical composition of the mineral oil bituminous rocks

Deposit	Components, wt. %							
	SiO_2	AL_2O_3	TiO_2	Fe_2O_3, FeO	CaO	SO_3	Na_2O	K_2O
Iman-Kara	85.38	6.40	0.32	1.48	0.90	1.00	1.00	3.12
Mortuk	84.02	5.48	0.87	1.64	1.40	0.45	0.88	4.58

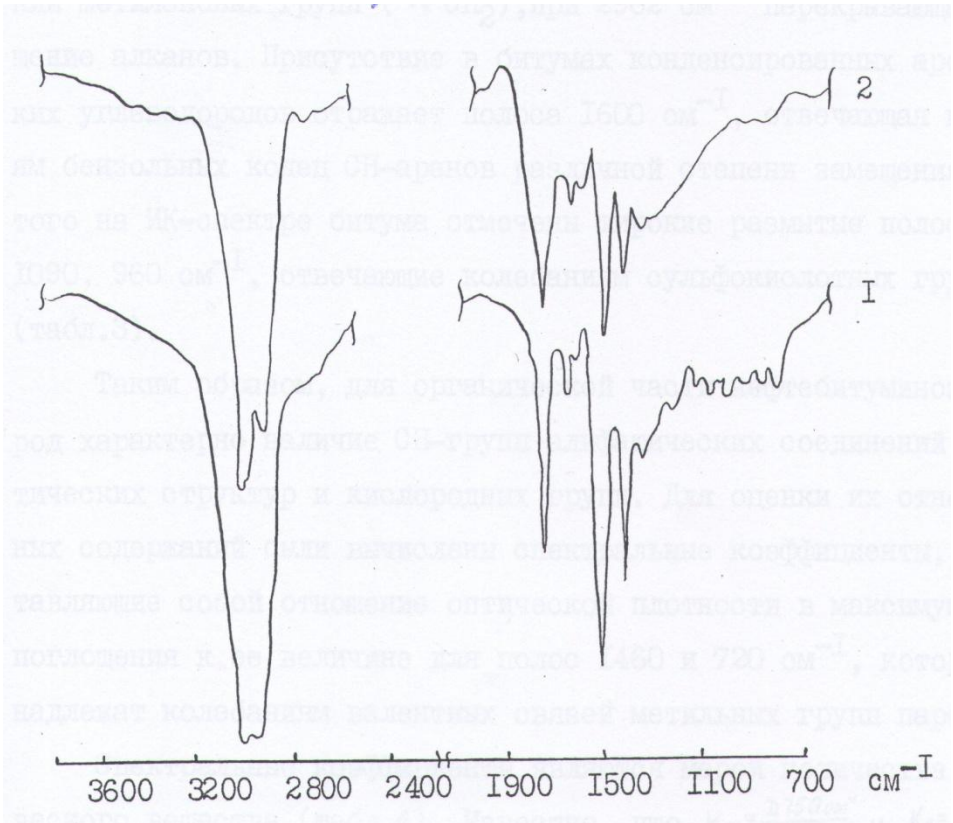
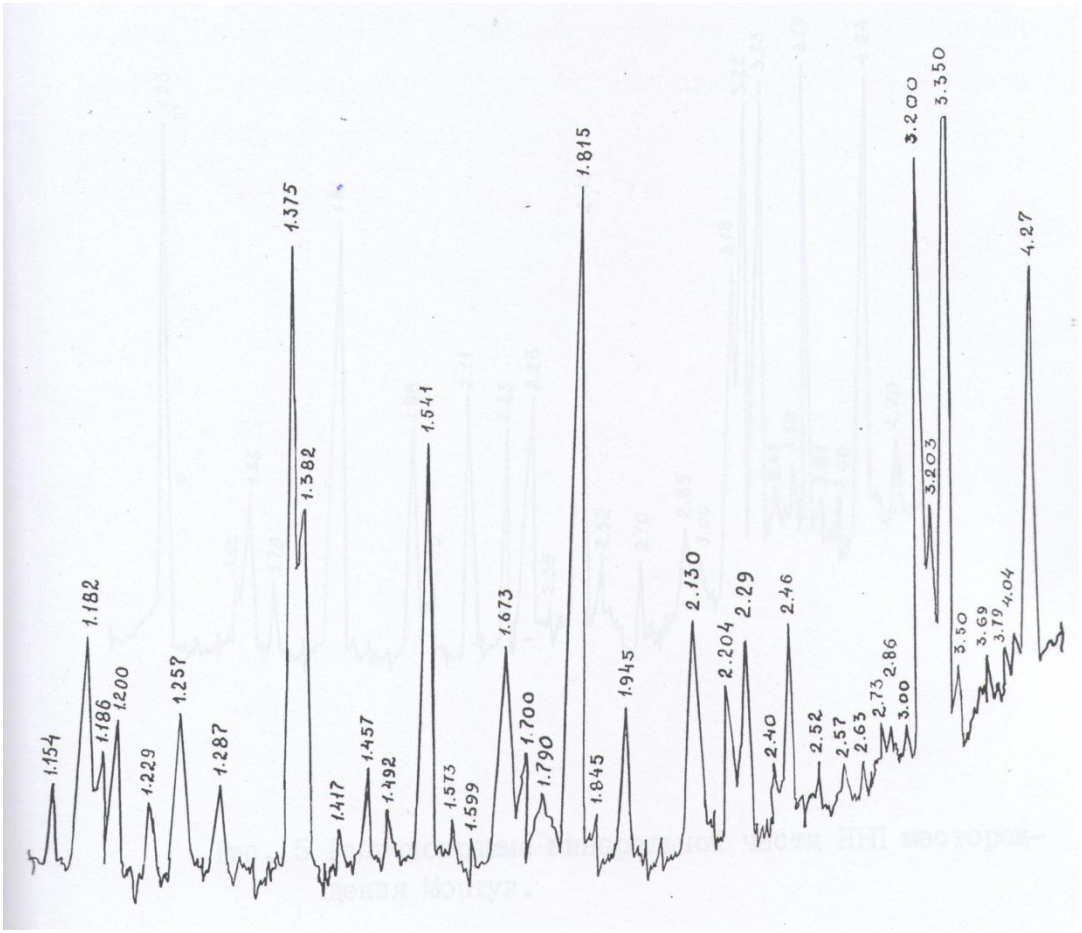


Figure 1. IR absorption spectra of the organic part of the bitumen deposits Iman-Kara (I) and Mortuk (2)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1.182
1.186
1.200
1.229
1.257
1.287
1.375
1.382
1.417
1.457
1.492
1.541
1.573
1.599
1.673
1.700
1.790
1.815
1.845
1.945
2.130
2.204
2.29
2.40
2.46
2.52
2.57
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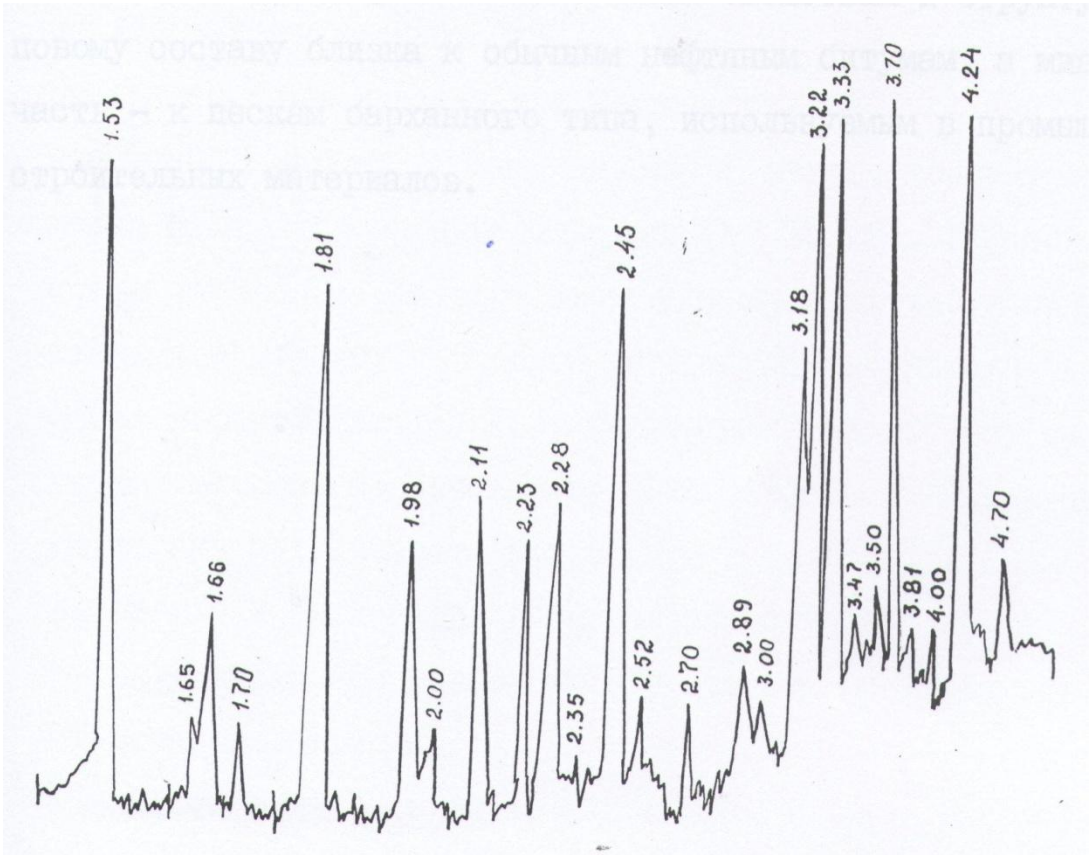
3.50
3.69
3.79
4.04
4.27

A



B

Figure 2. XRD patterns of the mineral deposits OBR Iman-Kara (A) and Mortuk (B)