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TECHNOLOGICAL PROPERTIES AND GEOLOGY OF RUSSIAN "GILSONITE"

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Abstract. *We proved the need of receiving high-quality binding agents for asphalt concrete at the expense of the oil bitumens modified by polymers, and gilsonites asphaltites of Lekkemskiy field in Komi Republic to strengthen the wearing quality of top layers of road surfaces. Due to the increasing demand in wearing quality of asphalt concrete mixtures we gave the justification of need to develop gilsonites on Lekkemskiy field to solve this problem using main roads in severe climatic conditions on the North of Russia.*

Keywords: *asphaltite, asphalt concrete, bitumen, polymers, mineral gilsonites, melting temperature*

Examined increased rates of road construction development in our country demand a high-quality of bitumen raw materials for road surfaces. On the North at sharp seasonal climatic fluctuations very high requirements are demanded to the quality of construction materials, in particular, asphalt concrete mixtures. 20 - 30 years ago constructing the highest category roads we used a two-layer asphalt concrete surfaces which thickness was 10 - 12 cm on spalls. Nowadays such designs are suitable and ad-missible only for domestic territories. On road highways, beginning from their federal value and large bridge outcomes through water barriers, we use the concrete as a road basis which thickness is 20 - 35 cm, and for the top coat layer the thickness is 18 - 25 cm [1].

The most well-known type of road surfaces is spalls – lutaceous asphalt concrete. It was developed in the 60s of XX century in Germany and it is widely used in Western Europe. Because of the considerable additives of waterproof binding material in spalls – lutaceous asphalt concrete humidity cannot be penetrated into the layer of asphalt concrete and it is stable to aging processes, formation of bursts, to water and frost.

Nowadays the application of binding additives modified by polymers, and also natural bitumens with specific properties increases reliability and wearing quality of road asphalt concrete surfaces by 2 - 3 times rather than those 10 - 15 years ago [2].

The main indicator of asphalt concrete surface durability at using it in environmental conditions is the thermal stability of prepared mixtures. Today bitumen is the main binding component in them, according to its technical characteristics it is suitable for preparing similar mixtures (GOST: BND 60/90, BDU 70/100, BDU 100/130), the softening temperature of mixtures is +50 °C. However, at seasonal high temperatures of warming up (+30…50 °C) the durability of road surface can be decreased. It leads to

partial destruction of surface microstructure. As a result the terms of surface operational reliability are reduced. Nevertheless, in the North conditions such surface is still been using.

To improve the quality of road surface top level it is recommended to use bitumens modified by polymers and which have the higher indicators of physical-mechanical properties in comparison with usual road bitumens.

They are:

– copolymers of butadiene and styrene (SBS) as powder and crumb;

– solutions of synthetic rubbers of styrene type (SKS), used for preparation of bitumen and rubber biding brands BKV. Application of such polymers allows to expand the plasticity interval of usual road bitumens and to raise surface service life. In comparison with usual ("oil") road bitumens the polymeric and bitumen binding materials (PBV) have a complex of new properties which are different from properties of usual bitumens: the increased elasticity, stability to bursts, plasticity and durability at stretching [3]. Polymeric binding mixtures are made by dissolution them in bitumen of thermoelasticlayer which is consisted of divinyl block copolymers with styrene and intensive dispersion in colloidal mill.

Other comparative effect has the natural asphaltites bitumen which softening temperature is 100 - 200 °C. Asphaltites concrete surface with such binding bitumen won't have structural destructions even in the hottest days. Therefore the terms of their operational wearing quality are 10 - 12 years.

Such asphaltites bitumen with specific properties contains mineral "gilsonites", class asphaltites, and subclass unlike the second subclass is "grahamite" according to classification of Goldberg natural bitumens [4].

The mineral is called in honor of Gilson who begun the development of its deposits in the USA, in Utah at the beginning of the 20th century. It has the firm fragile substratum which melts at T = 100 - 200 °C, whereas grahamite melts at T = 180 - 300 °C. It has a rather low temperature of melting, the high content of hydrogen (8,5 - 10,0 %), recurrence of connections in gilsonites causes the increased binding properties. It defined its usage as a binding additive for asphaltites concrete mixtures when preparing road surfaces with long-term operational reliability.

For this reason long since North American and Trinidadian gilsonites have a great demand on the world market of building materials. Iranian gilsonites have joined to them recently. But Russia has not been buying and producing gilsonites.

In the territory of modern Russia the fields of asphaltites were developed in 20-30th years XX century in Orenburg region (Satkinskiy) and in Komi Republic near the settlement Lekkem on Izhma River. The last field where Ukhta prospecting expedition worked is a contoured area of distribution of asphaltite limestones and dolomite of the Devonian and carbonic age. Limestones and dolomite are tectonically broken forming the monoclinal stage of northwest course, dissected by cross-section breaks and called

Verkhne-Izhemskaya stage. The extracted asphaltite was used in paint and varnish industry. Production was conducted till 1967; it was stopped because asphaltite was changed into technogenic oil bitumen taken from Ukhta oil refinery plant. Its gilsonite structure was established by professor Chernov A.A., the pioneer of field development.

Verkhne-Izhemskaya stage of Timan anteclise is bounded from the East by Voy-Vozhskiy break of northwest course. Along this break dome-shaped structures (Nyamedskaya, Kushkodzhskaya North Sedelskaya, Rozdinskaya, Sedyelskaya, Voy-Vozhskaya, Nibelskaya) go from the West. Gas and oil and gas fields are involved into the structures. Fields of asphaltites (Lekkemskiy, " oil beam", Nibelskiy) are in an arch-like part of structures, according to Nyamedskaya, Voy-Vozhskaya and Nibelskaya near the terrestrial surface. There are gas and oil and gas deposits on deep depths in 600 - 700 m according to Fig. 1. According to the available calculations the forecasting reserves of gilsonites is 10 million tons.

Stringer-porphyry nature of inclusions of firm bitumen in crumbling – vugular, dense carbonate light gray breeds testifies about addition of bitumen substance by ascending heated UV-fluids. According to Goldberg's classification asphaltites are the products of destruction and oxidation of heavy tarry oil of naphthenetic row. Perhaps, UV-gases which have formed gas and gas-oil deposits in dome structures of the area participated in this process as by- products. Liquid and semi-firm bitumens rose to a terrestrial surface only along the tectonic cross-section cracks and breaks of an open type, as a rule. The last ones helped to raise bitumens above gas and oil-gas deposits level. The gilsonite contents as a sedimentation product from the oil fluid reaches to 4 - 5 %. The capacity of the layer riched with bitumen reaches 2 - 3 m, "roof" is 10 - 12 m and consists of quaternary friable deposits. Hyper gene changes of bitumen substance are expressed in its limonitization, dislodgement and dissolution of containing carbonate breeds. Production was carried out with the open cut way.

There is a great need in high-quality of bitumens for road surfaces in Russia. That is why in 2007 - 2009 according to data from V.V. Kolesov, director of "Oil and gas company" (St. Petersburg), technological tests of Lekkemskiy asphaltite were carried out. They showed that its structure and properties are close to American gilsonite. To receive the oil technological bitumen which will be close to gilsonite, we are required quite heavy, tarry naphthenetic oils. It is produced only at Ukhta oil refinery plant and its production demands big laborious and financial expenses. On the contrary, natural gilsonite on Lekkemskiy field, which has a very high quality as binding agent and heat stability, demands rather small expenses to develop and receive the concentrate. The raised content of Ni in it (840 g/t) and V (230 g/t) ecologically isn't dangerous, as its application calculated only in the form of additives [5]. We do not need special installations to receive bitumen or warmed-up wagons for its transportation or the equipment.

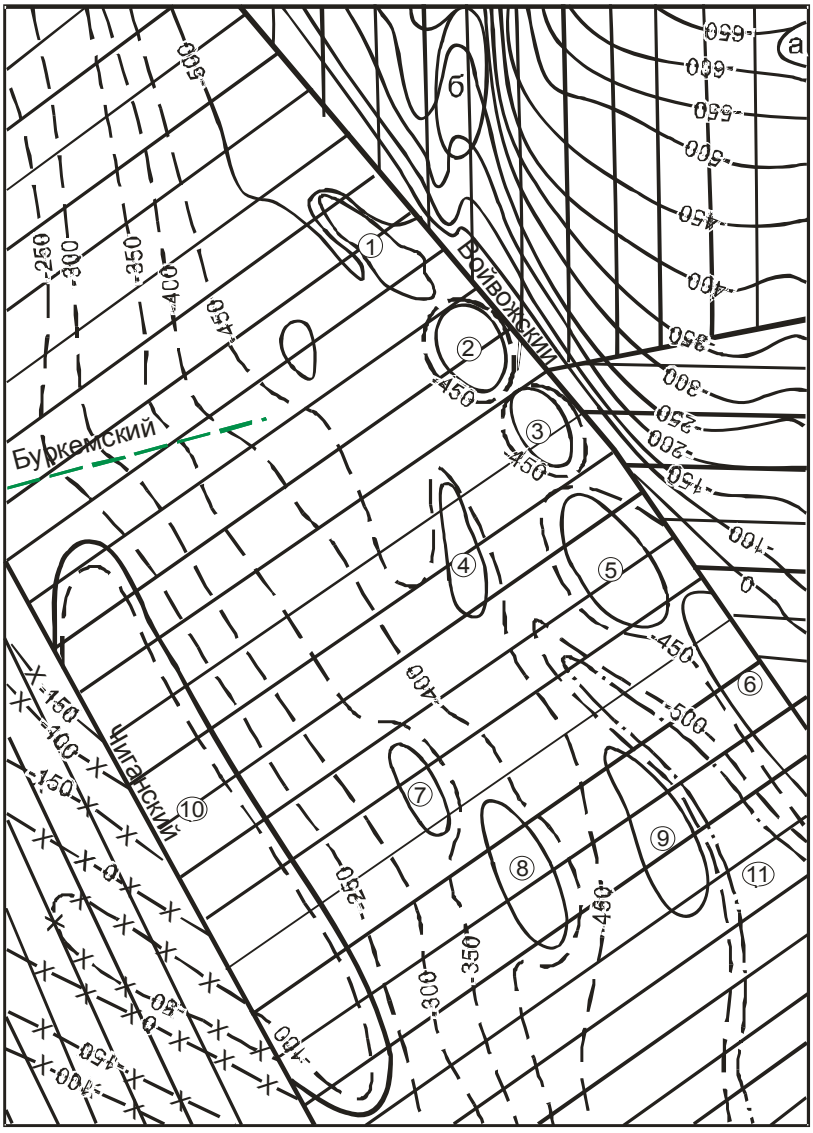

Fig. 1. Tectonic scheme of the sheet P-40-VII (Scale 1:500000):

Symbols: – Pechora syneclise; – Timan anteclise;

Structures of Pechora syneclise:

– Omra-Soyvenskoe reclamation; – Burkem-Dzherskaya structural terrace;

anticline structures: а – Dzherskaya, б – Verkhne-Odesskaya.

Structures of Timan anteclise:

– Ukhta-Izhemskiy bar; – Verkhne-Volskaya synclinal;

Anticline structures: 1 – Nyamedskaya, 2 – Kushkodzhskaya, 3 – North-Sedelskaya, 4 – Rozdinskaya, 5 – Sedelskaya, 6 – Voyvozhskaya, 7 – Izurelskaya, 8 – West-Izkosugorinskaya, 9 – Izkosgorinskaya, 10 – Keranskaya (forecasted);

downfolds: 11 – Izhma-Asyvvozhskiy;

contour lines: – bottoms of semilukskiy deposits in Ukhta-Izhma bar;

– bottoms of coal formations in Verkhne-Volskaya synclinal;

– bottoms of clays of medium carbon in Pechora depression.

Войвожский – Voyvozhskiy; Буркемский – Burkem; Чиганский – Chiganskiy

Therefore we can confirm with full confidence that Lekkemskiy field asphaltite development will justify itself during short terms from the moment of production, it will increase quality of asphalt concrete mixtures and their operational reliability by 3 - 4 times.

In our opinion, we are having all preconditions for development of asphaltites Lekkemskiy field as major raw materials for road construction. Its supposed evaluated reserves are 10, 0 million of tons.

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