Institute of Petroleum Refining and Petrochemistry

BITUMENS AND ROADS

2020

The main types of road surface destruction

Premature cracking and fatigue fracture of the wearing coat

The main types of road surface destruction

Increased rutting

The main causes of premature failure of the road surface

- Insufficient viscosity of commercial bitumen
- Increased content of paraffin in bitumen
- Reduced content of structure-forming asphaltic resinous components in bitumen
- Low adhesive capacity of bitumen (unfavorable hydrocarbon type content)
- Accelerated aging of bitumen
- Non-compliance with the requirements for the composition, paving and compaction of bitumen-concrete mixture

Causes of unsatisfactory quality of bitumen

- The main feed of a fuel refinery – light West-Siberian oil with a high content of light fractions and a low sulfur content – is not suitable for bitumen production.
- The production of bituminous raw materials by a leftover principle results in "overdried" residues after the deep extraction of oils and fuel components from crude oil.
- The expectation of serious quality changes in bitumen products at a fuel refinery is futile.
- The discrepancy between the existing standards for bitumen and the real features of local road and climatic conditions.

Differences in the requirements for raw materials for fuels and bitumen

Raw materials	Density, кg/m^3	Viscosity at 50 ºC	Content, %				Fraction yield, %
			Paraffins	Sulfur	Resins	Asphaltenes	up to 350 ºC
For bitumen*	905	13,5	2,4	3,4	23,1	9,3	39,7
For fuels*	843	3,3	2,3	0,6	7,0	1.3	59,4

* Comparisons are drawn using the examples of Bashkir (Arlan) and West Siberian (Samotlor) oils

Comparison of the new BNDV 60 standards

Name of indicators	Requirements for BNDV 60 grade bitumen				
	BNDV 60	Finland	USA	Euro standard	Russia GOST 33133-14
Obligatory indicators for determination					
Needle penetration depth at 25^{0}C, 0.1 mm	50-70	50-70	60-70	50-70	50-70
Softening point, ^{0}C,	48-54	46-54	47-55	46-54	51-53
Elasticity at 25^{0}C, cm, not less than	100	-	100	-	47
Brittleness temperature, ^{0}C, not higher	- 19	- 8	-	- 8	- 16
Flash point, ^{0}C not lower than	240	230	230	230	230
After warming up in a thin film					
Weight change, %, not more than	0.5				0.6
Needle penetration depth at 25^{0}C, % of the initial value, not less than	75	50	75	50	-
Change in the softening point, ^{0}C, not more than	5	$\geq$ 48*	-	9	7
The change in the brittleness temperature, ^{0}C, not more than	2	-	-	-	3
Elasticity at 25^{0}C, cm, not less than	65	-	50	-	-

* Softening temperature after warming in a thin film

Improvement of quality characteristicsof road bitumens

Bitumen should become a target product for the processing of specially prepared bituminous raw materials obtained from high-viscosity, high-resinous, high-sulfur oils!

Improvement of quality characteristicsof road bitumens by using polymeric modifiers

Polymers neither change the basic properties of bitumen, nor its operational characteristics such as adhesion and resistance to aging

The polymers enhance bitumen with additional specific features such "elastic skeleton", due to which the stability of the modified material to cracking increases under the influence of intensive loads at low temperatures

Modification of bitumen with polymer increases the cost of the final product – asphalt concrete by 20 ÷ 30%

Examples of road pavements

The Beloretsk-Uchaly road. The section (26 -36 km)

The section was built using unoxidized compounded road bitumen under the Technical Conditions of the Republic of Bashkortostan in June 1994.
The picture was taken in July 2012.
It has not been repaired for 18 years.
Potholes, cracks, other visible damages to the pavement are absent.

Highway bridge across the Ufa river

The bridge was built in 2008.
It has not been repaired for 10 years.
There are no similar achievements in the Russian Federation.
It is impossible to achieve this result by using conventional commercial bitumens.

Suggestions for implementation

Construction of a Public Private Partnership plant for the production of BNDV high-quality road bitumens with a capacity of 560 thousand tons of bitumen a year from heavy, high-viscosity, high-sulfur regional oils

Technical and economic parameters of the project

Name	Amount, thous. tons	% of withdrawal
CDU		
Feed: Arlan Oil	1,000	100,0
Yield:		
Straight-run gasoline	100	10,0
Straight-run diesel	297	29,7
Sum of refined	397	39,7
Fuel oil	592	59,2
Gas +Losses	11	1,1
Oxidation of fuel oil		
Feed: Fuel oil	592	100,0
Yield:		
Bitumen	560	94,6
Light fuel oil (black solar)	18	3,1
Losses (oxidation gases)	14	2,3

- construction works – 0,7 billion rubles
- installation works – 0,7 billion rubles
- cost of equipment – 1,4 billion rubles
- other expenses (preparation of the site for construction, design and survey works, etc.) – 1,4 billion rubles.

Estimated cost of construction will be 4,3 billion rubles, of which the share of major construction facilities account for 66,3 % of total expenditures.