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Comparative Tests of Experimental Batches of a New Composition of Road Bitumen

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ABSTRACT: The paper presents the results of comparative tests of experimental batches of new road bitumen on physical and mechanical characteristics in accordance with the requirements of SST 22245-90. Experimental batch No. 3 after the test received good indicators of stability and fragility. The resulting sample No. 3 allows you to obtain a high-quality bitumen mixture and recommend further preparation of asphalt concrete mixture and implementation for covering highways.

KEYWORDS: Bitumen, oil sludge, gossypol resin (fat-oil plant), technical sulfur, asphalt concrete, road pavement.

I. INTRODUCTION

In the Petrochemistry laboratory of the Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, the experimental batches of a new composition of road bitumen from local waste of oil and gas and fat-and-oil production were sent for laboratory tests on physical and mechanical characteristics in accordance with the requirements of GOST 22245-90.

To date, sources [1, 2] present the results of research and experiments of samples that were obtained by modifying bitumen with various residues and waste from the oil and gas and fat and oil industries.

In [1], it was found from the experimental results that their concentration plays an important role in the use of ingredients used in the modification of the gossypol scale, including slaked lime, GMTA (hexamethylenetetramine) and hydrolyzed lignin. Proceeding from this, it should be assumed that when modifying the gossypol scale, it is desirable to take the concentration of GMTA as 3-4% and lignin as 15-20% of the optimal concentration [1].

In [2], the physicomechanical properties of BND 40/60 bitumen with modified sulfur were studied. Samples were compiled using coarse and fine fillers, sand and filler, such as 23, 33, 40 and 4 wt.% respectively. Various batches of asphalt mixtures were prepared with a mass percentage of sulfur 0%, 20%, 30%, 40% and 50% according to GOST 12801-84. The solubility of sulphur in asphalt is about 18-20% at the mixing temperature [2].

The aim of the work is to obtain the results of comparative tests of experimental batches of four samples of new road bitumen according to physical and mechanical characteristics in accordance with the requirements of GOST 22245-90.

The novelty of the work is as follows: according to the received act of September 21, 2021, the result of comparative tests of a prototype batch of four samples of new road bitumen according to physical and mechanical characteristics in accordance with the requirements of GOST 22245-90 was obtained from the central factory laboratory of the Ferghana Oil Refinery. For comparison, we selected experimental batch No. 3 and carried out a comparative analysis on three indicators of the results obtained with known works [1, 2].

II. METHODS AND RESEARCH

The obtained experimental batches of road bitumen are presented in Table No. 1

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Table 1

Bitumen Components	Experimental batch №1	Experimental batch №2	Experimental batch №3	Experimental batch №4
Bitumen BND-60/90	55	55	55	55
Oil sludge, %	20	20	15	15
Tar (MJK)	20	15	15	10
Technical sulfur (S) ground,%	5	10	15	20

The manufactured 4 samples of the experimental batch were sent to the central factory laboratory of shop No. 10 of the Fergana Oil Refinery to test the experimental batch of road bitumen according to physical and mechanical characteristics in accordance with the requirements of GOST 22245-90.

In the central factory laboratory, 4 samples of experimental batches of new road bitumen were tested according to the following indicators: needle penetration depth of 0.1 mm at 25 °C and at 0 ° C at least, softening temperature along the ring and ball, extensibility at 25 ° C and at 0 ° C at least, brittleness temperature ° C, flash point ° C, softening temperature change after warming ° C, as well as penetration index [3].

III. DISCUSSION OF THE RESULTS

The results of comparative tests of experimental batches of new road bitumen on physical and mechanical characteristics in accordance with the requirements of GOST 22245-90 are shown in Table No. 2.

Table 2

Name of indicators	Requirements of GOST 22245-90 for bitumen grade BND-60/90	Experimentalbatch№1	Experimentalbatch№2	Experimentalbatch№3	Experimentalbatch№4	Test method
1. Needle penetration depth, 0.1 mm:						According to GOST 11501
at 25 ° C	61-90	94	92	88	80	
at 0 °C, atleast	20	26	24	21	18	
2. Softening temperature of the ring and ball, ° C, not lower	47	41	43	45	49	According to GOST 11506
3. Extensibility, sm, not less:						According to GOST 11505
at 25 ° C	55	57	59	58	53	
at 0 °C, atleast	3,5	3,6	3,7	3,8	3,3	
4. Brittleness temperature, °C, not higher	-15	-17	-15	-16	-14	According to GOST 11507
5. Flash point, °C, not lower	230	230	230	230	235	According to GOST 4333
6. Change in the softening temperature after warming up, ° C, no more	5	5	5	6	8	According to GOST 18180
7. Penetration index	From-1,0 till +1,0	1	1	1	1	According to GOST 11506

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Comparative tests of experimental batches of new road bitumen on physical and mechanical characteristics in accordance with the requirements of GOST 22245-90 showed that almost all 4 experimental batches of new road bitumen gave good performance. At the same time, we selected experimental batch No. 3 because experimental batch No. 1 and experimental batch No. 2 after the addition of technical sulfur, there was no change in the composition of the mixture that can be used to cover highways, and experimental batch No. 4 after the addition of technical sulfur, 20% changed the structure formation of bitumen and increased the fragility index of bitumen. Experimental batch No. 3 after the test received good indicators of stability and fragility.

The samples obtained according to the recipe of the experimental batch No. 3 allows us to obtain a high-quality bitumen mixture and recommend further preparation of asphalt concrete mixture and implementation for covering highways.

The results of comparative tests of our experimental batch No. 3 of new road bitumen with the results of well-known works [1, 2] and physical and mechanical characteristics in accordance with the requirements of GOST 22245-90 are shown in Table No. 3.

Table 3

Name of indicators	Requirements of GOST 22245-90 BND-60/90	Requirements of GOST 22245-90 BND-40/60	From work [1]	From work[2]	Fromourwork	Test method
1. Needle penetration depth, 0.1 mm:						According to GOST 11501
at 25 ° C	61-90	40-60	25-90	30-58	80-94	
at 0 °C, atleast	20	13	-	13	21	
2. Softening temperature of the ring and ball, ° C, not lower	47	51	20-65	42-52	41-49	According to GOST 11506
3. Extensibility, sm, not less:						According to GOST 11505
at 25 ° C	55	45	40-100	38-48	53-59	
at 0 °C, atleast	3,5	-	-	-	3,8	

Based on Table No. 3, comparing the physical and mechanical characteristics, it became known that from the work [1] on the first point, the needle penetration depth ranges from 20 to 65, it depends on the mass fraction of gossypol resin in the bitumen composition. According to the second and third points, the softening temperature indicators for the ring and ball also fluctuate.

From the work [2] on the first, second and third indicators, it is clear that an increase in the sulfur content leads to an increase in the hardness of the mixture.

In our work, we can see that the ratio of oil sludge, tar and technical sulfur changes the quality of bitumen of the BND-60/90 brand and we adopted the best ratio of the experimental batch No. 3.

After reviewing the results of the study, specialists and researchers of the Petrochemistry laboratory of the Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan sent a recipe for new road bitumen to the production enterprise of Bukhara Prosper Invest LLC for the production of new road bitumen.

IV. CONCLUSION

1. An analysis of two well-known published works was carried out to compare the test results obtained.

2. In the central factory laboratory, 4 samples of new road bitumen were tested according to physical and mechanical characteristics.

3. The results of comparative tests of experimental batches of new road bitumen on physical and mechanical characteristics in accordance with the requirements of GOST 22245-90 are presented.

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4. Experimental batch No. 3 after testing received good indicators of stability and fragility.

5. The obtained sample No. 3 makes it possible to obtain a high-quality bitumen mixture and recommend further preparation of asphalt concrete mixture and implementation for covering highways.

6. The results of comparative tests of our experimental batch No. 3 of new road bitumen with the results of well-known works [1, 2] and physical and mechanical characteristics in accordance with the requirements of GOST 22245-90 are presented.

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