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BITUMEN COMPOSITION OF IMPROVED QUALITY FOR PAVING

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The article presents the results of secondary polyethylene modification of oil asphalt containing 2.0–2.8% of rubber crumbs. It is shown that at an optimal concentration of black oil M-40 in the content of bitumen composition with an increase in the amount of the introduced plasticizer – secondary polyethylene – from 1.4 to 4.0 mass %, the softening point of the final product varies from 46 to 80°C, and the extensibility index – from 4 to 13 cm.

Keywords: *secondary polyethylene, black oil, rubber crumbs, softening point, extensibility.*

doi

Introduction

Creation of a solid and durable basis for paving, the quality of which is determined by the physical-mechanical properties of the used binder, is of current importance throughout the world. Road bitumen used to produce paving for quality does not always meet the demands, and therefore much attention is paid to the research on the modification of the operational qualities of bitumen by introducing various additives into the content of bituminous compositions, including waste from various industries, as well as polymeric materials waste.

In recent years, bitumen compositions modified with various polymeric waste, in particular polyisoprene rubbers (SKI – 3), divinylstyrene thermoplastic elastomer, ethylene-propylene copolymers, waste from thermoplastic polymers and production of high pressure polyethylene etc., have been widely used to create a practical paving [1–5].

In the present paper, spited are the results of the research describe the impact of black oil M-40 concentration, as well as the secondary polyethylene, which is involved as a plasticizer in the bitumen composition for paving.

Experimental part

In the investigations being conducted, in accordance with GOST black oil M-40 10585-99 characterized by kinematic viscosity at 80°C equal to 43 mm²/s, density at 20°C – 922.1 kg/m³, freezing point is minus 12°C, flash point – 184°C,

ash content – 0.0228 mass % is used. The mass fraction of sulfur was 0.23%.

As a raw material, bitumen, characterized by a softening point in KS – 110°C, penetration depth of the needle at 25°C – 16×0.1 mm and extensibility at 25°C – 3 cm is used.

As a rubber crumb, industrial rubber products waste with a diameter of 0.06 mm was used.

Stirring obtained mixture was heated to 160–170°C in order to provide complete dissolution of rubber crumbs in fluidizing bitumen. The bitumen composition obtained at this temperature sustained for the additional 30–40 min to ensure homogeneity, then the indices were determined.

Results and discussion

Technical characteristics of the obtained bitumen compositions are given in Table 1.

As is seen from Table 1, an increase in the proportion of black oil M-40 added to the content of bituminous compositions to 26–28 mass % ensures complete swelling of rubber crumbs and contributes to reduce the softening point of the high-melting bitumen taken as raw materials from 110°C to 51–62°C, softening point of oil road asphalt of BND 60–90 in accordance with GOST 1150673. In addition, the obtained samples of bitumen composition are characterized by relatively high penetration and extensibility parameters at 25°C. In particular, the depth of penetration of the needle was shown to increase from 16×0.1 mm to 84–95×0.1 mm, and the extensibility from 3 to 4–7 cm.

The specified concentration of black oil makes it possible to obtain a homogeneous composition by introducing it into the content 2–2.8 mass % of rubber crumbs that increases the service life of paving.

The investigation cycle on modification of astringent bitumen for paving was carried out using secondary polyethylene as a plasticizer.

The composition content involving secondary bitumen is also carried out by the above mentioned technique: heating a mixture of bituminous raw materials and black oil to 60–70°C obtained at the above mentioned concentration of the latter was continuously mixed by

adding a certain amount of the mentioned polymer and the mixture was heated to 120°C, then to 160–170°C. The obtained composition was held at this temperature for 30–40 minutes and then the physical-mechanical properties were determined.

The obtained results presented in Table 2 testify to the plasticizing effect of the secondary polyethylene added into the content of the bituminous composition. In this case, according to softening point on KS of the bitumen compositions obtained with the introduction of 1.4–4 mass % of secondary polyethylene, decreases from 110°C to 46–80°C.

Table 1. Physical-mechanical properties of bituminous compositions

Name	Softening point according to KS, °C GOST 11506-73	Penetration depth of the needle at 25°C×0.1 mm GOST 11501-73	Extensibility, sm at 25°C GOST 11505-75
GOST 22245-90 on bitumen oil road BND 60/90 grade	f.s. 47	61–90	55
bitumen (raw material)	110	16	3
bituminous composition: bitumen–72.0 mass % rubber crumb–2.0 mass % black oil–26.0 mass %	51	95	4
bituminous composition: bitumen–70.1 mass % rubber crumb–2.5 mass % black oil–27.4 mass %	62	84	5
bituminous composition: bitumen–69.2 mass % rubber crumb–2.8 mass % black oil–28.0 mass %	54	90	7

*factory standard

Table 2. Physical-mechanical properties of the obtained bituminous compositions

N	Name	Softening point according to KS, °C GOST 1506-73	Penetration depth of the needle at 25°C×0.1 mm GOST 11501-73	Extensibility, sm. at 25°C GOST 11505-75
	Bitumen (raw material)	110	16	3
I	Experiment 1. Bituminous composition: Bitumen – 70.6 mass % Secondary polyethylene – 1.4 mass % Black oil – 28.0 mass %	46	71	13
II	Experiment 2. Bituminous composition: Bitumen- 69.4 mass % Secondary polyethylene – 4.0 mass % Black oil – 27.8 mass %	63	80	6
III	Experiment 3. Bituminous composition: Bitumen – 69.0 mass % Secondary polyethylene – 4.0 mass % Black oil – 27.0 mass %	80	51	4

With this, the compositions obtained with a content 1.4 mass % of secondary polyethylene are characterized by relatively low softening point index, that obviously related to obtaining a homogeneous composition content. This, the resulting sample of bitumen composition is characterized by a better extensibility index at 25°C (13 cm), against 3 cm for the initial material.

With the increase in the amount of secondary polyethylene introduced into the bitumen content, the obtained composition is characterized by relatively high melting point (80°C), as well as an extensibility (4 cm), that may be related to both – with seal of the obtained bitumen composition and heterogeneity.

Thus, the conducted research cycle found that the bitumen composition obtained by modifying the introduction of additive as plasticizing secondary polyethylene in the amount of 1.4 – 4.0 and 27–28 mass % of the fluidizing compo-

nent of black oil possess improved parameters, and thereby allows the use of the mentioned composition under various climatic conditions.

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XASSƏLƏRİ YAXŞILAŞDIRILMIŞ YOL ÖRTÜYÜ BİTUM KOMPOZİSİYASI

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Məqalədə tərkibində 2.0–2.8% kütlə rezin qırıntıları saxlayan neft bitumunun təkrar emal polietilenlə modifikasiyasının nəticələri verilmişdir. Göstərilmişdir ki, tərkibində 26–28% M-40 markalı mazut saxlayan bitum kompozisiyasına modifikator kimi daxil edilən təkrar emal polietilenin miqdarı 1.4–4.0% kütlə artdıqca son məhsulun Halqa və Şar (H və Ş) üsulu ilə yumşalma temperaturu 46–80°C, dartılma göstərici isə 4–13 sm intervalında dəyişir.

Açar sözləri: yol bitumu, modifikasiya, plastifikator, təkrar emal polietilen, bağlayıcı.

БИТУМНЫЙ СОСТАВ УЛУЧШЕННОГО КАЧЕСТВА ДЛЯ ДОРОЖНОГО ПОКРЫТИЯ

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Представлены результаты модификации вторичными полиэтиленом нефтяного битума, содержащего 2.0–2.8% резиновой крошки. Показано, что при оптимальной концентрации мазута марки М-40 в содержании битумной композиции при увеличении количества вводимого пластификатора – вторичного полиэтилена с 1.4 до 4.0 масс % точка размягчения конечного продукта изменяется от 46 до 80°C, а индекс растяжимости – от 4 до 13 см.

Ключевые слова: вторичный полиэтилен, мазут, резиновая крошка, точка размягчения, растяжимость.