ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
Satbayev University

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

SERIES
OF GEOLOGY AND TECHNICAL SCIENCES

6 (444)

NOVEMBER – DECEMBER 2020

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).
Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ39VPY00025420** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *геология және техникалық ғылымдар бойынша мақалалар жариялау.*

Мерзімділігі: жылына 6 рет.
Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Редакцияның мекенжайы: Қазақстан, 050010, Алматы қ., Қабанбай батыр көш., 69а.
Қ. И. Сәтбаев атындағы геология ғылымдар институты, 334 бөлме. Тел.: 291-59-38.

Типографияның мекенжайы: «NurNaz GRACE», Алматы қ., Рысқұлов көш., 103.

«Известия НАН РК. Серия геологии и технических наук».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан (г. Алматы).
Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ39VPY00025420**, выданное 29.07.2020 г.

Тематическая направленность: *публикация статей по геологии и техническим наукам.*

Периодичность: 6 раз в год.
Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел.: 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Адрес редакции: Казахстан, 050010, г. Алматы, ул. Кабанбай батыра, 69а.
Институт геологических наук им. К. И. Сатпаева, комната 334. Тел.: 291-59-38.

Адрес типографии: «NurNaz GRACE», г. Алматы, ул. Рыскулова, 103.

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty).
The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ39VPY00025420**, issued 29.07.2020.

Thematic scope: *publication of papers on geology and technical sciences.*

Periodicity: 6 times a year.
Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Editorial address: Institute of Geological Sciences named after K.I. Satpayev
69a, Kabanbai batyr str., of. 334, Almaty, 050010, Kazakhstan, tel.: 291-59-38.

Address of printing house: «NurNaz GRACE», 103, Ryskulov str, Almaty.

N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278
Volume 6, Number 444 (2020), 261 – 267 **https://doi.org/10.32014/2020.2518-170X.155**

UDC 691.16

M. Zh. Zhurinov[1], B. B. Teltayev[2], Ye. D. Amirbayev[2], A. O. Elschibayev[2]

[1]JSC "D. V. Sokolskiy Institute of Fuel, Catalysis and Electrochemistry", Almaty, Kazakhstan;
[2]JSC "Kazakhstan Highway Research Institute", Almaty, Kazakhstan.
E-mail: nanrk.mzh@mail.ru, ao_kazdornii@mail.ru

COMPARATIVE ANALYSIS OF LOW TEMPERATURE STRENGTH OF MODIFIED ASPHALT CONCRETES

Abstract. A comparative analysis has been performed in this work for low temperature strength of 31 types of the conventional (non-modified) and modified road asphalt concretes. The neat bitumens of the grades BND 70/100, BND 100/130 and BND 130/200 have been produced by the Pavlodar petrochemical plant from the crude oil of the Western Siberia (Russia) by the method of direct oxidation and they satisfy the requirements of the standard ST RK 1373-2013. The polymers Elvaloy 4170, Elvaloy AM, Kraton, Calprene 501, Butonal NS, SBS (L 30-01 A), KUMHO KTP and crumb rubber have been used for the modification of the bitumens. The modification of the bitumens has been performed in the laboratory of Kazakhstan Highway Research Institute. The modified bitumens satisfy the requirements of the standard ST RK 2534-2015. The conventional and modified asphalt concretes satisfy the requirements of the standards ST RK 1225-2019, ST RK 1223-2019, ST RK 2028-2010, ST RK 2373-2019 and GOST 31015-2002.

The strength of the asphalt concretes at uniaxial direct tension at a constant strain rate of 1 mm/min at the temperatures of -10 °C, -20 °C and -30 °C determined in the device TRAVIS under the standard EN 2697-46 has been accepted as a characteristic of their low temperature strength.

It is found out that various modifiers affect the asphalt concrete strength in different ways: a degree of impact depends both on a type of an asphalt concrete and a modifier, as well as on a negative temperature value. Some modifiers increase, and some of them decrease the strength of the asphalt concretes at low temperatures compared with the original asphalt concretes. Among the modifiers the polymer Elvaloy AM has been found to be the most efficient at low temperatures. The asphalt concretes of type B with the bitumens of grades BND БНД 100/130 and BND 130/200 at modification by the polymer Elvaloy AM had the biggest strength at all the considered low temperatures: at -10 ºC – 6.79 MPa and 6.43 MPa; at -20 ºC – 7.57 MPa and 7.87 MPa; at -30 ºC – 7.35 MPa and 8.86 MPa. The stone mastic asphalt concretes 15 and 20 with the polymers and without them at all the considered low temperatures practically had the strength not higher than the basic asphalt concretes of type B with neat (original) bitumens of grades BND 100/130 and BND 130/200.

Key words: bitumens, polymers, low temperatures, strength.

Introduction. An asphalt concrete as one of main road materials is widely used in the world. One of important characteristics of an asphalt concrete is its low temperature strength. In road practice and science, it is accepted that an asphalt concrete must have a low temperature strength not less than the required value defined in accordance with climatic conditions of a road location.

In present several (direct and indirect) methods for experimental evaluation of low temperature characteristics of road asphalt concretes are known [1]. In our opinion the direct methods provide a higher accuracy of the evaluations.

This paper is a continuation of the series of works of the authors devoted to the investigation and the comparative analysis of the characteristics of road bitumens and asphalt concretes [2-21]. In this paper a comparative analysis of low temperature strength of conventional and modified asphalt concretes is carried out.

Materials and methods. In present paper neat road bitumens of three grades (BND 70/100, BND 100/130, BND 130/200) were used for preparation of 31 kinds of conventional and modified asphalt

concretes. The conventional (non-modified) bitumens were produced by the Pavlodar petrochemical plant and were used for preparation of the conventional asphalt concretes. Polymer modified bitumens were used for preparation of the modified asphalt concretes. The neat and modified bitumens satisfy requirements of the Kazakhstan standards ST RK 1373-2013 and ST RK 2534-2015 respectively. The conventional and modified asphalt concretes satisfy requirements of the standards ST RK 1225-2019, ST RK 1223-2019, ST RK 2028-2010, ST RK 2373-2019 and GOST 31015-2002. Modification of the bitumens by polymers (Elvaloy 4170, Elvaloy AM, Kraton, Calprene 501, Butonal NS 198, SBS (L 30-01 A), KUMHO KTP) and a crumb rubber, preparation of the conventional and modified asphalt concretes has been performed in a laboratory of Kazakhstan Highway Research Institute. More detailed information about modification of the bitumens can be found in works [19, 22]. Information about types of the tested asphalt concretes, kinds and content of the modifiers is given in table.

Strength of the asphalt concretes at direct tension (constant deformation rate:1 mm/min) has been evaluated in the device TRAVIS at temperatures -10 ºC, -20 ºC and -30 ºC under the standard EN 12697-46.

Data about the tested asphalt concretes

№	Bitumen grade	Kind and type of asphalt concrete	Modifier, %	Short designation
1	BND 70/100	Type B	–	PNHZ_70-100_B
2	BND 100/130	Type B	–	PNHZ_100-130_B
3	BND 100/130	Type B	Elvaloy 4170-1.4	PNHZ_100-130_B+Elvaloy1
4	BND 100/130	Type B	Elvaloy AM-2.0	PNHZ_100-130_B +Elvaloy2
5	BND 100/130	Type B	Kraton-4.0	PNHZ_100-130_B +Kraton
6	BND 100/130	Type B	Calprene 501-4.0	PNHZ_100-130_B +Calprene
7	BND 100/130	Type B	Butonal NS 198-3.0	PNHZ_100-130_B +Butonal
8	BND 100/130	Type B	SBS (L 30-01 A)- 3.0	PNHZ_100-130_B +SBS
9	BND 100/130	Type B	KUMHO KTP-3.0	PNHZ_100-130_B +KUMHO3
10	BND 100/130	Type B	KUMHO KTP-6.0	PNHZ_100-130_B +KUMHO6
11	BND 100/130	Type B	Crumb rubber-15	PNHZ_100-130_B +PK15
12	BND 130/200	Type B	Elvaloy 4170-1.7	PNHZ_130-200_B +Elvaloy 1
13	BND 130/200	Type B	Elvaloy AM-2.2	PNHZ_130-200_B +Elvaloy 2
14	BND 130/200	Type B	Kraton-6.0	PNHZ_130-200_B +Kraton
15	BND 130/200	Type B	Calprene 501-6.0	PNHZ_130-200_B +Calprene
16	BND 130/200	Type B	Butonal NS 198-3.5	PNHZ_130-200_B +Butonal
17	BND 130/200	Type B	SBS (L 30-01 A)- 4.0	PNHZ_130-200_B +SBS
18	BND 100/130	Type A	–	PNHZ_100-130_A
19	BND 130/200	Type A	Elvaloy 4170-1.6	PNHZ_130-200_A +Elvaloy 1
20	BND 130/200	Type A	Elvaloy AM-2.2	PNHZ_ 130-200_A +Elvaloy 2
21	BND 130/200	Type A	Kraton-4.0	PNHZ_130-200_A+Kraton
22	BND 130/200	Type A	Calprene 501-5.0	PNHZ_130-200_A+Calprene
23	BND 130/200	Type A	Butonal NS 198-3.5	PNHZ_130-200_A +Butonal
24	BND 130/200	Type A	SBS (L 30-01 A)- 4.0	PNHZ_130-200_A +SBS
25	BND 100/130	SMA-15	–	PNHZ_100-130_SMA15
26	BND 100/130	SMA-20	–	PNHZ_100-130_SMA20
27	BND 130/200	SMA-20	Elvaloy 4170-1.7	PNHZ_130-200_SMA20+Elvaloy 1
28	BND 130/200	SMA-20	Calprene 501-5.0	PNHZ_130-200_SMA20+Calprene
29	BND 130/200	SMA-20	SBS (L 30-01 A)-5.0	PNHZ_130-200_SMA20+SBS
30	BND 130/200	SMA-20	Butonal NS 198-3.5	PNHZ_130-200_SMA20+Butonal
31	BND 130/200	SMA-20	Kraton-5.0	PNHZ_130-200_SMA20+Kraton

Results and discussion. Strength values of the considered asphalt concretes at tension at temperatures -10 ºC, -20 ºC and -30 ºC are shown in figures 1-3. The analysis of the obtained results shows that different modifiers affect the asphalt concretes strength in different ways: it is found out that the degree of impact depends both on an asphalt concrete type and a modifier, as well as on a negative temperature value.

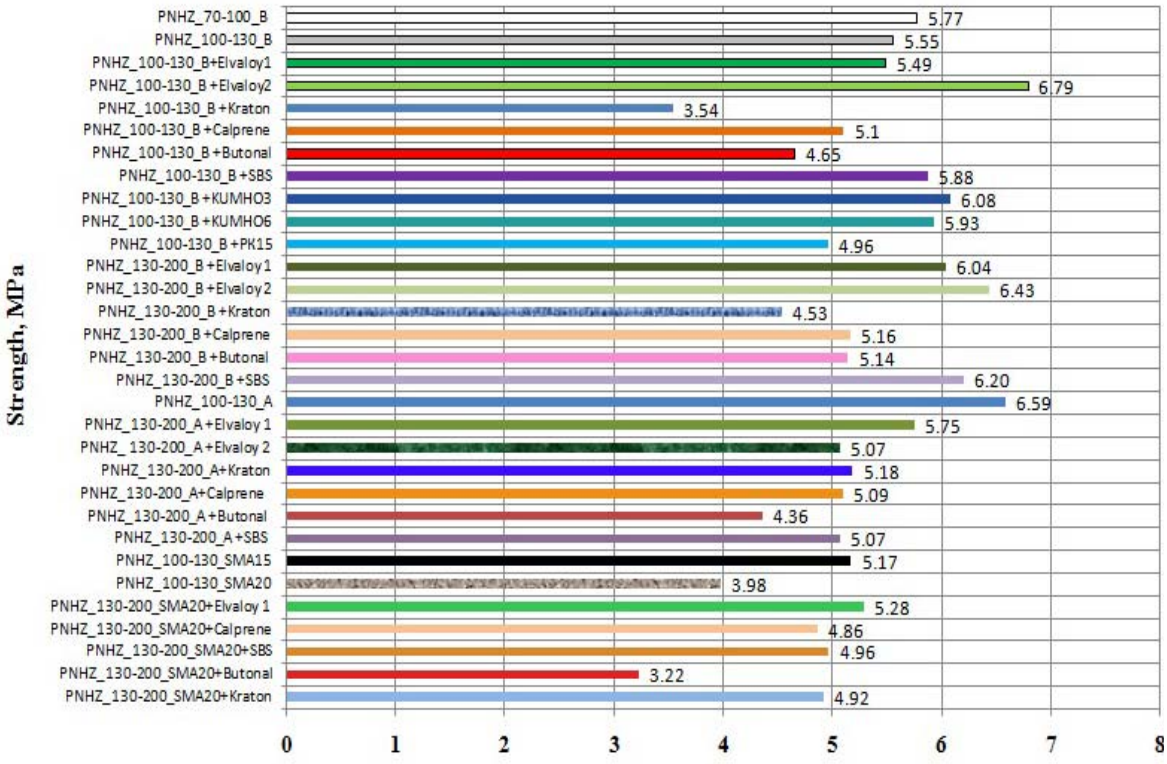

Figure 1 – Strength of the asphalt concretes at tension at temperature -10 ºC

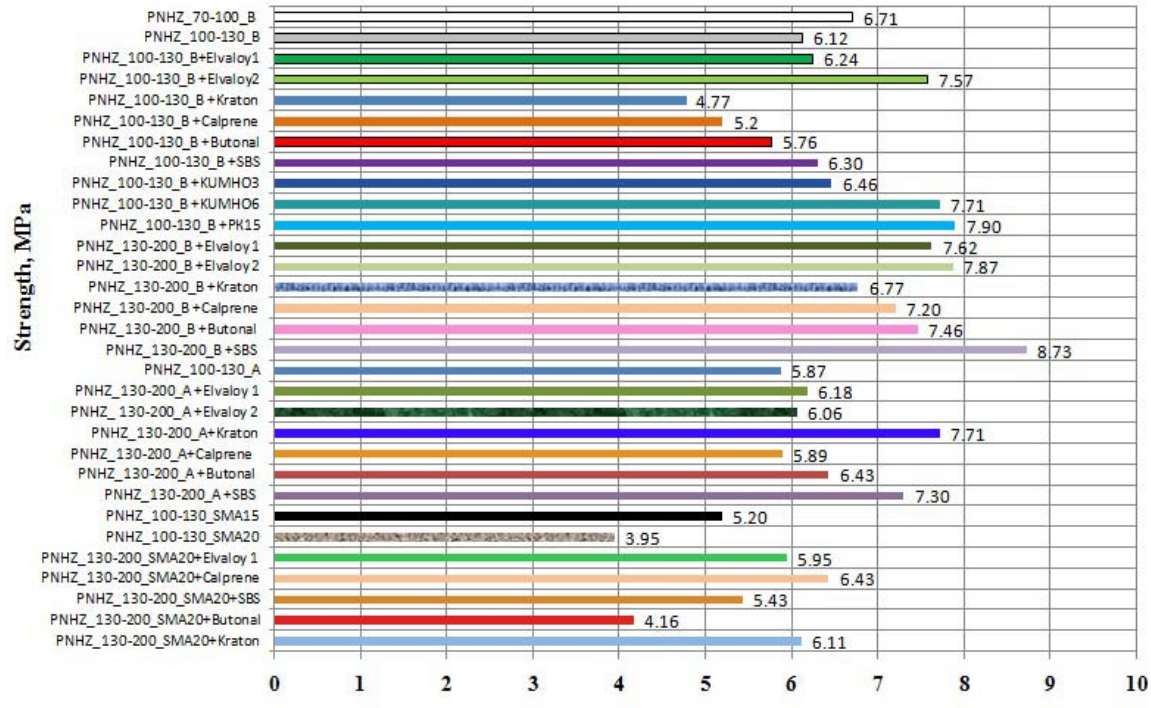

Figure 2 – Strength of the asphalt concretes at tension at temperature -20 ºC

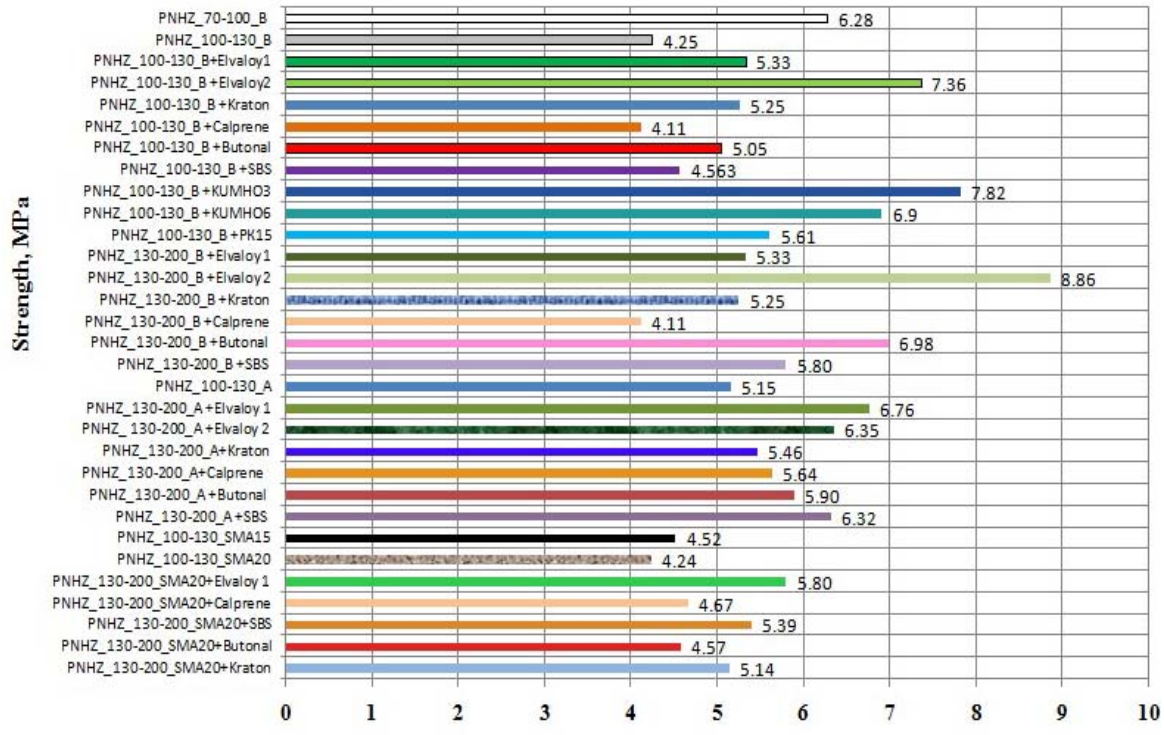

Figure 3 – Strength of the asphalt concretes at tension at temperature -30 ºC

The least strength at the temperature of -10 ºC has been shown by: asphalt concretes of type B with the bitumens of grades bND 100/130, BND 130/200 and the polymer Kraton; an asphalt concrete of type A with the bitumen of grade BND 130/200 and the polymer Butonal; the stone mastic asphalt concrete 20 with the bitumen of grade BND 100/130 and the stone mastic asphalt concrete 20 with the bitumen of grade BND 130/200 and the polymer Butonal. The biggest strength had: asphalt concretes of type B with the bitumens of grades BND 100/130 and BND 130/200 and the polymer Elvaloy AM; the asphalt concrete of type B with the bitumen of grade BND 130/200 and the polymer SBS; the asphalt concrete of type A with the bitumen of grade BND 100/130.

Many modified asphalt concretes had a high strength at the temperature of -20 ºC: the asphalt concretes of type B with the bitumen of grade BND 100/130 and the polymers Elvaloy AM, KUMHO (6 %) and crumb rubber (15 %); the asphalt concretes of type B with the bitumen of grade BND 130/200 and the polymers Elvaloy 4170, Elvaloy AM, Butonal, SBS; the asphalt concrete of type A with the bitumen of grade BND 130/200 and the polymer Kraton. The lowest strength has been shown by: the asphalt concrete of type B with the bitumen of grade BND 130/200 and the polymer Kraton; the stone mastic asphalt concrete 20 with the bitumen of grade BND 100/130; the stone mastic asphalt concrete 20 with the bitumen of grade BND 130/200 and the polymer Butonal.

At the temperature of -30 ºC most of the tested asphalt concretes have shown not very high strength (from 4.11 MPa to 5.8 MPa). The biggest strength had: the asphalt concretes of type B with the bitumens of grade BND 100/130, BND 130/200 and the polymer Elvaloy AM, the asphalt concrete of type B with the bitumen of grade BND 100/130 and the polymer KUMHO (3 %).

It should be noted that the stone mastic asphalt concretes 15 and 20 with the polymers and without them at all the considered low temperatures practically had the strength not higher than the basic asphalt concretes of type B with neat (original) bitumens of grades BND 100/130 and BND 130/200.

Conclusion. Based on the results of the comparative analysis for the low temperature strength of 31 types of conventional and modified asphalt concretes one can draw the following conclusions:

1. Various modifiers affect the asphalt concrete strength in different ways: a degree of impact depends both on a type of an asphalt concrete and a modifier, as well as on a negative temperature value.

2. Some modifiers increase, and some of them decrease the strength of the asphalt concretes at low temperatures compared with the original asphalt concretes.

3. The polymer Elvaloy AM has been found to be the most efficient at low temperatures. The asphalt concretes of type B with the bitumens of grades BND БНД 100/130 and BND 130/200 at modification by the polymer Elvaloy AM had the biggest strength at all the considered low temperatures: at -10 ºC – 6.79 MPa and 6.43 MPa; at -20 ºC – 7.57 MPa and 7.87 MPa; at -30 ºC – 7.35 MPa and 8.86 MPa.

4. The stone mastic asphalt concretes 15 and 20 with the polymers and without them at all the considered low temperatures practically had the strength not higher than the basic asphalt concretes of type B with neat (original) bitumens of grades BND 100/130 and BND 130/200.

Grant IRN AP 08857446 has been received from the Committee of Science of the Ministry of Education and Science of the Republic of Kazakhstan in support of our research work. Agreement No. 230 dated 12 November, 2020.

М. Ж. Жұрынов[1], Б. Б. Телтаев[2], Е. Д. Әмірбаев[2], А. О. Елшібаев[2]

[1]«Д. В. Сокольский атындағы жанармай, катализ
және электрохимия институты» АҚ, Алматы, Қазақстан;
[2]«Қазақстан жол ғылыми-зерттеу институты» АҚ, Алматы, Қазақстан

МОДИФИЦИРЛЕНГЕН АСФАЛЬТБЕТОННЫҢ ТӨМЕН ТЕМПЕРАТУРАЛЫҚ БЕРІКТІГІН САЛЫСТЫРМАЛЫ ТАЛДАУ

Аннотация. Жұмыста әдеттегі (модификацияланбаған) және модификацияланған жол асфальтбетондарының 31 түрінің төмен температуралық беріктігіне салыстырмалы талдау жасалды. МЖБ 70/100, МЖБ 100/130 және МЖБ 130/200 маркалы таза битумдарды Павлодар мұнай-химия зауыты Батыс Сібірдің (Ресей) шикі мұнайынан тікелей тотығу әдісімен өндірді және ҚР СТ 1373-2013 стандартының талаптарын қанағаттандырады. Битумды модификациялау үшін Elvaloy 4170, Elvaloy AM, Kraton, Calprene 501, Butonal NS, SBS (L 30-01 A), KUMHO KTP полимерлері және резеңке үгіндісі қолданылды. Битумдарды модификациялау Қазақстан жол ғылыми-зерттеу институтының зертханасында жүзеге асырылды. Модификацияланған битумдар ҚР СТ 2534-2015 стандартының және әдеттегі және түрлендірілген асфальтбетондар ҚР СТ 1225-2019, ҚР СТ 1223-2019, ҚР СТ 2028-2010, ҚР СТ 2373-2019 және МЕМСТ 31015-2002 стандарттарының талаптарын қанағаттандырады.

Асфальтбетондардың төмен температуралық беріктігінің сипаттамасы ретінде TRAVIS қондырғысында EN 2697-46 стандарты бойынша анықталған -10 °С, -20 °С және -30 °С температурада 1 мм/мин тұрақты деформация жылдамдығы барысында бір осьті тікелей созылу кезіндегі беріктігі қабылданды.

Түрлі модификатордың асфальтбетон беріктігіне әр қырынан әсер ететіні анықталды: әсер ету дәрежесі асфальтбетон мен модификатор түріне де, теріс температура мәніне де байланысты. Кейбір модификаторлар бастапқы асфальтбетондармен салыстырғанда төмен температурада асфальтбетонның беріктігін арттырады, ал кейбіреулері төмендетеді. Модификаторлардың ішінде Elvaloy AM полимері төмен температурада ең тиімді болды. Elvaloy AM полимерімен модификациялау кезінде МЖБ 100/130 және МЖБ 130/200 маркалы битумдары бар Б типті асфальтбетондар барлық қарастырылған төмен температурада ең жоғары беріктікке ие болды: -10 ºС кезінде – 6,79 МПа және 6,43 МПа; -20 ºС кезінде – 7,57 МПа және 7,87 МПа; -30 ºС кезінде – 7,35 МПА және 8,86 МПа. Полимерлі және полимерсіз 15 және 20 шағыл тасты-мастикалық асфальтбетондар барлық қарастырылған төмен температурада МЖБ 100/130 және МЖБ 130/200 маркаларының таза (бастапқы) битумдары бар Б типті базалық асфальтбетондарға қарағанда беріктігі жоғары емес.

Түйін сөздер: битумдар, полимерлер, төмен температура, беріктік.

М. Ж. Журинов[1], Б. Б. Телтаев[2], Е. Д. Амирбаев[2], А. О. Ельшибаев[2]

[1]"Институт топлива, катализа и электрохимии им. Д. В. Сокольского", Алматы, Казахстан;
[2]"Казахстанский дорожный научно-исследовательский институт", Алматы, Казахстан

СРАВНИТЕЛЬНЫЙ АНАЛИЗ НИЗКОТЕМПЕРАТУРНОЙ ПРОЧНОСТИ МОДИФИЦИРОВАННЫХ АСФАЛЬТОБЕТОНОВ

Аннотация. В настоящей работе выполнен сравнительный анализ низкотемпературной прочности 31 вида обычных (немодифицированные) и модифицированных дорожных асфальтобетонов. Чистые битумы марок БНД 70/100, БНД 100/130 и БНД 130/200 были произведены Павлодарским нефтехимическим заводом из сырой нефти Западной Сибири (Россия) методом прямого окисления и удовлетворяют требованиям стандарта СТ РК 1373-2013. Для модифицирования битумов были использованы полимеры Elvaloy 4170, Elvaloy AM, Kraton, Calprene 501, Butonal NS, SBS (L 30-01 A), KUMHO KTP и резиновая крошка. Модификация битумов была осуществлена в лаборатории Казахстанского дорожного научно-исследовательского института. Модифицированные битумы удовлетворяют требованиям стандарта СТ РК 2534-2015. Обычные и модифицированные асфальтобетоны удовлетворяют требованиям стандартов СТ РК 1225-2019, СТ РК 1223-2019, СТ РК 2028-2010, СТ РК 2373-2019 и ГОСТ 31015-2020.

В качестве характеристики низкотемпературной прочности асфальтобетонов принята их прочность при одноосном прямом растяжении при постоянной скорости деформирования 1 мм/мин при температурах -10 °С, -20 °С и -30 °С, определенная в установке TRAVIS по стандарту EN 2697-46.

Установлено, что разные модификаторы по-разному влияют на прочность асфальтобетонов: степень влияния зависит как от вида асфальтобетона и модификатора, так и от значения отрицательной температуры. Некоторые модификаторы повышают, а некоторые понижают прочность асфальтобетонов при низких температурах по сравнению с исходными асфальтобетонами. Из модификаторов наиболее эффективным при низких температурах оказался полимер Elvaloy AM. Асфальтобетоны типа Б с битумами марок БНД 100/130 и БНД 130/200 при модификации полимером Elvaloy AM имели наибольшую прочность при всех рассмотренных низких температурах: при -10 ºС – 6,79 МПа и 6,43 МПа; при -20 ºС – 7,57 МПа и 7,87 МПа; при -30 ºС – 7,35 МПа и 8,86 МПа. Щебеночно-мастичные асфальтобетоны 15 и 20 с полимерами и без них при всех рассмотренных низких температурах практически имели прочность не выше, чем базовые асфальтобетоны типа Б с чистыми (исходными) битумами марок БНД 100/130 и БНД 130/200.

Ключевые слова: битумы, полимеры, низкие температуры, прочность.

Information about authors:

Zhurinov M.Zh., Doctor of Chemical Sciences, Professor, Academician, President of NAS RK, Almaty, Kazakhstan; nanrk.mzh@mail.ru, https://orcid.org/0000-0001-5314-1219

Teltayev B.B., Doctor of Technical Sciences, Corresponding Member of NAS RK, Professor, President of JSC "Kazakhstan Highway Research Institute", Almaty, Kazakhstan; bagdatbt@yahoo.com, https://orcid.org/0000-0002-8463-9965

Amirbayev Ye.D., Chief of Road Construction Materials Division of JSC "Kazakhstan Highway Research Institute", Almaty, Kazakhstan; https://orcid.otg/0000-0001-8508-8803

Elschibayev A.O., Chief of Road Structures and New Technologies Division of JSC "Kazakhstan Highway Research Institute", Almaty, Kazakhstan; https://orcid.otg/0000-0002-6197-8905

REFERENCES

[1] Papagiannakis A.T., Masad E.A. Pavement design and materials. New Jersey, Wiley &Sons, Inc., 2008. P. 1-542.

[2] Teltayev B.B., Kaganovich E.V. Bitumen and asphalt concrete requirements improvement for the climatic conditions of the Republic of Kazakhstan // Proceedings of 24th World Road Congress. Mexico, 2011.

[3] Teltayev B., Kaganovich E. Thermal resistance of blown bitumens to the conditions of sharp-continental climate // Journal of Applied Sciences. 2012. Vol. 12, N 12. – P. 1297-1302.

[4] Teltayev B., Izmailova G., Amirbayev Ye. Rheological properties of oxidized bitumen with polymer additive // Journal of Applied Sciences. 2015. Vol. 15, N 1. P. 129-137.

[5] Radovskiy B.S., Teltayev B.B. Viscoelastic properties of asphalt based on penetration and softening point. Almaty: "Bilim" baspasy, 2013. 152 p. (in Russ.).

[6] Radovskiy B.S., Teltayev B.B. Viscoelastic properties of asphalt based on penetration and softening point // Cham: Springer International Publishing AG, 2018. 115 p.

[7] Rossi C.O., Spadafora A., Teltayev B., Izmailova G., Amirbayev Ye., Bortolotti V. Polymer modified bitumen: Rheological properties and structural characterization // Colloids and Surfaces A: Physicochemical and Engineering Aspects. 2015. 480. P. 390-397.

[8] Teltayev B., Rossi C.O., Izmailova G., Amirbayev Ye., Elschibayev A. Evaluating the effect of asphalt binder modification on the low-temperature cracking resistance of hot mix asphalt // Case Studies in Construction Materials. 2019. N 11. P. 1-13.

[9] Porto M., Caputo P., Loise V., Eskandarsefat S., Teltayev B., Rossi C.O. Bitumen and bitumen modification: A review on latest advances // Applied Sciences. 2019. 9. P. 1-35.

[10] Teltayev B.B., Kalybai A.A., Rossi C.O., Amirbayev E.D., Sivokhina E.S. Increasing of low temperature stability of bitumen with the use of nanocarbon powder. Proceedings of X International Symposium "The Physics and Chemistry of Carbon and Nanocarbon Materials". September 12-14, 2018. Almaty.

[11] Teltayev B.B., Kalybai A.A., Izmailova G.G., Rossi C.O., Amirbayev E.D., Sivokhina E.S. Nanostructured bitumen with nanocarbon // Eurasian Chemico-Technological Journal. 2019. 21. P. 303-310.

[12] Zhurinov M.Zh., Teltayev B.B., Kalybai A.A. Characteristics of road bitumen modified with nanocarbon nanopowder // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 2019. 5 (437). P. 223-228. https://doi.org/10.32014/2019.2518-170X.146

[13] Zhurinov M.Zh., Teltayev B.B., Kalybai A.A. Effect of road bitumen modification with nanocarbon powder // Reports of the National Academy of Sciences of the Republic of Kazakhstan. 2020. 1 (329). P. 134-138. https://doi.org/10.32014/2020.2518-1483.17.

[14] Kalybai A.A., Teltayev B.B., Abzhali A.K. Nanoenergetic materials and low carbon energetic on common resource and technological basis. Proceedings of X International Symposium "The Physics and Carbon and Nanoenergetic Materials". September 12-14, 2018. Almaty.

[15] Kalybai A.A., Teltayev B.B., Abzhali A.K. Nanoenergetic materials and low carbon energetic: regularities, technology and raw materials // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 2019. 3 (435). P. 189-202. https://doi.org/10.32014/2019.2518-170X.85

[16] Zhurinov M.Zh., Kalybai A.A., Teltayev B.B. Characteristics and properties of physical and quantum fields of nanocarbon and their applications // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 2019. 5 (437). P. 229-236. https://doi.org/10.32014/2019.2518-170X.147

[17] Zhurinov M.Zh., Teltayev B.B., Kalybai A.A., Amirbayev E.D. Asphalt concrete with nanocarbon bitumen // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 2020. 3 (441). P. 186-191. https://doi.org/10.32014/2020.2518-170X.71

[18] Zhurinov M.Zh., Teltayev B.B., Kalybai A.A., Rossi C.O., Amirbayev E.D. Comparative analysis of standard indicators for nanocarbon asphalt concrete and other asphalt concretes // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 2020. 4 (442). P. 120-126. https://doi.org/10.32014/2020.2518-170X.92

[19] Teltayev B.B., Rossi C.O., Izmailova G.G., Amirbayev E.D. Effect of freeze-thaw cycles on mechanical characteristics of bitumens and stone mastic asphalts // Applied Sciences. 2019. 9. P. 1-18.

[20] Zhurinov M.Zh., Teltayev B.B., Kalybai A.A., Rossi C.O., Amirbayev E.D. Comparative analysis of low temperature resistance for nanocarbon and other bitumens // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 2020. 5 (443). P. 89-96. https://doi.org/10.32014/2020.2518-170X.108

[21] Zhurinov M.Zh., Teltayev B.B., Rossi C.O., Amirbayev E.D., Elschibayev A.O. Standard indicators of modified bitumens // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 2020. 5 (443). P. 188-195. https://doi.org/10.32014/2020.2518-170X.120.

[22] Teltayev B., Rossi C.O., Izmailova G., Amirbayev Ye., Elschibayev A. Evaluating the effect of asphalt binder modification on the low-temperature cracking resistance of hot mix asphalt // Case Studies in Construction Materials. 2019. N 11. P. 1-13.

Publication Ethics and Publication Malpractice
in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www:nauka-nanrk.kz

ISSN 2518-170X (Online), ISSN 2224-5278 (Print)

http://www.geolog-technical.kz/index.php/en/

Редакторы *М. С. Ахметова, Д. С. Аленов, А. Ахметова*
Верстка *Д. А. Абдрахимовой*

Подписано в печать 15.12.2020.
Формат 70x881/8. Бумага офсетная. Печать – ризограф.
17,6 п.л. Тираж 300. Заказ 6.

Национальная академия наук РК
050010, Алматы, ул. Шевченко 28, т. 272-13-19, 272-13-18