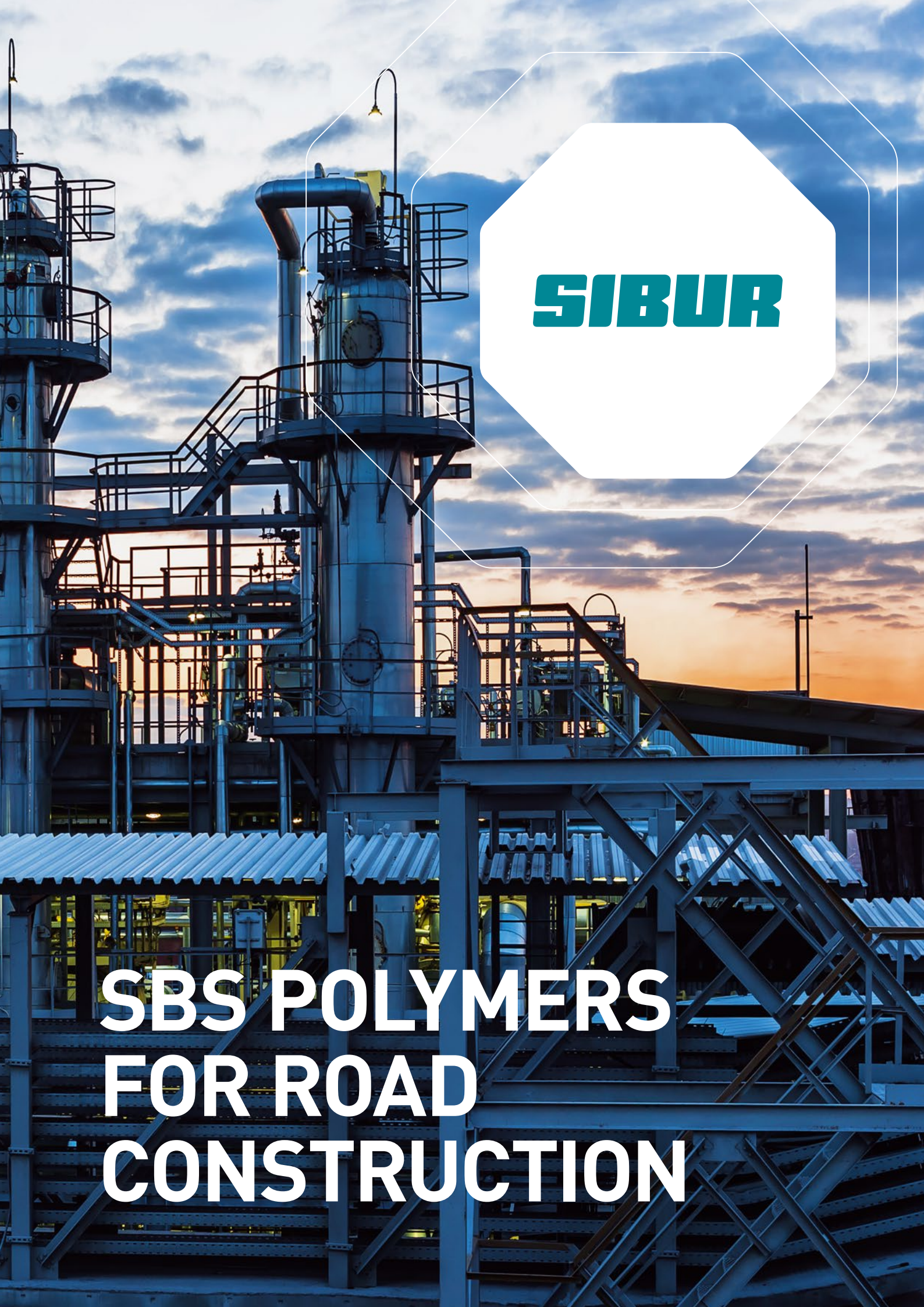


SIBUR

SBS POLYMERS FOR ROAD CONSTRUCTION

CONTENTS

Over
1.400
clients in **100** countries all over the world

SIBUR — GLOBAL PLAYER

ON THE GLOBAL PETROCHEMICAL MARKET

№ 1 FOR PRODUCTION CAPACITY IN THE CIS AND EASTERN EUROPE

More than **523** BLN USD SALES IN 2020

More than **11** MLN TONS* OF PRODUCTION CAPACITIES IN 2020

23 000 HIGHLY QUALIFIED EMPLOYEES

- Midstream Segment
- Plastics, Elastomers & Intermediates
- Olefins & Polyolefins
- Project under Construction
- Investment Projects under Consideration
- R&D Centres
- Infrastructure Facilities
- Export Sales Company
- Business Support
- Loading Racks
- Corporate Health and Wellness Resort
- NIPIGAS, Centre for engineering, procurement, logistics, construction management

* Joint ventures:
- RusVinyl LLC (Kstovo), JV with SolVin
- Yuzhno-Priobsky GPP LLC (Khanty-Mansiysk), JV with Gazprom Neft Group
- NPP Neftekhimia LLC (Moscow), JV with Gazprom Neft Group
- Poliom LLC (Omsk), JV with Gazprom Neft Group and Titan Group of Companies
- Reliance SIBUR Elastomers Private Limited (Jamnagar), JV with Reliance Industries Limited

** LPG and light oil transshipment complex, Terminal Operator functions

* Including production facilities of joint ventures, excluding midstream

INTERNATIONAL OFFICES:

ADVANTAGES OF WORKING WITH SIBUR

№ 1

WORLD CLASS PRODUCTS

- A wide range of standard and special grades of SBS polymers for polymer modified bitumen (PmB), road surface markings, mastic compounds and sealants
- Quality appreciated all over the world

№ 2

TECHNICAL COMPETENCES AND INNOVATIONS

- A unique R&D center working to improve product quality, develop new brands and select recipes
- Technical customer service

№ 3

PARTNERSHIP AND CLIENT-ORIENTED APPROACH

- Joint R&D work, including revision of brands according to customer requirements
- Technical Customer Service, including assistance in development of PmB
- Capability to ensure reliable and uninterrupted supply

PRODUCT PORTFOLIO OF SBS POLYMERS

SIBUR'S PRODUCTIVE CAPACITY FOR SBS POLYMERS — 135 THOUSAND T PER YEAR.

KEY AREAS OF APPLICATION

SBS Brand	Road bitumen modification	Road markings	Mastic compounds	Sealants	Road bitumen modification	Compounds
Standard, linear grades						
SBS L 30-01A	✓	✓	✓	✓	✓	✓
DST L 30-01	✓	✓	✓	✓	✓	✓
SBS L 7342	✓	✓	✓	✓	✓	✓
Standard, radial grades						
SBS R 30-00A	✓	✓	✓	✓	✓	✓
DST R 30-00	✓	✓	✓	✓	✓	✓
SBS R 7382	✓	✓	✓	✓	✓	✓
Special Grades						
DST L 30-01(SR)	✓					
SBS R 35-00 SBS R 7372					✓	✓
SBS L 7322	✓	✓		✓		✓
SBS L 7420	✓	✓		✓		✓
SBS L 7417	✓	✓		✓	✓	

DST R 30-00, SBS R 30-00A, SBS R 7382

are radial styrene-butadiene SBS resulting from block copolymerization of styrene and butadiene in a ratio of 30:70 in a hydrocarbon solution in the presence of an alkyllithium initiator. Stabilized with non-darkening antioxidants.

- HIGH HEAT RESISTANCE
- GOOD FROST RESISTANCE
- GOOD PHYSICAL AND MECHANICAL PROPERTIES
- HIGH PROCESSABILITY

DST L 30-01, SBS L 30-01A, SBS L 7342

is styrene-butadiene SBS of Linear structure resulting from block copolymerization of styrene and butadiene in a ratio of 30:70 in a hydrocarbon solution in the presence of an alkyllithium initiator. Stabilized with non-darkening antioxidants.

- HIGH LEVEL OF STRENGTH PROPERTIES OF ASPHALT CONCRETE
- GOOD CRACKING RESISTANCE
- GOOD TRACKING RESISTANCE
- EXCELLENT PROCESSABILITY

DST L 30-01 (SR)

is styrene-butadiene SBS of Linear structure resulting from block copolymerization of styrene and butadiene in a ratio of 30:70 in a hydrocarbon solution in the presence of an alkyllithium initiator. Stabilized with non-darkening antioxidants.

- HIGH LEVEL OF STRENGTH PROPERTIES OF ASPHALT CONCRETE
- GOOD CRACKING RESISTANCE
- GOOD RUTE RESISTANCE
- EXCELLENT STABILITY IN TRANSPORTATION AND STORAGE

SBS R 35-00, SBS R 7372

are radial styrene-butadiene SBS resulting from block copolymerization of styrene and butadiene in a ratio of 34:66 in a hydrocarbon solution in the presence of an alkyllithium initiator. Stabilized by a triple system of non-darkening antioxidants.

- EXCELLENT HEAT RESISTANCE
- GOOD FROST RESISTANCE
- GOOD PHYSICAL AND MECHANICAL PROPERTIES
- HIGH PROCESSABILITY

SBS L 7417, SBS L 7420, SBS L 7322

is styrene-butadiene SBS of Linear structure resulting from block copolymerization of styrene and butadiene in a hydrocarbon solution in the presence of an alkyllithium initiator. Stabilized with non-darkening antioxidants.

- LOW VISCOSITY
- FOR THE PRODUCTION OF TRANSPARENT PRODUCTS
- HIGH PROCESSABILITY
- HIGH DURABILITY AND HARDNESS

BRAND DESCRIPTION

Properties \ Brand	DST L 30-01	SBS L 30-01A	SBS L 7342	DST L 30-01 (SR)	DST R 30-00	SBS R 30-00A	SBS R 7382	SBS R 35-00	SBS R 7372	SBS L 7417	SBS L 7420	SBS L 7322	Method of measure-ment
Structure	linear			linear	radial	radial		radial		linear			
Kinematic viscosity of 5.23% solution in toluene at a temperature of (25 ± 0.1) ° C, cSt	14±5			12±5	25±10	26±4	26±4	≥22		15 % TVS: 40-50	-	-	ASTM D 5668
Volatile matter content,%	≤ 0,8	≤ 0,8	≤ 0,5	≤ 0,8	≤ 0,8	≤ 0,8	≤ 0,5	≤ 0,8		≤ 0,5			ASTM D 5668
Ash content, % - calcium stearate - silicon dioxide	 ≤ 0,3 ≤ 1,0	 ≤ 0,3 ≤ 1,2		 ≤ 0,3 ≤ 1,0	 ≤ 0,3 ≤ 1,0	 ≤ 0,3 ≤ 1,2	 ≤ 0,3 ≤ 1,2	 ≤ 0,3 ≤ 1,0		 ≤ 0,3 ≤ 1,2			ASTM D 5667
Bound styrene content, %	28,5-31,5			28,5-31,5	28,5-31,5	28,5-31,5	28,5-31,5	33,5-35,0		36,0-38,0	38,5-41,5	27,5-30,5	Vendor's internal method
Melt flow rate, 190 ° C / 5 kgf, g / 10 min	< 1						< 1			16,0-25,0	3,0-11,0	3,0-9,0	ASTM D 1238
Tensile strength at stretching, MPa	≥ 14,7			≥ 14,7	≥ 8,0	≥ 8,0	≥ 8,0	≥ 18,0		≥1,7	>17,0	≥ 10,0	ASTM D 412
Tensile stress at 300% elongation, MPa	≥ 2,7	≥ 2,7	≥ 2,0	≥ 2,7	≥ 2,0	≥ 2,0		≥ 3,0		-	-	≥ 2,0	ASTM D 412
Relative elongation at break, %	≥ 700			≥ 700	≥ 550	≥ 550		≥ 650		≥ 250	≥ 550	≥ 800	ASTM D 412
Shore A hardness, conv un	72±5	80±3	80±3	72±5	75±5	82±5	82±5	≥ 85		80-92	86-98	69-81	ASTM D 2240
Description	High strength properties of asphalt concrete, good cracking resistance, good tracking resistance, excellent processability Capability to produce porous granules			High strength properties of asphalt concrete, cracking resistance, good tracking resistance, excellent stability in transportation and storage	High heat resistance, good frost resistance, good physical and mechanical properties, good processability	High heat resistance, good frost resistance, good physical and mechanical properties, good processability		High heat resistance, good frost resistance, good physical and mechanical properties, good processability		Good pro-cessability, low viscosity	High transparency, high strength at break, excellent properties at low temperatures	Good solubility in standard and non-polar solvents	
Application	Bituminous modification of road and roofing materials, modification of plastics, in TEP-compounds for various applications, in mastic compounds and protective coatings			Bituminous modification of road materials. Has improved properties providing high resistance to delamination (storage stability) of the polymer-bitumen binder	Bituminous modification of road and roofing materials, plastics modification, in TEP-compounds for various applications, in mastic compounds and protective coatings	Bituminous modification of road and roofing materials, plastics modification, in TEP-compounds for various applications, in mastic compounds and protective coatings		Bituminous modification of road and roofing materials, modification of plastics, in TEP-compounds for various applications, in mastic compounds and protective coatings Can be used in regions with hot climate		Adhesives (HMA), self-adhesive roofing materials	Plastic modification, adhesives (HMA), bitumen modification, shoe compounds	Plastics modification, adhesives (HMA), bitumen modification, shoe compounds	

SBS-BASED POLYMER-BITUMEN BINDER

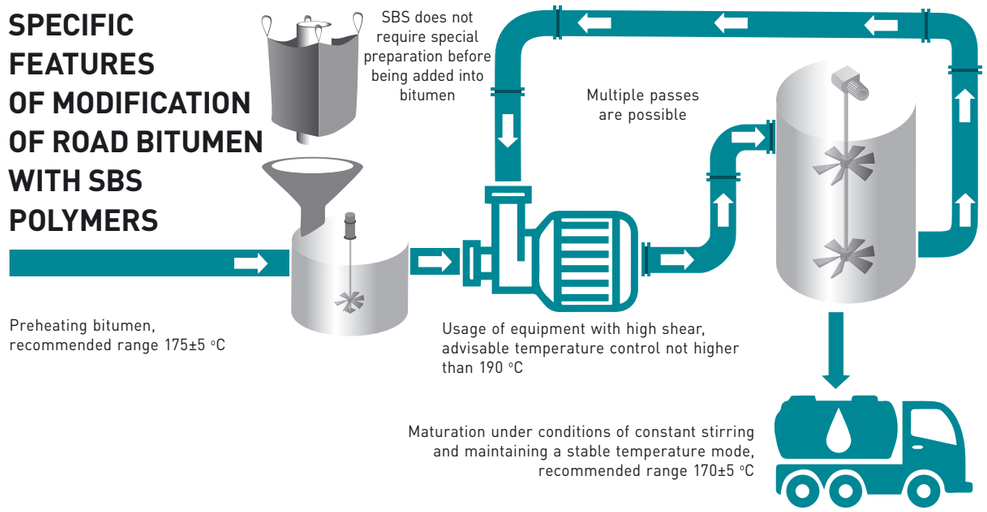
PURPOSE

- SBS type thermoplastic elastomer is intended for use as a bitumen modifier for the production of polymer-bitumen binder or modified bitumen and its further use in the production of asphalt concrete of various types.
- It is used in traditional PmB formulations, as well as in the SuperPave volumetric design system for asphalt concrete as a bitumen modifier.
- It ensures a high level of strength properties of asphalt concrete, a wide range of performance and extends the service life of the roadway.

PREPARATION

- Various grades of road bitumen are used as a basis for modification;
- SBS thermoplastic elastomer does not require special preparation before being added to bitumen;
- The modifier is added into a previously prepared and heated bitumen raw materials;
- SBS is mixed with bitumen using various types of mixing plants, both with high shear forces, and blade and frame mixers;
- Recommended mixing temperature of the modifier with bitumen is in the range of 175±5°C;
- The mixing time depends on the type of technology and the requirements for the final product.

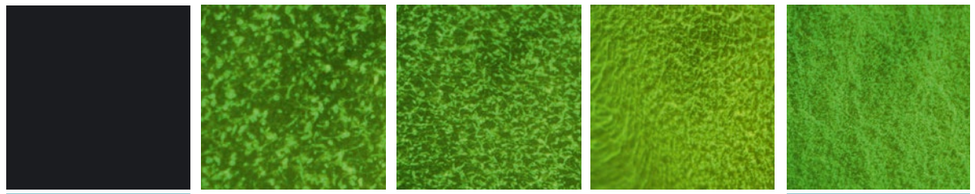
SPECIFIC FEATURES OF MODIFICATION OF ROAD BITUMEN WITH SBS POLYMERS



DEFINITION OF PROPERTIES

- To control the readiness of the binder, the method of fluorescence microscopy is used in the process of maturation.
- The whole complex of indicators is determined in accordance with GOST R 52056-2003, STO 2.30-2016, EN 14023-2010, GOST R 58400.1-2019, GOST R 58400.2-2019

POLYMERIC MATRIX FORMATION IN THE PROCESS OF MODIFICATION



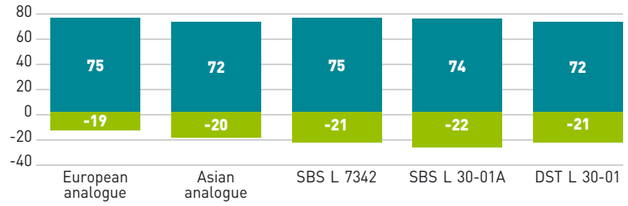
When swollen in bitumen, SBS can get a 7-9 times' increase in volume due to the absorption of bitumen maltenes and plasticizers added into PmB

COMPARATIVE ASSESSMENT OF SIBUR'S SBS AND IMPORT ANALOGUES

MODEL FORMULATION

Ingredient	Content, %
in 70/100	96,0
Polymer	4,0

OPERATING TEMPERATURE RANGE OF THE BINDER, °C



Indicator	European analogue	Asian analogue	SBS L 7342	SBS L 30-01A	DST L 30-01
Needle penetration depth, 0.1 mm, at 25 °C at 0 °C	44 22	48 26	49 22	45 23	47 25
Elongation, cm, at 25 °C at 0 °C	63 8	59 9	77 11	75 10	72 9
Change in softening temperature after heating, °C	5	5	4	4	5
Weight change after heating, %	0,1	0,1	0,1	0,1	0,1
Dynamic viscosity at 135 °C, mPa•s	1900	1600	1600	1500	1400
Elasticity, % at 25 °C at 0 °C	85 53	87 55	90 60	89 61	87 60

SBS-BASED POLYMER-BITUMEN BINDER

BANK OF FORMULATIONS

SIBUR'S SBS is a universal modifier used for the production of PBB in accordance with GOST R 52056-2003, European standard EN 14023-2010 and various PG grades in the Superpave system (GOST R 58400.1-2019, GOST R 58400.2-2019)

GOST R 52056-2003

Ingredient	Content, %
Bitumen	91,9-86,9
SIBUR'S SBS	3,0-4,5
Additives based on the mixture of aromatic hydrocarbons	5,0-8,0
Adhesive additives	0,1-0,6

GOST R 58400.1-2019, GOST R 58400.2-2019

Ingredient	Content, %
Bitumen	92,8-84,6
SIBUR'S SBS	2,0-6,5
Additives based on the mixture of aromatic hydrocarbons	5,0-8,0
Adhesive additives	0,1-0,6
Stabilizing additives	0,1-0,3

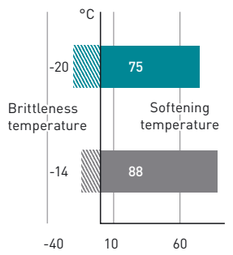
EN 14023-2010

Ingredient	Content, %
Bitumen	96,4-94,2
SIBUR'S SBS	3,5-5,5
Stabilizing additives	0,1-0,3

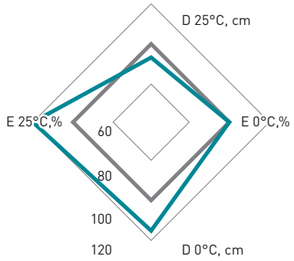
Model Formulations							
	№ 1	№ 2	№ 3	№ 4	№ 5	№ 6	№ 7
Bitumen 1	96		96	96	96	96	96
Bitumen 2		96					
SBS L 30-01 / SBS L 7342	4	4					
DST L 30-01			4		4	4	
DST L 30-01 (SR)				3			4
SBS R 30-00				1			
Cross-linking agent						0,1	

ROLE OF BITUMEN BASE

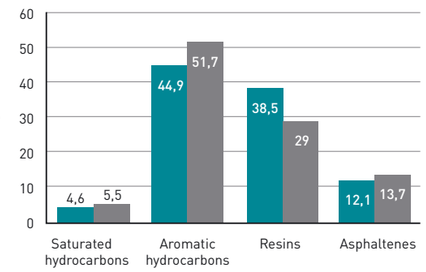
PmB operating temperature interval



Comparative evaluation of elongation and elasticity



Group composition of construction bitumen

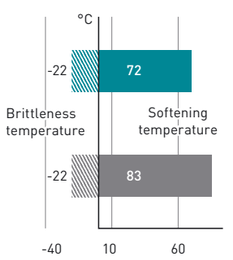


Formulation No. 1 Formulation No. 2

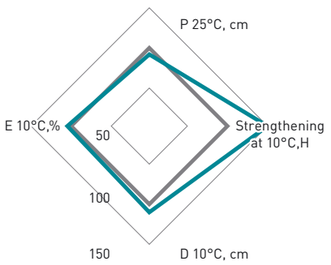
When selecting formulations for the same bitumen grades, it is important to rely on the component composition of bitumen. An increase in the proportion of aromatic hydrocarbons favors the combination of SBS with bitumen and increases elasticity of PBB. With an increase in the proportion of asphaltenes, PmB becomes more heat-resistant, but also more brittle.

COMBINATION OF DIFFERENT TYPES OF SBS

PBB operating temperature interval



Comparative assessment of PmB properties

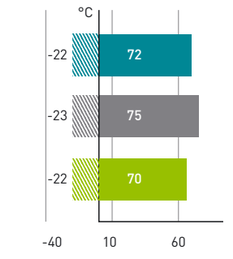


Formulation No. 3 Formulation No. 4

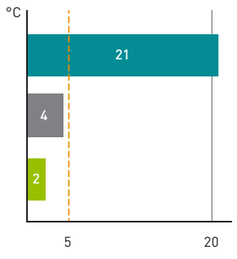
The dosage and type of polymer play an important role. The combination of DST L 30-01 (SR) and SBS R 30-00 in the PmB formulation extends the operating range of the binder, provides the necessary set of properties and stability of the binder during storage and transportation..

SPECIAL SBS ROAD GRADES

PBB operating temperature interval



Change in softening temperature after 72h



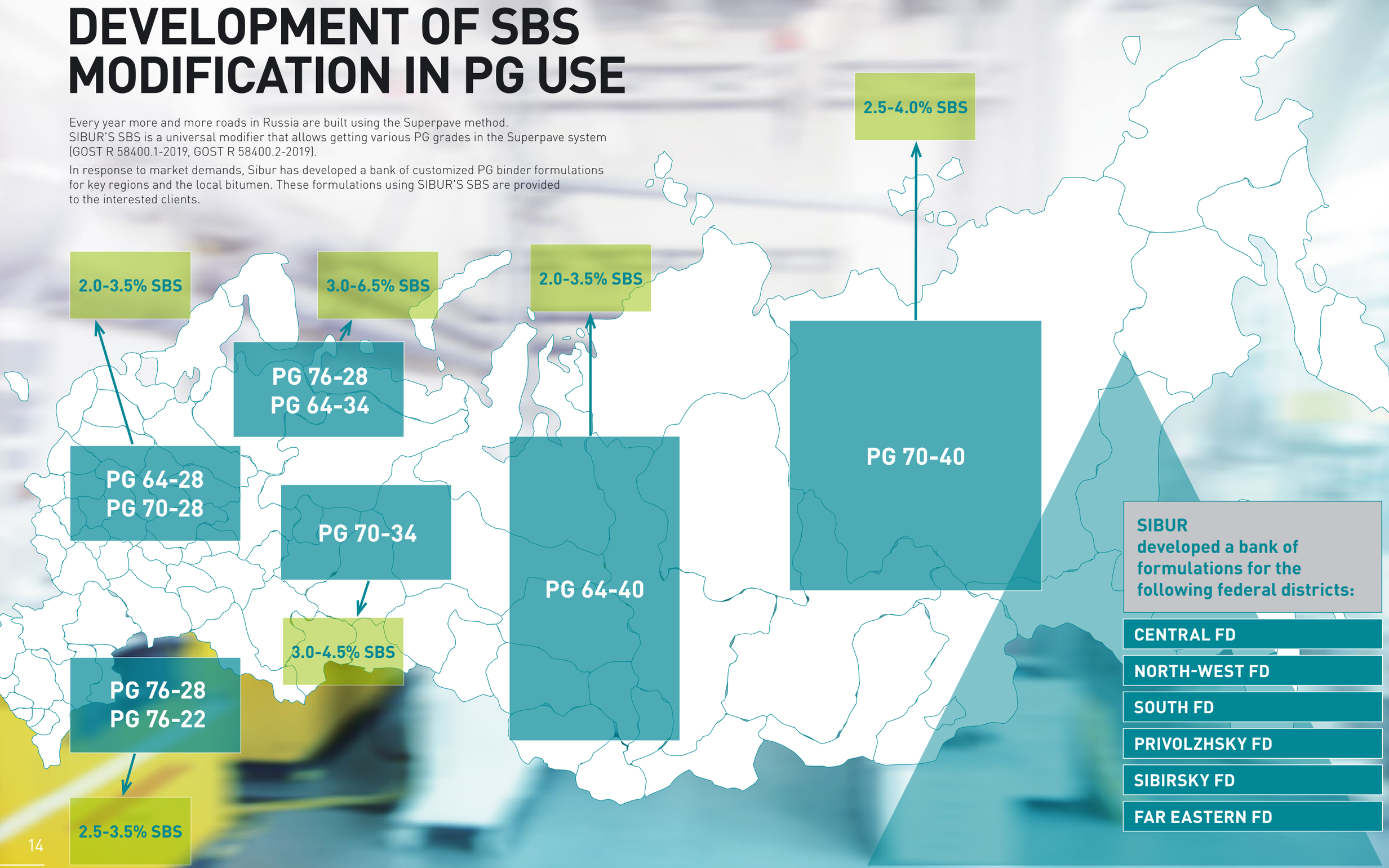
Formulation No. 5 Formulation No. 6 Formulation No. 7

The use of crosslinking additives is a standard practice in the production of PmBs based on SBS batch grades to achieve maximum stability of PmB during transportation and storage, which requires strict dosage control. The use of a special grade DST L 30-01 SR offers the best binder stability without the use of additional additives due to improved compatibility with bitumen.

DEVELOPMENT OF SBS MODIFICATION IN PG USE

Every year more and more roads in Russia are built using the Superpave method.
SIBUR'S SBS is a universal modifier that allows getting various PG grades in the Superpave system (GOST R 58400.1-2019, GOST R 58400.2-2019).

In response to market demands, Sibur has developed a bank of customized PG binder formulations for key regions and the local bitumen. These formulations using SIBUR'S SBS are provided to the interested clients.



SIBUR developed a bank of formulations for the following federal districts:

- CENTRAL FD
- NORTH-WEST FD
- SOUTH FD
- PRIVOLZHSKY FD
- SIBIRSKY FD
- FAR EASTERN FD

R&D CENTERS

ON SBS POLYMERS AND ELASTOMERS

NIOST LLC

"ELASTOMERS" CENTER, VORONEZH

- Development of new products, technologies, analytical methods, formulations of final products, development of a brand assortment;
- Scaling of the developed production processes;
- In-depth analysis and testing of elastomers, certification of feedstock and materials for production processes: BR-ND, DST, SBS, SSBR, SBR;
- Technical client support

NIOST LLC, TOMSK

- Development of petrochemical synthesis and heterogeneous catalysis;
- Increasing production efficiency, pre-FEED study, implementation of new process solutions;
- Analytical support of R&D projects, manufacturing plants and SIBUR's functions, training of employees of central plant laboratories ;
- Expert examination of the quality of chemical products, support of certification of analogues / substitutes of feedstock and materials;
- Scientific and technical support for industrial production facilities.

SIBUR POLILAB, MOSCOW, SKOLKOVO INNOVATION CENTER

SIBUR's innovative R&D center for the development and processing of polymers

- Development of new brands and applications;
- Joint development of new products with industry partners;
- Technical customer support, partner's cost optimization;
- Training and knowledge exchange, creating a Resource Center in the industry.

MAIN GOALS AND OBJECTIVES

MOLECULE DESIGN

- New grades
- Production technical support and optimization
- Innovative ideas and products

APPLICATION SOLUTIONS

- Development of applications for the clients
- Pilot tests at the client's

ANALYTICS

- Analytical service
- Certification of new feedstock and materials

MANUFACTURING APPLICATION

- New products and grades: pilot production and scaling
- Production optimization

EQUIPMENT FOR ASSESSMENT OF CONSUMER PROPERTIES IN PBB SEGMENT

- IKA homogenization system
- Full complex of physical and mechanical properties of the binder
- Optical microscopy
- Rotational viscometer
- RTFOT short-term aging

SIBUR OFFERS A WIDE RANGE OF

CLIENT SERVICES

SUPPORTING CLIENTS IN DAILY WORK
AND STRATEGIC DEVELOPMENT

GUARANTEE OF DELIVERY

Safety stock guarantees delivery of products to customers on time

SCHEDULED DELIVERY

Product delivery within the deadlines specified by the client

JOINT PRODUCT DEVELOPMENT

Making changes in the product formulation to meet the client's needs

TECHNICAL SERVICE VISITS

Visits of technical specialists to the customer's factory for regular support

SIBUR'S E-COMMERCE PLATFORM

Capability to interact through an e-commerce channel, where it is possible to place an order, and get additional services

R&D AND LABORATORY SUPPORT, DEVELOPMENT OF FORMULATIONS FOR THE CLIENT

R&D Center and competencies of SIBUR are used for development or modification of client's product formulations, running tests and doing research for the client

CONTACTS

SALES

SIBUR LLC
16 building 3 Krzhizhanovskogo St., Moscow, 117997
Tel.: +7 495 777 55 00
Fax: +7 495 777 55 00
e-mail: sales_SBS@sibur.ru www.sibur.ru

TECHNICAL SUPPORT

SIBUR LLC
16 building 3 Krzhizhanovskogo St., Moscow, 117997
Tel.: +7 495 777 55 00
Fax: +7 495 777 55 00
e-mail: techservice@sibur.ru, SBS_Tech_support@sibur.ru www.sibur.ru

MARKETING

SIBUR LLC
16 building 3 Krzhizhanovskogo St., Moscow, 117997
Tel.: +7 495 777 55 00
Fax: +7 495 777 55 00
e-mail: marketing_SR@sibur.ru www.sibur.ru

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