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TECHNOLOGY AND ADVANTAGES OF PREPARING MODIFIED VITUME TO INCREASE THE TEMPERATURE RESISTANCE OF ASPHATE CONCRETE COATING

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Abstract
Modified bitumen is a highly effective binding material with polymer or elastomeric additives, the strength, elasticity, and temperature stability of which are significantly enhanced. Its improved composition increases the crack resistance of the asphalt pavement, provides deformation resistance, and significantly extends its service life. Therefore, modified bitumen is used as the most reliable and long-term solution in heavy traffic, severe climate change, and high-load road structures.

Keywords: Asphalt concrete pavement, bitumen, binding materials, transport, service life, reactor, temperature.

Introduction

In recent years, large-scale scientific research has been conducted in the road construction industry to improve the quality of asphalt pavements and extend their service life. In this process, one of the main directions has become the improvement of the physical and mechanical properties of bitumen by enriching it with polymers, elastomers, or other modifying additives. Modified bitumen has higher elasticity, resistance to temperature changes, and deformation resistance compared to ordinary bitumen and is used as a reliable binding material in modern road surfaces.

Today, modern road construction increases the demand for road construction materials, especially binding materials, in particular, bitumen used in asphalt concrete. However, the quality of road surfaces in Uzbekistan remains a pressing problem. As a rule, asphalt concrete pavements based on bitumen today cannot provide the necessary physical and mechanical properties and durability in conditions of high traffic and intensive transportation. For example, statistical analysis shows that the service life of road surfaces made of bitumen-mineral composites is only 50-70% of the standard. Low elasticity, sufficient crack resistance, and low temperature indicators limit the use of these products in hot summers and winters, especially

in regions with a sharply continental climate. These are the main shortcomings that prevent bitumen from meeting the requirements for it.

Based on the physical nature and structural properties of asphalt concrete, one of the main ways to increase the service life of asphalt concrete pavements is to change the structure and properties of organic binders used in its preparation. The most common methods include modification with surfactants and polymer additives or their production waste.

Today, several Uzbek road scientists have conducted experiments on this modified bitumen and published articles and doctoral dissertations based on their experience. These are; Such scientists as Tilakov.S.M., Rakhmatov.B.Kh., Tursunov.A.A., Ismailov.U.U. in their articles emphasized the advantages of modified bitumen. Today, modified bitumen is developed not only in Uzbekistan, but also in foreign countries.

Scientists who contributed to this; Scientists such as Sh.I. Musostov, I.O. Lvov, D.S. Smirnov, A.I. Abdullin, S.A. Ivanov noted that adding polymers to the composition of bitumen is preferable to ordinary bitumen.

Methods:

Bitumen modification is the process of improving its strength, elasticity, temperature stability, and durability by adding an additional substance. The main methods are:

One of the methods of bitumen modification is the introduction of rubbers. Rubber gives the composition a new property - elasticity, characteristic of rubbers in a wide temperature range. The appearance of a new rheological state ensures the deformation of the composition at low temperatures, despite the absence of plastic properties of the bitumen.

When studying the properties of the bitumen-rubber system, a qualitative change was observed - an increase in the softening temperature.

When rubber is introduced into bitumen, an increase in the softening temperature and, accordingly, a decrease in elongation and penetration are observed, which is associated with the structure of the entire system. In the preparation of polymer bitumen modifiers, the following are used: BND 60/90 and 90/130 bitumen grades, most commonly used in the conditions of central Uzbekistan; rubber crusher with a particle diameter of 0.5-0.9 mm, containing rubber production waste; This is SKI-3 rubber with a viscosity of 75-85; The degree of viscosity is 36-45.

The process of preparing these modifiers is carried out as follows. First, a rubber crusher is added to the bitumen heated to 160°C and mixed; the rubber is inflated at 180°C for 1-1.5 hours. Then the temperature is gradually raised to 250 °C to destroy the rubber crusher, and then the mixing is continued at 250 °C for another 30 minutes. The heating is turned off, and after cooling the mixture to 180°C, pre-inflated SKI and SKEPT rubbers (or SKI rubbers and polyethylene pre-dissolved in bitumen) are added during mixing.

The rubbers are pre-inflated and mixed with oil using rollers in a 1:1 component ratio. To facilitate further mixing with bitumen, the rolled product is cut with strips (0.5 x 5 x 10 cm). Polyethylene is pre-melted in bitumen at 160°C and mixed (in a ratio of 1 to 2 components). The mixture of all components is mixed at 180°C for 0.5-1 hour to achieve a homogeneous state and poured into separated molds through a heated valve. The product is air-cooled and granulated. The proposed bitumen modifier is obtained as a solid, non-adhesive mass. It is

easily cut and can be easily added directly to heated bitumen in specified proportions on roads or construction sites. The use of the proposed modifier eliminates the need to transport the finished polymer-bitumen binder in heated bitumen trucks.

The technology for producing modifiers consists of:

Table 1

N/^{0}	Stage	Polymer-added bitumen (SBS, AVA, PE)	Bitumen with the addition of rubber waste	Bitumen with the addition of natural or artificial rubber
1	Raw material preparation	Bitumen (60/70 or 80/100), polymer (SBS, EVA)	Bitumen, crushed rubber powder (0.5-2 mm)	Bitumen NR/BR rubber granules
2	Bitumen heating	undefined 160-180 C	undefined 160-190^0 C	undefined 170-180^0 C
3	Preparation of additional material	Polymer up to 5-7%	Rezia powder is dried by 10-20%	Rubber is obtained by grinding 3-6%
4	Reactor injection	Bitumen is poured into the reactor.	Bitumen is poured into the reactor.	Bitumen is poured into the reactor.
5	Beginning of mixing	20-30 min on a mixer at 1000-3000 rpm	30-60 min on a mixer at 700-1500 rpm	20-30 min on a mixer at 1000-2000 rpm
6	Adding an additional substance	The polymer is gradually added to 5-7%.	Rubber powder is added 10-20%	Rubber is added at 3-6%
7	Continue the reaction	The polymer is completely melted at 180-190^{0}C for 1-2 hours.	Rubber powder 1-3 hours at 190-200^{0}C	1-2 hours at 175-185^{0}C
8	Cooling	undefined 140-150^{0}C	undefined 140-150^{0}C	undefined 140-150^{0}C
9	Laboratory product	Softening temperature elasticity	Penetration, viscosity, degree of swelling	Flexibility, hardness

The proposed bitumen modifier contains a pre-damaged rubber grinder with a particle diameter of 0.5-0.9 mm. This crusher is a byproduct of the production of rubber products. Crumb is a recyclable polymer, the use of which significantly reduces the consumption of expensive synthetic polymers and thereby significantly reduces the cost of the modifier. Crumb degradation leads to partial destruction of the vulcanization network in the rubber, thereby contributing to its uniform mixing with bitumen. The presence of 10-25% crushed pulp by weight provides flexibility and simultaneously a high softening point of the resulting modifier and the PBB based on it. use of a crusher in an amount of less than 10% does not simultaneously achieve a high softening point and a low brittleness point, use of a bitumen in an amount of more than 25% by weight, does not form a homogeneous mixture of crusher and other modifiers.

The use of reactors for the preparation of these processes in laboratory conditions makes the work even easier. Reactors are the most important technological means in the production of modified bitumen or other bitumen-based products. They perform the following functions:

1. Process management and control

The temperature, pressure, mixing speed, and time inside the reactor are precisely controlled. This allows for the uniform and effective addition of polymers or other modifiers to bitumen.

2. Uniformity of modification

Polymers, rubber powder, or chemical additives are completely dissolved inside the reactor and evenly distributed to the bitumen. As a result, the physical and mechanical properties of the modified bitumen are the same throughout the entire volume.

3. Production efficiency and safety

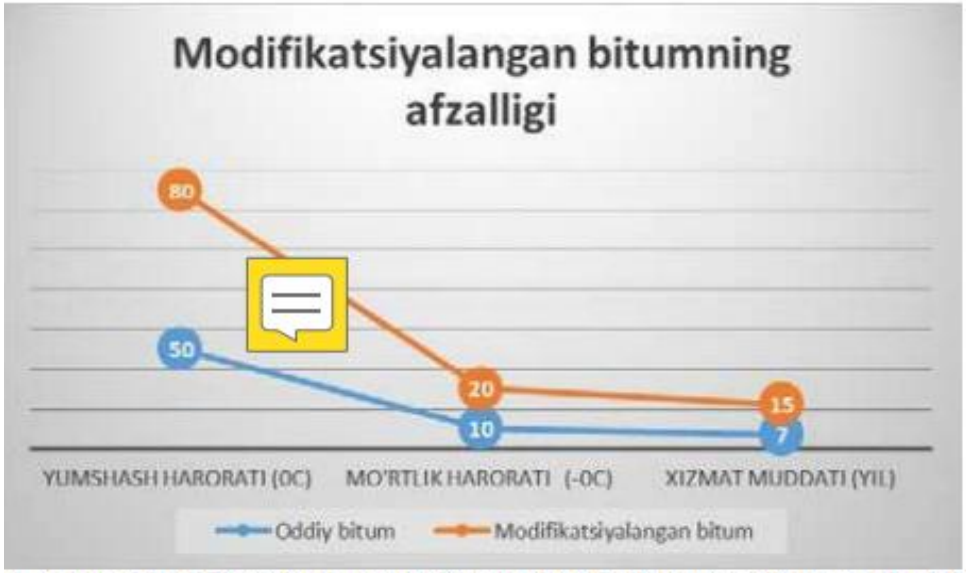
The reactors operate in a closed system, which reduces the risk of exhaust gases, extreme temperatures, or explosions. The process of continuous mixing and heating makes the preparation of the modifier faster and more efficient.

4. Quality of service and product stability

Modified bitumen produced using reactors is crack-resistant, elastic, and long-lasting. This ensures long-term stability and strength of asphalt pavements.

Results:

You can see that modified bitumen has higher elasticity compared to ordinary bitumen and is resistant to high temperatures. Today, Uzbekistan is considered one of the most suitable materials for climatic conditions, because it would not be an exaggeration to say that Uzbekistan is also one of the regions with a hot climate.



1-rasm. Modifikatsiyalangan bitumning fizik mexanik xossalarini taqqoslash grafigi.

The main reason why it is necessary to use modified bitumen based on these processes is that PMB increases the heat resistance (softening in heat, rotting in cold) and deformation resistance of road surfaces - this increases the service life of roads. With the help of PMB, the mechanical

properties of asphalt concrete pavements are improved: flexibility, crack resistance, wear resistance. Some modifiers (for example, plastic waste or recycled rubber) also provide environmental benefits - waste is recycled, resources are used more efficiently.

Summary:
Modified bitumen is an effective means of improving quality and durability in road construction. Polymers, rubber, or other additives enhance the elasticity of bitumen, increase its resistance to deformation and cracks, and extend its service life. At the same time, the modified bitumen is resistant to climate change and adapts to heavy transport loads. Studies show that the use of this material in modern road and infrastructure projects is an economically and technically effective solution.

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