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Nuriddinov A.O.
PhD student of Tashkent University of Architecture and Civil Engineering
Supervisor: Dsc., prof. Kasimov I.I.
PhD student of Tashkent University of Architecture and Civil Engineering

RESEARCH ON THE FROST RESISTANCE AND CORROSION RESISTANCE OF ASPHALT CONCRETE BASED ON MODIFIED BITUMEN WITH STRUCTURE-FORMING POLYMER ADDITIVE AND SURFACTANT

Abstract. This article presents the results of modification of bitumen as a binder for asphalt concrete using polymer modifier "SBS KRATON D1101" and surfactant "SP-OEP" additives and research of its properties. Effects of additives have been studied on Frost resistance and corrosion resistance of asphalt concrete.

Key words: surfactant, styrene butadiene styrene (SBS), modified bitumen binder (MBB), intensive non-oxidation technology, modified asphalt concrete mix.

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Нуриддинов А.О.
докторант Ташкентский архитектурно-строительный университет
Научный руководитель: д.т.н., проф. Касимов И.И.
Ташкентский архитектурно-строительный университет

ИССЛЕДОВАНИЕ МОРОЗОСТОЙКОСТИ И КОРРОЗИОННОЙ УСТОЙЧИВОСТИ АСФАЛЬТОБЕТОНА НА ОСНОВЕ МОДИФИЦИРОВАННОГО БИТУМА С СТРУКТУРООБРАЗУЮЩЕЙ ПОЛИМЕРНОЙ ДОБАВКОЙ И ПАВ

Аннотация. В данной статье представлены результаты модификации битума как вяжущего для асфальтобетона полимерным модификатором «СБС КРАТОН Д1101» и добавки ПАВ «СП-ОЭП» и исследования его свойств. Исследовано влияние добавок на морозостойкость и коррозионную стойкость асфальтобетона.

Ключевые слова: ПАВ, стирол-бутадиен-стирол (СБС), модифицированное битумное вяжущее (МБВ), интенсивная безокислительная технология, модифицированная асфальтобетонная смесь.

1.Introduction

In recent decades, with progress in all fields of science, road construction was also included in this scientific development. The mixture of stone materials with bitumen provided a composite material called asphalt mixture. This material has a limited durability like other construction materials. However, two main factors, traffic loads and climate condition, cause more decrease in durability of asphalt mixtures than other construction materials[1]. On the other hand, in recent years the costs of roads construction and their maintenance have increased. Therefore, the main issue is to improve the strength and durability asphalt with improving the properties of bitumen[2,3].

The exposure of bitumen to temperature changes depends on the ratio of viscosity and softening temperature. The brittleness temperature is an indicator of the viscosity of bitumen at subzero temperatures, which determines the indicator of the visco-ductile state of asphalt and roofing coatings in winter. An increase in the brittleness of bitumen-mineral coatings leads to the formation of cracks and destruction associated with the staining of the coating[5].

One of the main properties of asphalt concrete under operating conditions in road surfaces is their frost resistance and corrosion resistance. When using MBB in asphalt concrete, a special structure with closed air pores is created, contributing to a significant increase in its frost resistance

A specificity of the territories of hot-dry climate especially Uzbekistan is a record number of "temperature transitions through zero". The volume of water, depending on the composition, increases by about 9% during freezing and microcracks appear in the contact zone, as a result, its structure is destroyed, melting and re-hardening cracks water breaks the coating and reduces the frost resistance of asphalt pavements[6].

Various salt solutions, harmful compounds in soils and reagents used in winter against ice weaken the bond of bitumen with stone materials, and also destroy chemical compounds of bitumen-stone material. These factors significantly affect the corrosion of asphalt concrete pavement, and consequently on the reduction of operational properties and durability.

It should be noted that the existing methods [7] the definitions of frost resistance are sufficiently conditional and do not take into account real conditions, that is, in the real mode of operation of coatings, there are various solutions of salts, reagents and a five percent solution of an anti-icing reagent based on a combination of salts of NaCl, CaCl and KCl and harmful compounds. Therefore, the determination and improvement of parameters such as corrosion resistance are also the main task of asphalt concrete modification.

Figure 1.1 shows that with the complex use of various polymers and a structure–forming additive, the best results of frost resistance and corrosion resistance were observed after 5, 10, 15, 25, 50 freezing-thawing cycles. The most resistance of asphalt binders is observed with the use of polymers SBS "Kraton D1101" and "BK – 1040T" with a structure-forming additive surfactant "SP-OEP" than without the additive.

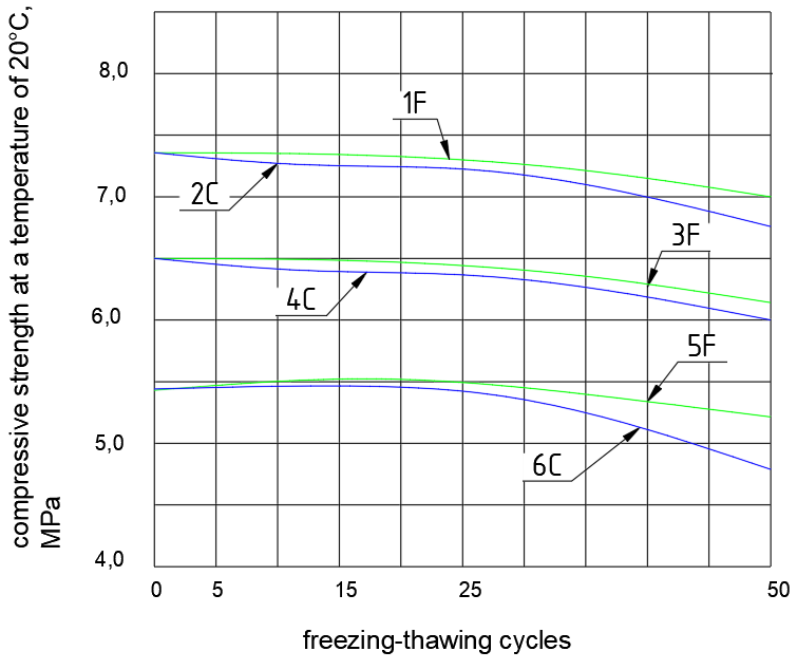

Figure1.1. Frost resistance (F) and corrosion resistance (C) of modified asphalt binders with the addition of surfactants "SP-OEP" after 5, 10, 15, 25, 50 cycles of freezing–thawing: 1M, 2C-R_{sc} with SBS "Kraton D1101"; 3F, 4C–R_{sc} with "BK–1040T"; 5F, 6C-R_{sc} with without additives;

The results of tests for frost resistance and corrosion resistance of modified asphalt binders with the addition of surfactants "SP-OEP" after 5; 10; 15; 25; 50 freeze–thaw cycles are shown in fig. 6.3. The strength of the modified asphalt samples after 50 freeze–thaw cycles decrease by no more than 0.5 MPa, that is, by 5% compared to the initial values, for samples without additives by more than 10%. Moreover, the resistance of modified asphalt in the case of salt solutions and reagents to the effects of aggressive media confirms the hypothesis that modifiers increase the resistance of the material to frost and corrosion. Frost resistance and corrosion resistance of asphalt concrete mainly depends on their water resistance and porosity. However, when using porous mineral materials, especially dispersed and acidic rocks, characterized by low adhesive properties, it is necessary to impose special requirements for frost resistance and corrosion resistance of polymer-bitumen compositions . The tests were carried out according to GOST 10060-2012 in the presence of aggressive media. The tests of the samples were also repeated in the presence of aggressive media in a five percent solution on NaCl[8].

Thus, the studies of asphalt binders on the basis of the MBB offered by us have a significant impact on increasing frost resistance and corrosion resistance, and, accordingly, on the operational properties and service life of road surfaces.

From now on, the studies give reason to consider them consistent with our theoretical ideas about the relationship between the structure, properties and methods of obtaining viscous and heat-resistant high-quality modified bitumen with the performance characteristics of asphalt concrete pavements, providing crack resistance at minus temperatures and corrosion, water resistance, as well as shear resistance at high temperatures.

In conclusion, the optimal values of the properties of asphalt concrete based on MBB with the use of the polymer SBS "Kraton D1101" and the structure-forming additive surfactant "SP-OEP" were determined. The use of the surfactant additive "SP-OEP" makes it possible to save 3-5% of bitumen. The obtained data on all indicators meets the requirements of GOST 9128-13. The use of triple MBB compositions significantly increases the operational properties at high and low temperatures, which

made it possible to use low-viscosity bitumen for the preparation of hot asphalt concrete in the conditions of hot-dry climate.

The effects of the proposed MBB additives on water resistance and water resistance during prolonged water saturation of asphalt concrete showed that the results are primarily related to the effectiveness of the effect of the proposed additives on the properties of bitumen,increasing frost resistance and corrosion resistance of asphalt concrete coatings.

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