Spectrum Journal of Innovation, Reforms and Development
Volume 34, December - 2024 | ISSN (E): 2751-1731
WEBSITE: WWW.SJIRD.JOURNALSPARK.ORG

EFFECT OF STRUCTURAL ADDITIVES ON ROAD BITUMEN

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Abstract
In this article, as a result of the complex application of structural and polymer additives to bitumen in modified asphalt concrete to improve the quality of roads and increase the operational properties and long service life of road surfaces, it was found that the resistance of bitumen to decay increases.

Keywords: Ultraviolet, radical, thermostat, softening temperature, bitumen, resin, catalyst, polycondensation, supramolecular.

Introduction

The economic service life of asphalt concrete pavements is starting to exceed their service life. This is due to the increase in oil and energy prices, the use of low-quality bitumen-mineral materials, and the increasing intensity of the impact on the pavements of vehicles, especially heavy trucks.

One of the factors affecting the service life of road surfaces is road bitumen. In Uzbekistan, the service life of road surfaces depends on the quality of bitumen used for roads, and in developed countries this indicator is 12-16 years. The quality of bitumen is one of the main determining factors in ensuring the durability of road surfaces [1].

During technological mixing of bitumen-mineral mixtures at a temperature of 140-160 ^{0}C, sharp changes in their chemical composition occur. When they interact with mineral materials, a thin layer of bitumen can be destroyed. The destruction process is observed to occur more slowly under the influence of external factors, in the temperature range from +80 to -26 °C in road works, and reversible and irreversible processes are observed in the properties of bitumen. These include a decrease in brittleness, viscosity, hydrophobicity, and an increase in the hardness of asphalt concrete pavements. The increase in the content of brittle solids in bitumen is due to the evaporation of their volatile components, polymerization under the influence of catalysts, polycondensation of compounds and the formation of water, which is associated with the elimination of hydrogen, and their location in the oily part. As a result, the content of tar and oil decreases. Adsorption of active functional groups of molecular compounds increases the resistance of bitumen to atmospheric weathering, while its chemical activity decreases depending on the composition of bitumen binders [2].

The action of ultraviolet rays forms free radicals as a result of the release of hydrogen from the destroyed ionized molecule. Their destruction by mechanical means occurs through the energy of intermolecular and chemical bonds in the chain. In the process of oxidation of bitumen, the destruction of reaction chains is observed due to the radical mechanism. The modification of bitumen, the use of bitumen-mineral materials in the technological process was carried out in accordance with the temperature regime of the preparation of mixtures [3].

In the research work, the most promising method is the combined use of building materials and polymer bitumen modifiers, which can be observed to ensure the stability of the coating during operation by increasing the temperature range of plasticity. As a result, it was found that the aging of binders is based on their composition and the presence of bonds in molecules containing active functional groups, and in rapidly oxidizable groups [4].

The results of the processes of change in the physical and chemical properties of SFM "SP-OEP" at a temperature of 180 ^{0}C with a content of 2.0% by mass of the polymer "Kraton D1186" without additives and modified bitumen in the mixture are presented in [5].

The durability of the material, ensuring the objectivity and reliability of the results, its ability to maintain its properties for a long time under operating conditions, was determined in experimental tests. Therefore, we evaluated the bonding properties of thermostat bitumen after 7, 14 and 28 days at a temperature of 80 ^{0}C using the method recommended by Ferganeftsintez LLC.

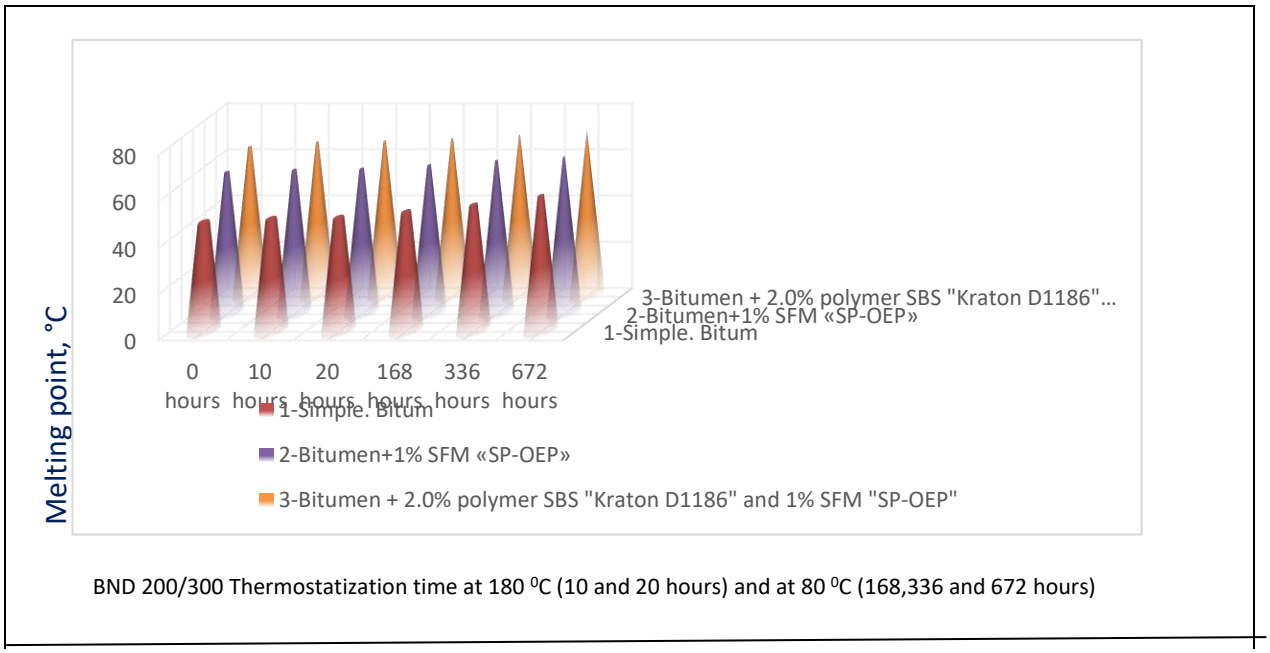

Figure 1. Variation of softening temperature of BND 200/300 bitumen and modified bitumen from temperature control time.

From the data presented in Figure 1, we know that the initial bitumen without modification before the test has a much lower softening temperature than the modified bitumen, but already in the initial period of temperature control, a rapid increase in the softening temperature is observed. Analysis of the parameters of the studied compositions: needle penetration depth (viscosity),

temperature and weight loss, showed that the degradation increases more rapidly in the modified bitumen. Modified bitumen samples slow down the degradation. Bitumen with a 1% SFM of "SP-OEP" turned out to be very thermostable, where the degradation occurs more slowly than in other bitumen compositions.

Polymer-modified bitumen exhibits increased resistance to erosion, with a 43% reduction in softening temperature rise during temperature control and a 75% reduction in diabetes.

The study of the thermal stability (aging) of the high-quality coating bitumen we proposed showed that the composition is sufficiently stable during the temperature control period at 180 ^{0}C for 10 and 20 hours, and at 80 ^{0}C for 168 hours, respectively, and also for periods of 336 and 672 hours. It was found that the degradation process of these test phenomena is associated with the formation of additional supramolecular structures that ensure the separation of hydrogen from hydrocarbons under the influence of oxygen and thereby increase the strength of bitumen-mineral materials [6].

It has been found that the complex application of structural and polymer additives to the proposed modified bitumen increases the resistance of bitumen to erosion. The erosion resistance of modified bitumens in coatings is determined by the formation of independent bitumen structures, as well as the compatibility of the components, the chemical nature and the effectiveness of the additives, as determined in research studies [7].

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