The Condition of Sealing Waterproofing Materials Used in The Construction and Repair of Roads, And Their Requirements

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ABSTRACT

It is known that the widespread use of asphalt concrete and petroleum mineral coatings in Uzbekistan is complicated, especially in recent years, due to their insufficient shear resistance at high summer and crack resistance at low winter negative temperatures.

Keywords: asphalt concrete, negative temperatures, bitumen, road surface operation, surface mineral material, chemical composition, rubber and polymer industry.

In the general transport system of the Republic of Uzbekistan, the dominant position is assigned to highways, which transport about 90% of national economic goods and 98% of passengers from the total volume of traffic carried out by all modes of transport. Network

The republic's highways amount to more than 127.8 thousand km, including a public road network of 43.4 thousand km, departmental and on-farm roads of more than 759 thousand km and streets of cities, towns and villages of more than 9.2 thousand km [1-3].

Public road network, paved roads make up 39.5 thousand km, of which 21.7 km (54.9%) with asphalt concrete, 17.6 thousand km (44.6%) with petroleum mineral and -0.2 thousand km (0.5%) with cement concrete. On-farm roads (about 70%) are built from a gravel-sand mixture, 30% of roads are built from a black gravel surface.

80% of the streets of cities, towns and villages (7.3 thousand km) are built of asphalt concrete pavements, the remaining 20% are made of black gravel pavements.

In addition, there are 11 airports in the republic with a total area of about 600 thousand m2, covered with concrete and asphalt concrete.

The general condition of the republic's highway network in terms of their length and configuration currently meets the needs of the national economy.

It is known that the widespread use of asphalt concrete and oil-mineral coatings in Uzbekistan is complicated, especially in recent years, due to their insufficient shear resistance at high summer and crack resistance at low winter temperatures. Their service life sometimes does not exceed 5-6 years [10].

To ensure the required durability, including shear resistance and crack resistance

of asphalt concrete and oil-mineral coatings, it is necessary to choose the property of bitumen depending on the working conditions, i.e. on the climatic conditions of the construction area, the type of mineral fillers, as well as the technology of preparation of asphalt concrete mixtures [11-18].

As is known, the climatic conditions of Uzbekistan are sharply continental – the maximum air temperature in summer in the southern regions (Termez) reaches + 46oC, and in the north (Ustyurt) up to +38oC, the minimum temperature in winter drops to -8 and - 25oC respectively [10]. In addition, a certain part of the territory of the republic is located in mountainous conditions, which also differ in terms of load and temperature conditions from the plains.

For bitumen, a distinctive characteristic from other binders is the viscosity, which varies widely depending on temperature. This determines the specifics of the process of preparing asphalt concrete mixtures and the operation of road surfaces [19].

When preparing an asphalt concrete mixture, bitumen is heated to 140-160 ° C. At the same time, a certain part of the light fraction evaporates. Moreover, by interacting with hot mineral material and oxygen, bitumen is oxidized and polymerized, i.e. its physico-mechanical and chemical properties change significantly. Further, in road surfaces, under the influence of air temperature, solar radiation and humidity, the processes of oxidation and polymerization continue. As a result, the viscosity of bitumen increases, asphalt concrete coatings become rigid and brittle [10]. To ensure the required strength and durability of asphalt concrete, it is important that the viscosity of bitumen changes to a lesser extent in the temperature range at which the coating operates.

Currently, there are two plants in the republic for the production of road oil bitumen – the Ferghana Refinery with a bitumen workshop capacity of 90 thousand tons and the Khanabad oxidation plant “Tashgordorstroy" with a capacity of 20-30 thousand tons per year.

Operational experience shows that one of the reasons for the destruction of asphalt concrete coatings is the loss of bond (adhesion) between organic and mineral materials. The strength of such adhesion depends on both the chemical composition and the surface structure of the mineral material, the chemical composition, structure and properties of bitumen, as well as on the effects of various environmental factors [10]. To prevent and destroy them, it is necessary to increase the adhesion strength between the surfaces of the materials interface.

It should be noted that the quality of bitumen produced in the republic does not yet fully meet the requirements of the standard. The main reason is that the extracted petroleum products of the republic contain a large amount of paraffin and sulfur. Bitumen obtained from highly paraffin-sulfur tar is characterized by low adhesive properties and a reduced softening temperature.

Therefore, one of the problems of improving the quality of asphalt concrete is to increase the adhesive ability and temperature stability of the bitumen obtained. It can be solved by adding secondary resources of the rubber and polymer industries to bitumen, as well as by selecting appropriate surfactants, namely, by creating an effective composite.

In world practice, when obtaining asphalt concrete coatings for areas of sharply continental climate, a method is usually used to increase the thermal and crack resistance of coatings by introducing additives from polymer materials into bitumen.

The introduction of leached substances into bitumen in order to create highly effective polymer bitumen binders makes it possible to purposefully regulate the structural and mechanical properties of materials [43]. The properties and structure of polymer bitumen compositions are determined to a large extent by the type of polymer and the dispersed structure of bitumen.

In recent years, the following groups of polymers have been widely used, mainly: rubber-like elastomers, as well as thermoplastic, thermosetting and thermoplastic polymers [25-27, 35-39].

It can be noted that in a number of countries around the world, in particular the USA, 1.5-3% styrene butadiene rubber is used in the construction of asphalt roads. In Italy, in 1969 – 1970, about 120 km of road pavement was built using bitumen containing (3-6%) synthetic rubber – elastane. During the construction of highways in England, France and Germany, various types of rubbers and polymer materials have been tested in small quantities (3-6%) as part of bitumen. In the Hungarian People's Republic, the first asphalt concrete coating using bitumen improved with the addition of 8% powdered rubber was built on heavy-traffic road sections in Budapest, which was successfully operated for more than 18 years (from 1951 to 1969). During the construction of experimental sections of heavy-traffic roads in Russia (Moscow and St. Petersburg), polymer bitumen and rubber mixtures were used.

Currently, it has been established that the quality of asphalt concrete coatings can be improved, not only by increasing the properties of bitumen itself, but also by improving the strength and thermomechanical characteristics of asphalt concrete coatings by mechanochemical activation of mineral fillers [10].

Crushed gravel is used as crushed stone in Uzbekistan. It follows from this that part of the material will have a rounded smooth surface, it is known that in the mineralogical composition of gravel there is up to 45% silica (SiO2), to which bitumen adheres poorly. At the same time, it should be pointed out that for the preparation of asphalt concrete, in the vast majority of cases using natural sand with a rounded surface and a size modulus of up to 2, not only reduces the friction force between the particles, but also significantly worsens the strength of asphalt concrete [10].

It is known that higher-resource structures are obtained from those materials in which the binding organic material interacts well with mineral fillers. With insufficient adhesive interaction of mineral materials with binders, aqueous aggressive media can gradually penetrate structures, peeling off the bitumen film and particles of mineral materials, which leads to premature failure of the coating.

The low adhesive interaction of bitumen with natural silicates limits the use of fine natural sands with a grain size modulus of less than 2.0 both in composition and content. Therefore, in the preparation of asphalt concrete mixtures, in addition to natural ones, up to 50% of crushed sands are used – crushed gravel with various fractional compositions, which requires quite high labor and energy costs. Fine natural sands, including sand dunes, with inexhaustible reserves in many regions of the Republic (Bukhara, Navoi, Khorezm, Surkhandarya, Syrdarya, Ferghana, etc. They are practically not used for asphalt concrete mixtures due to the low interaction force with bitumen.

Another negative quality of traditional asphalt concrete pavements used in high-altitude conditions is their low resistance to wave formation, especially in areas of descent and ascent of roads. This not only limits the capacity of roads in terms of technical speeds of modern vehicles, but also in terms of their carrying capacity.

According to the terms of international agreements, sections of the highway on the Silk Road through the territory of the Republic of Uzbekistan must ensure the passage of large-tonnage vehicles with a total weight of 40 tons. A similar condition is 38 tons for sections of highways in the Republic of Kazakhstan, and even less for other CIS republics [10].

In our opinion, ensuring such an international standard for highways of the Republic of Uzbekistan, only on the basis of well-known bitumen from Russia or asphalt concrete mixtures from German companies, on which our road builders have high hopes, is practically difficult and economically inexpedient in a hot climate and highlands.

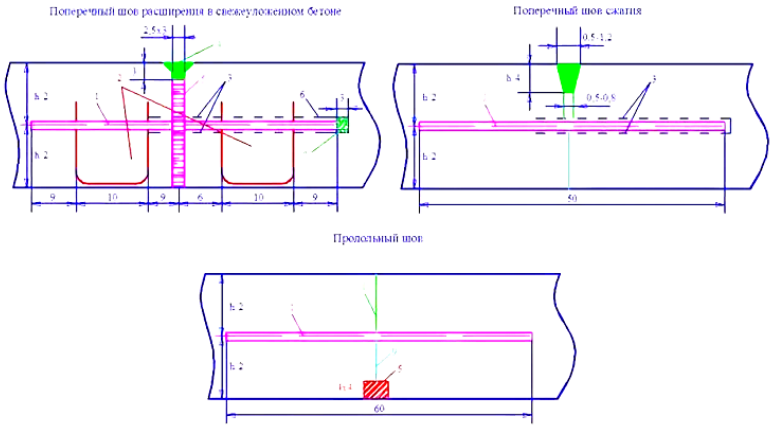
It should be noted that in recent years, the construction of cement concrete pavements in the Republic has been increasingly used, especially in the construction of motorways designed for heavy and heavy traffic. The advantages of further distribution of cement concrete coatings are mainly due to their high durability and the results of long-term

observations in the road sectors of the Republic.

Thus, increasing the strength, heat resistance and, consequently, the deformation and wear-resistant characteristics of cement concrete and asphalt concrete coatings in high-altitude and hot climates is an urgent, strategically important task.

It should be noted that timely methods of filling concrete joints and cracks of coatings with sealing waterproofing mastics play an essential role in ensuring the durability of deformation and wear-resistant characteristics of concrete and asphalt concrete coatings. In this regard, the issues of sealing deformation joints and cracks of concrete and asphalt concrete pavements and airfields by means of waterproofing materials are discussed in detail below.

In order to avoid the destruction of concrete from the combined action of the moving load and temperature factors, which increase significantly with the increase in the length of the plates, in concrete road surfaces and airfields, it is very important to use expansion joints [9-13] for various purposes, which is clearly seen from Fig.1.



a - expansion seam; b - compression seam; c - longitudinal seams; 1 - false type steel pin; 2 - mastic for filling the upper part of the seam; 3 - bitumen coating; 4 - cap; 5 - main board; 6 - longitudinal seam reinforced with pins; 7 - longitudinal seam of sheet pile type; 8 - elastic polymer (isolic) tape.

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