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ANALYSIS OF PROBLEMS OCCURRING ON ASPHALT-BETONE AND CEMENT-BETONE ROADS

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Abstract
In this article, a thorough comparative analysis of the technological, economic, and environmental aspects of the most commonly used materials in road surfaces Asphalt concrete and Cement concrete was carried out. The analysis pays special attention to the harsh continental climate conditions of Uzbekistan, in particular, the problem of asphalt concrete deformation during hot summer temperatures. Also, the issue of ecological load (toxic emissions, CO_2) during the production and operation of asphalt concrete was studied, and the ecological advantages of cement concrete due to its durability, high-temperature resistance, and the possibility of complete recycling were shown. The second part of the article presents the results of laboratory testing methodology and determination of compressive strength of asphalt concrete mixtures based on GOST 12801-98 standards. Research justifies the need to introduce modern foreign technologies (PMB, SMA, Whitetopping, HPC) that are suitable for the conditions of Uzbekistan.

Keywords: Asphalt concrete, Cement concrete, road pavement, track, environmental load, polymer-modified bitumen (PMB), Whitetopping, compressive strength, GOST.

Introduction

Cold Patch Mixtures (CPMs) are important as a quick and effective solution for repairing defects and potholes in road surfaces. The strength and durability of CPMs largely depend on the quality of the binder used. Therefore, binder modification is the most important practical way to improve the performance of CPMs.

The main goal of modification is to improve the properties of traditional bitumen (usually bitumen of penetration class 60/70 or 80/100), i.e., to increase the hardness of the binder at high temperatures and maintain its flexibility at low temperatures, as well as to increase fatigue resistance. This study analyzes various methods of CPM binder modification, advanced and innovative technologies, their mechanisms, and results in road surfaces.

Comparative analysis of asphalt concrete (Russian context and general)

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Advantages of asphalt concrete Table 1

Advantage	Analysis & Comment
Affordable price	The cost of asphalt itself and its laying is lower than that of concrete. This is a significant cost advantage.
Fast laying and reinforcement	Asphalt paving (asphalting) and its complete strengthening occurs quickly, which minimizes traffic congestion.
High repair comfort	It is possible to repair only a small fragment of the damaged part without replacing the entire plate. This significantly reduces operating costs.
Smoothness and aesthetics	The asphalt pavement is smooth and even, aesthetically pleasing.
Waterproofing	High-quality asphalt concrete does not allow water to penetrate into the inner layers, which prevents cracking of the pavement as a result of water freezing.
Service life	In places where there is no constant (intensive) traffic, the service life can be very long.

Disadvantages of asphalt concrete Table 2

Deficiency	Analysis & Comment
Heat sensitivity	At high temperatures (around 35-40°C), the bitumen in the asphalt softens, which leads to the formation of depressions. (This is a big problem for regions like Uzbekistan where temperatures are very high in the summer).
Resistance to constant traffic	If there is constant and heavy traffic, the asphalt wears out and cracks faster, which requires constant repairs.

Technological and Terminological Accuracies Table 3

Term	Description (Composition)	Properties
Asphalt (Natural)	Material formed from a mixture of bitumen (binder) and mineral fillers (sand, mineral powder).	Suitable for quick coating formation, has greater plasticity.
Asphalt concrete	It is a complex composite material containing asphalt (bitumen and sand), large stone fractions (gravel, crushed stone), sand, and various additives.	It has more accurate resistance to mechanical loads, deformation, and wear.

Types of asphalt concrete (by temperature):
Hot (Hot): Laying at high temperatures, for roads occurring at high temperatures.
Warm: The deposition temperature is much lower.
Cold: Allows operation even at low (negative) temperatures (often for patch repair).
Environmental and Economic Analysis (Asphalt vs Concrete Struggle)
Asphalt concrete: Source of harmful emissions

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Asphalt concrete pavements have a negative impact on the environment at the stages of construction, production, and operation:

Table 4

Stage	Type of impact	Analysis
Production (Factories)	Industrial emissions into the atmosphere	Asphalt plants emit toxic substances such as CO_2, carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_x), and PAU (Polyaromatic hydrocarbons) during their production.
Construction/Leaving	Direct chemical emission	Asphalt is laid at 140°C. At this temperature, organic compounds are released from the fresh asphalt into the air.
Operation (Summer)	Separation of heavy metals at high temperature	At temperatures above 25°C and exposed to sunlight, harmful emissions increase to 300%. In old coatings, heavy metals (lead) accumulate and disperse into the environment.
Indirect influence	Increased fuel consumption	The quality of the asphalt pavement (especially when depressions appear) increases the vehicle's wheel resistance, resulting in fuel consumption increasing by $5-7\%$ and CO_2 emissions.

Alternative: Ecological advantages of cement concrete
As an alternative to asphalt, cement-concrete roads have significant ecological advantages:

Table 5

Advantage	Analysis & Reason
High Temperature Harmlessness	Cement does not melt and deform, does not emit toxic gases. This is a decisive advantage for regions with a hot summer climate.
Lower Fuel Consumption	In concrete, the rolling resistance of wheels is lower. As a result, fuel consumption will decrease by $3-6\%$, which will reduce CO_2 emissions.
Longevity and Low Repairs	Concrete roads last longer (25-50 years) and require less repair.
Complete Processing	Cement concrete 100% recycled (*secondary recycling*).

Foreign technologies adapted to the conditions of Uzbekistan
Uzbekistan's sharply continental climate requires coatings resistant to high temperatures and deformation.

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Asphalt Concrete Improvement Technologies

Table 6

Technology	Advantage (for Uzbekistan)	Application context
Polymer Modified Bitumen (PMB)	By adding polymers to bitumen, it significantly reduces the softening of asphalt at high temperatures and the formation of depressions.	European Union (Germany, France), Turkey, USA.
Stone Mastic Asphalt Concrete (SMA)	There are many large, interconnected gravel fractions. Gives the coating high internal strength, resistance to deformation under heavy loads.	Germany, Scandinavian countries.
Warm Asphalt Mixtures (WMA)	The production temperature is lower. Reduces the environmental burden (less CO_2 and toxic gases).	USA, Canada, European countries.

In the conditions of Uzbekistan, SMA technologies based on polymer-modified bitumen are most suitable for high heat resistance and heavy loads.

Table 7

Technology	Advantage (for Uzbekistan)	Application context
Thin Concrete Coatings (Whitetopping)	Laying a new, thin layer of cement concrete on top of the existing old asphalt pavement. It allows for quick and inexpensive reconstruction.	USA (rapid road restoration programs).
High Performance Concrete (HPC)	Increasing the fast hardening and strength of concrete with the help of special additives. This reduces construction time and eliminates the main drawback of cement concrete.	China, India (fast-track highways).

The practical implementation of the US and Chinese experience in concrete roads (especially HPC and Whitetopping technologies) in Uzbekistan will be very useful. Methodology of laboratory testing of asphalt concrete mixtures Standards of the testing process

Testing of the physical and mechanical properties of asphalt concrete mixtures in road construction is carried out in accordance with the requirements of the interstate standard GOST 12801-96.

Sample Preparation:

1. The asphalt concrete mixture taken as a sample from the object is dried in a drying cabinet (2B-151) at a temperature of 50°C for 12-14 hours until its properties are restored.
2. After drying, it is placed in a (SNOL-1.6) melting oven in a crushed state and melted at a temperature of $150-160^\circ\text{C}$.

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3. Before placing in asphalt concrete cylinders (71.4 mm), the cylinders are heated to a temperature of 100°C for 30-40 minutes. The weight of standard asphalt concrete should be within 670-700 grams.

Methodology

After manufacturing a product in industrial production enterprises, this product undergoes internal inspection at the manufacturing enterprise. When testing asphalt concrete mixtures, the degree of durability is checked in accordance with the requirements of the interstate standard GOST 12801-96. If it is not controlled by a measuring instrument in accordance with the requirements of the standard, our standard-produced product may also be included in the non-standard product.

Asphalt concrete mixtures according to the Interstate Standard GOST 12801-98

Compression density testing is determined experimentally based on the following conditions. In this case, the asphalt concrete mixture taken as a sample from the facility is dried in a drying cabinet (2V-151) for 12-14 hours at a temperature of 50℃ until its properties are restored.

Figure 1. Drying cabinet brand 2B-151.

Asphalt concrete, after drying, is placed in a crushed state in a smelting furnace (SNOL-1.6) and melted at a temperature of 150-160°C.

Figure 2. Melting cabinet brand СНОЛ-1.6.

Cylinders (71.4 mm) are required for preparing asphalt concrete mix. To warm up the cylinders, they are also heated in a heating cabinet at a temperature of 100℃ for 30-40 minutes. Then the molten asphalt concrete is placed in a cylinder, and the weight of the sample asphalt concrete is in the range of 670-700 grams. The sample asphalt concrete in the cylinder is compressed using a P-50 pressing device. A cylinder with asphalt concrete is installed on two support plates for testing. The function of the supporting slabs here is to protect asphalt concrete from being subjected to high pressure.

Figure 3. Press P-50 brand compression device

Compressive strength of asphalt concrete

Table *8.*

No	P, kN	a, cm	b, cm	Rsj
1.	390.1	15.	15.	17.34
	393.4	15.	15.	17.48
	412.8	15.	15.	18.35
	400.7	15.	15.	17.81
2.	395.6	15.	15.	17.58
	397.6	15.	15.	17.67
	395.4	15.	15.	17.57
	411.2	15.	15.	18.28
3.	401.6	15.	15.	17.85
	423.6	15.	15.	18.83
	419.7	15.	15.	18.65
	403.2	15.	15.	17.92

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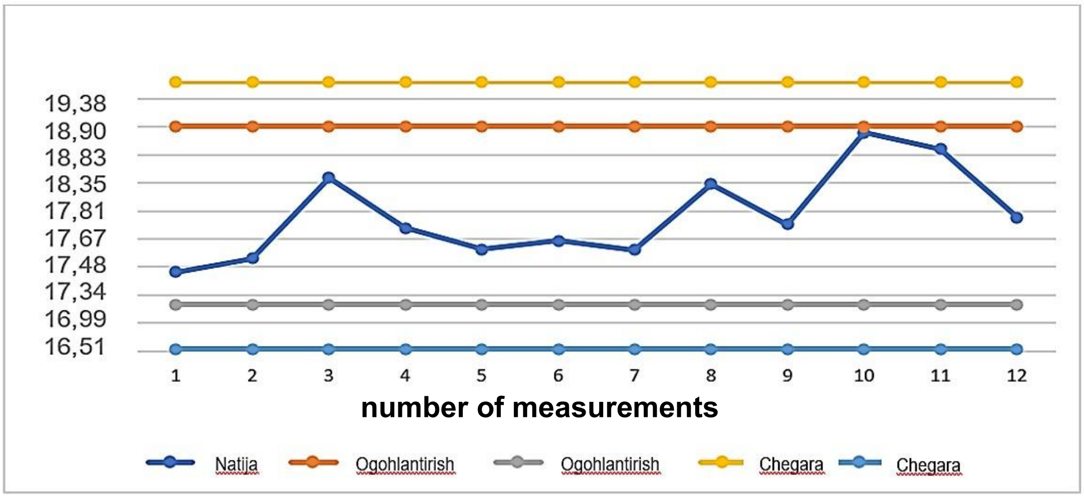
where, P - force degrading the quality of the sample, [N], a - height of the sample asphalt concrete, [cm], b - width of the sample asphalt concrete, [cm], Rsj
- compressive strength of asphalt concrete;
To determine our measurement results and the discrepancy between the standards specified in the standard requirements, the standard deviation is determined by the following expression:
u (x̅) = Sx̅= √n (n 1 −1) · · (xi − x̅) 2 n i=1 where, n - number of measurements, xi
- measurement result, x̅ - arithmetic mean of the measurement result.
between our measurement results and the norms established by the standard requirements

Table 9

Khsr	Xcp	Measurement result	Xsr+2S	Xsr-2S	Xsr+3S	Xsr-3S
1.	17.94	17.34	18.9	16.99	19.38	16.51
		17.48	18.9	16.99	19.38	16.51
		18.35	18.9	16.99	19.38	16.51
2.		17.81	18.9	16.99	19.38	16.51
		17.58	18.9	16.99	19.38	16.51
		17.67	18.9	16.99	19.38	16.51
3.	C	17.57	18.9	16.99	19.38	16.51
	0.48	18.28	18.9	16.99	19.38	16.51
		17.85	18.9	16.99	19.38	16.51
		18.83	18.9	16.99	19.38	16.51
		18.65	18.9	16.99	19.38	16.51
		17.92	18.9	16.99	19.38	16.51



4-Graph of compliance of the measurement result with the requirements of the standard.

As can be seen from this graph, high-quality asphalt concrete structures can be built as a result of the application of standards in the testing process, ensuring the use of products in the construction process in their quality state. Therefore, conducting inspections of industrial enterprises and manufactured products according to standards ensures high quality indicators.

Conclusion

The research results showed that Cement concrete (or Modified Asphalt Concrete) is the longest-lasting and most stable solution in the conditions of Uzbekistan due to high-temperature deformation and environmental load, although asphalt concrete is advantageous due to its low initial cost and ease of rapid laying.

To improve the operational quality of asphalt concrete, the introduction of foreign technologies such as PMB and SMA, and the use of WMA (Warm Mixtures) in repairs, is important in reducing the environmental burden. If longevity and heavy loading are priorities, it is necessary to switch to Cement concrete roads with HPC and Whitetopping technologies.

Laboratory tests confirmed that strict compliance with GOST 12801-96 standards ensures high quality indicators of building materials and guarantees the strength of the asphalt concrete structures being built.

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