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AUTHOR(S)	Iryna Mirchuk, Oleksandr Fedorenko
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REQUIREMENTS FOR METHYL METHACRYLATE-BASED MIXTURES: APPROACHES TO QUALITY ASSURANCE

Iryna Mirchuk
Oleksandr Fedorenko

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ABSTRACT

The article presents the requirements for polymer mixtures made on the f methyl methacrylate for the arrangement of thin-layer pavements of the deck. The pavement on bridges is an important structural element of the re, the condition of which affects the overall safety of the entire structure Given the constant increase in traffic volume and the load on the street k, materials that guarantee reliable operation of the roadway of bridge res should be used to increase the durability of road surfaces.

Road pavement is a key structural element for ensuring the safety and comfort of vehicular traffic, in particular due to its flatness, low noise level and roughness, which guarantees the proper coefficient of adhesion to the tires of vehicles while driving. However, it should be noted that during operation, such a coating is easily exposed to negative factors that lead to its premature deformation.

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Introduction.

In today's environment of intensive development of transport infrastructure, special importance is attached to the use of materials capable of ensuring the durability and reliability of road and bridge pavements. One of these materials is methyl methacrylate-based mixtures, which are becoming increasingly popular due to their exceptional performance properties. Methyl methacrylate mixtures provide high wear resistance, chemical resistance, fast curing and the ability to be used in various climatic zones. They also demonstrate excellent adhesion to various types of surfaces, which makes them particularly valuable for repairing and overlaying bridges and other complex structures.

However, in order to maximize the potential of methyl methacrylate-based materials, it is necessary to comply with the requirements for the quality of the initial components and the technology of manufacturing mixtures. Inadequate quality of raw materials or violations of technological processes can lead to deterioration of the coating's performance, its premature wear and the need for frequent repairs.

Presentation of the main material.

The design of the bridge deck on bridges must ensure both safe traffic and ensure the design service life and be maintainable.

Thin roadway pavements (10-20 mm) can be used in bridge reconstruction and are usually made on the basis of epoxy asphalts or methacrylates, or other materials, with a design life of 15 years or more.

In terms of its physical and mechanical properties, a thin-layer pavement must be sufficiently resilient and elastic, resistant to deformation from moving dynamic and vibration loads, and at the same time have high strength and wear resistance with a coefficient of adhesion to tires that ensures safe traffic on the bridge carriageway.

The thin-layer coating should be resistant to climatic factors (temperature fluctuations corresponding to climatic zones - from absolute minimum to absolute maximum, determined on the basis of long-term observations in the construction area; humidity and aggressiveness of the air environment; ultraviolet radiation), as well as to aggressive solutions of salts, acids, alkalis, and oil products.

To ensure the durability of the pavement on bridges, requirements have been established for polymer mixtures made on the basis of methyl methacrylate for the construction of thin-layer coatings of the bridge deck.

1.1. Requirements for polymeric binder.

To manufacture a polymer mixture based on methyl methacrylate for bridge pavement, it is necessary to use a polymer binder based on synthetic methyl methacrylate ether resin in accordance with the requirements of regulatory documents [1-3].

The catalyst is added immediately before using the polymer binder in accordance with the requirements [2].

To cure methyl methacrylate, a system consisting of technical dimethylaniline and benzoyl peroxide is used.

To accelerate the curing process of the polymer binder, cobalt naphthenate may be used in accordance with the requirements of regulatory documents.

To reduce the volatility of methyl methacrylate, petroleum paraffin should be used in accordance with the requirements of [4].

Emulsion polystyrene should be used to stabilize the curing reaction of a methyl methacrylate-based polymer binder.

As a plasticizing additive, use: catapine and/or alkamone and/or melamine-formaldehyde resins in accordance with the requirements of regulatory documents. When using melamine-formaldehyde resin, its amount should be from 0.5% to 1% by weight of the monomer.

Other hardeners, catalysts, plasticizers and accelerators that meet the requirements of regulatory documents may be used. Before use, it is necessary to check the compliance of the components with regulatory requirements and their compatibility with each other.

1.2. Requirements for aggregates.

In the production of a polymer mixture based on methyl methacrylate for a bridge pavement, andesite powder, quartz powder, marshmallow, diabase, and graphite powder are used as fillers in accordance with [5-7].

Before use, it is necessary to check the compliance of the components with the requirements of regulatory documents.

The moisture content of the fillers should not exceed 0.1%. The acid resistance of the fillers should be at least 98 %.

1.3 Requirements for fine aggregate.

In the process of producing a polymer mixture based on methyl methacrylate for bridge pavement, fine aggregates are used in accordance with [8,9] and Table 1.

The fine aggregate of the polymer mixture based on methyl methacrylate and the material for the layer that improves adhesion properties should have a Mohs hardness of at least 6 and consist of one or more materials, such as quartz, basalt, bauxite, corundum, crushed porphyry, aluminum oxide, or other similar hard and durable materials, the combination of which meets the requirements of Table 1.

Table 1. Properties of fine aggregate and layer material for improving adhesion properties.

Name of indicators	Requirements.
Grade of the source rock by crushability, not lower than	1000
Content of clay and dust particles, % by weight, not more than	0,1
Note. The content of clay particles in fine aggregate should be determined by the swelling method in accordance with DSTU B V.2.7-210.	

Sand should be used as a fine aggregate according to [33], quartz-iron sand and fine fraction for construction works from waste of mining and processing plants of Ukraine according to [10], sand from slag of ferrous and non-ferrous metallurgy according to [11], sand from rock crushing screenings of mining and processing plants of Ukraine according to [12], perlite swollen sand according to [13], sand from porous rocks according to [14], lightweight aggregates according to [15], artificial fine aggregate from sedimentary rock crushing screenings is prohibited.

It is forbidden to use fine aggregate containing carbonates (chalk, marble, limestone), binders (bitumen, lime, cement) and metal dust (steel, zinc).

The particle size distribution of fine aggregate in a polymer mixture based on methyl methacrylate should meet the requirements of Table 2.

Table 2. Particle size distribution of fine aggregate.

View	Content by weight, % of mineral grains smaller than a given size, mm						
	5	2,5	1,25	0,63	0,315	0,14	0,071
П	100	75 — 30	5 — 0	1 — 0	0	0	0
Т	100	100	75 — 51	50 — 14	25 — 0	2 — 0	0

1.4 Requirements for a polymer mixture based on methyl methacrylate.

Indicators of physical and technical properties of the cured polymer mixture based on methyl methacrylate for the bridge pavement should meet the requirements of Table 3.

Table 3. Requirements for the physical and technical properties of a polymer mixture based on methyl methacrylate and the cured material from it.

	Name of indicators	Normative values of indicators	Test method
1	Curing time, h, at temperature 32 °C, no more than 24 °C, no more than 16 °C and below, no more than	 2 3 4	DSTU B V.2.7-187
2	Density, г/см^3	1,9 — 2,4	DSTU B V.2.7-170
3	Water saturation, % by weight, not more than	0,5	DSTU B V.2.7-170
4	Bending tensile strength, after 24 h, MPa, not less than	1,7	DSTU B V.2.7-187
5	Compressive strength, after 24 h, MPa, at a temperature not less than: 0 °C, 20 °C, 50 °C,	 24,0 20,0 12,0	DSTU B V.2.7-187
6	Adhesion strength to the substrate, MPa, not less than — concrete, reinforced concrete — steel	 1,5 2,1	DSTU B GOST 28574, DSTU ISO 4624
	Frost resistance, cycles, not less than	300	DSTU B V.2.7-47, DSTU B V.2.7-49
7	Marks for water resistance, not less than	W12	DSTU B V.2.7-170
8	Adhesion coefficient according to DSTU 3587, not less than	0,45	DSTU 8746
9	Chemical resistance - resistance to acidic, alkaline, salt solutions and oil products	Resistant	DSTU ISO/TR 7620

In addition, material quality control is key to ensuring the durability, safety and effectiveness of thin-layer coatings on bridges, for a number of reasons:

- high-quality materials guarantee the durability of the coating, which minimizes the risk of premature damage such as cracks or plastic deformation;
- Thin-layer coatings on bridges often have the function of waterproofing and protecting metal and concrete elements from corrosion and destruction;
- the use of low-quality or inappropriate materials can lead to rapid wear of the coating and the need for frequent repairs, which increases the cost of maintaining structures;
- high-quality pavements provide good adhesion of car tires to the road, which is critical for safety, especially on bridges.

In view of the above, the article presents the requirements for quality control methods for methyl methacrylate-based compounds, namely:

✓ before testing, each sample of the polymer mixture based on methyl methacrylate is thoroughly mixed;

✓ the weight of the sample of the polymer mixture based on methyl methacrylate is determined to the nearest 0.1 g;

✓ measuring instruments, equipment and auxiliary devices used to control the requirements for the quality of materials in accordance with Section 6 shall be verified, certified or calibrated in accordance with the established procedure in accordance with regulatory or technical documentation;

✓ the temperature of the premises in which the tests are carried out shall be (20 ± 5) °C;

✓ materials for the production of methyl methacrylate-based polymer compounds shall be tested in accordance with the requirements of standards and specifications for these materials;

✓ resins, hardeners, and accelerators are tested in accordance with [16-19] and other regulatory documents, as well as [2];

✓ aggregate is tested in accordance with [5-7];

✓ fine aggregate is tested in accordance with [20];

✓ the temperature of the cured polymer mixture based on methyl methacrylate during the test should be (20 ± 2) °C;

✓ samples of the cured polymer mixture based on methyl methacrylate and mineral materials should be stored at a temperature of (20 ± 5) °C;

✓ the quality control of the polymer mixture based on methyl methacrylate and the cured material is carried out in accordance with the requirements of Table 3;

✓ before using a polymer mixture based on methyl methacrylate, control samples are made to be used to check compliance with the requirements of Table 3.

✓ samples of the polymer mixture based on methyl methacrylate are taken in accordance with

✓ [21];

✓ in laboratory conditions, samples of the polymer mixture based on methyl methacrylate are made in standard rectangular or cube shapes in accordance with

✓ [22];

✓ the viability of the methyl methacrylate-based polymer mixture is determined by visual inspection at a temperature of 23 °C. The time starts from the moment the methyl methacrylate resin is mixed with the catalyst and the methyl methacrylate polymer mixture loses its plasticity (gel-like state) as a result of too high a viscosity and deterioration of adhesion to the substrate;

✓ samples of the cured polymer mixture based on methyl methacrylate are tested in accordance with [23-29];

✓ quality control of the adhesion strength of the pavement of the cured polymer mixture based on methyl methacrylate with the base is carried out in accordance with [30-32].

Conclusions.

As a result of the analysis of the requirements for methyl methacrylate-based mixtures, several important conclusions can be drawn that emphasize the importance of these materials in modern road construction. Methyl methacrylate mixtures demonstrate exceptional performance characteristics, such as fast curing, high wear resistance, resistance to aggressive environments and excellent adhesion to various surfaces. This makes them ideal for use in conditions requiring increased strength and durability, in particular on bridges and road surfaces subject to heavy loads.

In general, methyl methacrylate-based mixtures have great potential in the road construction industry, and their proper use can significantly improve the quality and durability of pavements, which

in turn will increase road safety and comfort. It is important that in the future, road construction professionals, engineers and scientists work together to develop and implement new standards and practices that will ensure a high level of quality and reliability of methyl methacrylate-based pavements.

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