

USE OF MODIFIED BITUMEN ROAD EMULSION IN THE CONSTRUCTION AND REPAIR OF ROADS

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Annotation: This article highlights the effectiveness of using modified bituminous road emulsions in the construction and repair of roads, their physicochemical properties, and practical significance. Ways to improve the composition of bitumen emulsions by physicochemical modification, as well as the influence of polymer additives on the adhesion and elastic properties of bitumen, were studied. Based on the research results, it has been proven that the use of modified emulsions increases the service life of road surfaces and provides economic efficiency.

Keywords: bitumen emulsion, modification, polymer, road surface, surfactant, repair, adhesion, dispersion.

In recent years, the use of environmentally safe, energy-efficient, and effective binding materials in the construction and repair of roads has become a pressing issue. Among them, bitumen emulsions are distinguished by their favorable technological properties and the possibility of application at low temperatures. However, the heat resistance, water resistance, and elasticity of ordinary bitumen emulsions are insufficient. Therefore, their modification, i.e., improvement of quality indicators through physicochemical transformation, is an urgent direction.

Bitumen emulsion is a stable finely dispersed suspension of bitumen in an aqueous medium using a surfactant (SFM), which is widely used in road construction: in the preparation of cold mixtures, surface strengthening, repair of asphalt concrete pavements, and chip-seal technologies. The use of emulsions allows saving up to 30-40% of thermal energy, reducing harmful gas emissions, and carrying out repair work without stopping traffic. Modified bitumen is a mixture with the addition of polymers, latexes, rubber powders, or mineral additives to the composition of the main binder (bitumen), which increases the bitumen's heat resistance, elasticity, water resistance, and adhesion properties. One of the most effective modifiers is the styrene-butadiene-styrene (SBS) polymer, which makes bitumen resistant to deformation at high and low temperatures. Also, the use of cationic surfactants increases the stability of the emulsion.

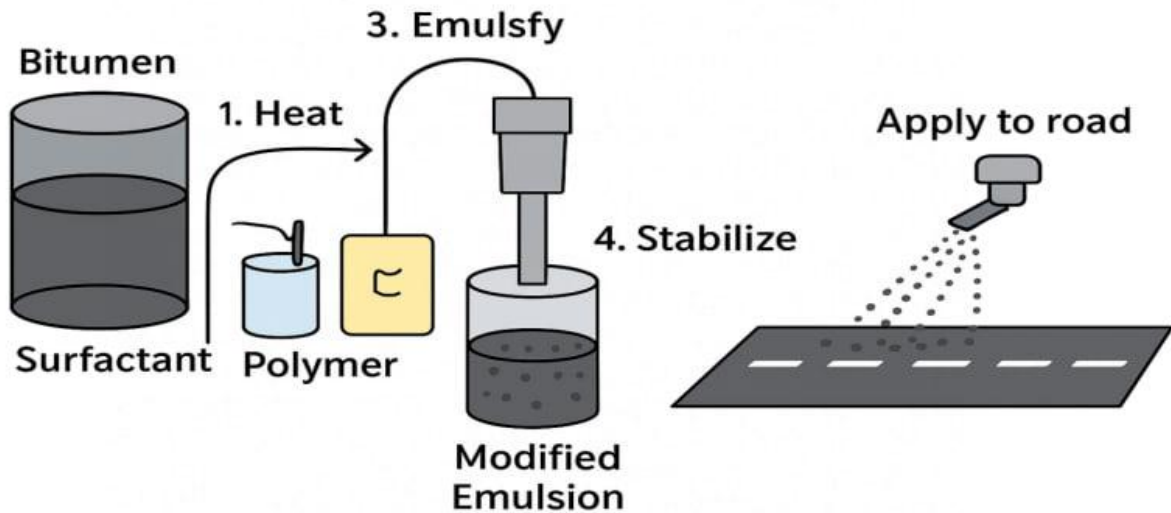


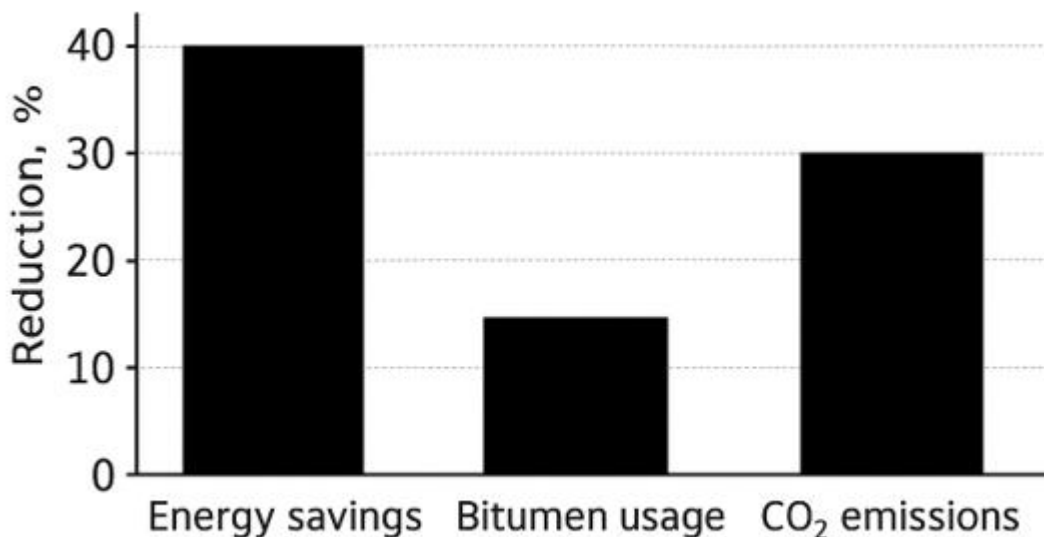
Figure 1. Emulsion modification process

The main stages in the preparation of bitumen emulsion are:

1. Heating bitumen to 120-140°C.
- Preparation of a surfactant solution (1-2% surfactant is dissolved in water).
- Emulsification using an emulsifier at a speed of 4000-6000 rpm.
4. Add the polymer (SBS, EVA or latex) in an amount of 2-4%.
- Stabilization of the obtained emulsion for 24 hours.

As a result, stable emulsions with a high adhesion index with fine dispersed particles (0.5-10 μm) are obtained.

Graph 1. Economic and environmental effectiveness of the modified emulsion



Research results

Laboratory tests showed that the viscosity of the modified bitumen emulsion increased by 25-30%; water resistance increased by 1.4 times; the degree of adhesion of the coating surface reached 95%; and the service life increased by 1.5-2 times. These results increase the strength and deformation resistance of the road surface, especially effective in regions with humid and cold climates.

As a result of the application of modified emulsions:

- in road construction, bitumen consumption is reduced by 10-15%;
- energy savings (low heating temperature);
- the amount of CO₂ released into the atmosphere decreases;
- improves environmental safety and working conditions.

There is also the possibility of using local raw materials, which is an import-substituting technology.

Conclusion

The research results show that bitumen emulsions obtained by physicochemical modification have high efficiency in the construction and repair of roads and have a number of advantages over traditional bitumen-based mixtures. Polymers and surfactants used in modified emulsions stabilize the dispersed state of bitumen, reduce its viscosity, and increase its resistance to temperature. This ensures the use of the emulsion in various climatic conditions.

As a result of the use of such emulsions in construction practice:

- the service life of road surfaces increases by an average of 30-50%;
- the temperature of preparation and laying of asphalt mixtures decreases to 100-120°C;
- bitumen consumption is reduced by 10-15%, and energy consumption by 35-45%;
- CO₂ emissions into the atmosphere decrease by 30-40%.

These indicators prove the economic advantage of bitumen-emulsion technology. In particular, the possibility of using modified emulsions using cold and semi-hot methods reduces the seasonal limitations of road repair work and makes the technological process environmentally safe.

Also, modified emulsions:

- increases the water resistance of the road surface;
- improves interlayer adhesion;
- increases the resistance to transport loads;
- can be effectively used in recycling technologies.

In general, the use of modified bitumen emulsions allows saving resources in the field of road construction and repair, reducing the environmental burden, and improving the operational indicators of the road network. This technology will serve as an important factor in the development of sustainable, economically beneficial, and

environmentally safe road infrastructure in the future in the conditions of Uzbekistan.

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