

Reducing environmental risks in the construction of roads from asphalt concrete

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Abstract. Roads, like a spider web, intertwine our world up and down, and every day people build hundreds of kilometers of roadway, sometimes without even thinking about the environmental friendliness of road construction methods. The urgency of the problem of dirty road construction should not raise questions in our time, and especially in the Russian state. The article highlights the issue of reducing the risks of environmental pollution during the construction of the road network, the issue of green building is touched upon. Focal points are highlighted, which are worth paying attention to during the preparation of documentation to reduce the risks of environmental pollution. As a result, conclusions were drawn on the list of materials that should be used in order to reduce the impact on the environment.

1 Introduction

The concept of "environmental safety", which (in a broad sense) characterizes the state of protection of the natural and social environment from certain influences, in the last 30 years has become increasingly widespread in the construction industry. According to [1], the term "environmental safety of a motor road" (hereinafter EB AD) includes the protection of nature and society from the impact of a motor road at all stages of its life cycle: construction, reconstruction, operation, maintenance and repair. In this case, the criterion for environmental safety is the acceptable quantitative values of sanitary and hygienic standards or the compliance of environmental parameters with the framework of background values for a particular area. The fulfillment of these conditions ensures the stability of natural ecosystems in the territories adjacent to the road transport system for an indefinitely long time.

The consistency of the concept of "environmental safety of the motorway" requires the identification and comprehension of all its subsystems and their constituent components; identifying quantitative and qualitative parameters for their assessment; justified restrictive values (maximum permissible concentrations, exposure levels, etc.); clear goal-setting and definition of functions. On this basis, both cross-sectoral integration and a coordinated, internally consistent set of measures, methods, and documents (regulatory, technical) should be formed that are designed to ensure the effectiveness of environmental and

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resource-saving measures. All design decisions (from organizational and managerial to technological and economic levels) should be based not only on compliance with environmental legislation, but also on innovations directly or indirectly related to resource and energy conservation and rational use of natural resources.

Attention to improving environmental safety in the construction and operation of highways is explained by the exacerbation of the environmental crisis, globalization processes, and the inclusion of our country in the pan-European environmental programs, which required updating the content of the regulatory framework in the field of environmental legislation of the Russian Federation. In this context, in the sectoral road methodological document "Environmental safety of the road: concept and quantitative assessment" [1], detailed recommendations are given regarding the performance of work on the construction, repair, operation of roads, the planning and implementation of measures aimed at ensuring environmental safety and minimizing negative impact on the environment. Greening concerns all stages of construction of an AD: surveys, design, procurement and transport works, construction and installation works, control and testing activities.

To characterize the directions of increasing the AD, let us single out two subsystems of sources of environmental hazard: a) road transport and b) vehicles. The first includes motor roads of various types (asphalt concrete, cement concrete, gravel), the second - cars and heavy vehicles. Both subsystems have a long-term or short-term effect (depending on a large number of external factors and their combination) on environmental objects. Engineering structures such as roadbed, overpasses, bridge crossings, drainage and culverts, as well as the condition of the sides of the AD, various road infrastructure objects (gas stations, stopping complexes, etc.) affect the condition of the soil, the quality of the atmospheric air, cleanliness of water bodies located in the zone of their influence. This article focuses on the first subsystem.

2 Materials and Methods

The set of environmentally friendly measures for road construction, according to the current regulatory documentation, includes:

- reduction of the allotted land areas (with the maximum saving of agricultural land);
- reduction of the amount of natural resources used in construction (soil and ground, forest, mineral materials, etc.);
- preservation of the fertile soil layer and land reclamation;
- observance of conditions that do not allow exceeding the maximum permissible concentrations of pollutants in air, water, soil; ensuring the noise level not exceeding the maximum permissible values;
- elimination of the possibility of the emergence and development as a result of road construction activities or the functioning of road transport objects of the processes of erosion, waterlogging and drainage of soils, the appearance of landslides;
- prevention of actions, the consequence of which is the deterioration of the living conditions of people, animals and plants;
- avoidance of causing aesthetic, historical and architectural damage to the existing landscape;
- Preventing accidents and reducing the severity of their consequences, including environmental ones, for example, those associated with accidents accompanied by oil spills and fires.

The importance of taking into account the listed aspects of road construction is noted in many publications, including works [1–6].

Strict observance of measures aimed at improving the environmental safety of the AB is of particular importance in the conditions of Western Siberia, which is associated with regional extreme natural and climatic factors. Road maintenance in winter conditions imposes additional responsibilities on road transport organizations [7]. The number of road accidents depends on their implementation. In this regard, it is necessary to note attention to the problem of reducing accidents, which is especially highlighted in the national project “Safe and High-Quality Roads”, according to which it is planned to reduce the number of hazardous areas to 50% by 2024, up to 4 people for 100 thousand. population the number of deaths in road accidents.

Analysis and generalization of scientific and technical literature on the problem under consideration allows the authors to conclude that the management and regulation of environmental activities in the road and economic sphere is reduced mainly to the implementation of environmental-oriented activities, in a generalized form presented on figure. The high quality of blood pressure (and the environmental safety directly related to it) is achieved through the systemic integration of all components of the life cycle.

Separate issues within the framework of the concept “Eco-friendly high quality road” (figure 1) that we are considering are devoted to publications [8-10], highlighting the issues of resource conservation and environmental protection, relevant for Russia and other countries. Unfortunately, most of the developments of scientists are not widely used in Russian road construction practice, remaining at the level of research and development work, often on a regional scale. It is necessary to make greater use of available effective technologies of domestic and foreign enterprises, positive experience of work in similar geoecological conditions.



Fig. 1. Environmental-friendly geogrid in road construction.

One of the ways to reduce the anthropogenic load on the natural environment is the creation of new “green” technologies [11].

“Green” technologies in road construction, in our opinion, can be called those in which production and consumption wastes are utilized and at the same time - due to the high quality of the obtained road infrastructure - the time and material resources required to maintain blood pressure are reduced. in proper condition during operation. The implementation of “green” technologies will make it possible, using foreign and domestic experience, to successfully implement the national project “Safe and high-quality highways”. Of greatest interest are:

- development of ways to increase the stability of asphalt concrete pavements [12, 13];

- study of the possibilities of using waste from local industrial enterprises (for example, still residues of the chemical industry) for modifying road bitumen [14];
- replacement of natural stone materials for the upper and lower layers of the AD coatings with stone crushing waste [15];
- use of waste plastics instead of expensive polymer modifiers [16–18].

The mentioned literary sources [12–18] reflect the variety of research works on the greening of road construction. Let us dwell on only some of them in detail.

Scientific and technical literature on reducing the cost of construction and increasing the reliability and durability of highways due to the use of large-scale industrial waste in the construction of engineering structures is quite extensive. Recycling, but not landfill storage, landfilling or incineration of waste consisting of polymeric materials is an environmentally sound and cost effective solution. At the same time, it is possible to preserve natural raw materials, stimulate the development of waste-free, resource-saving technologies, vacate landfill areas, and improve environmental components. So, to improve the characteristics of a road binder, it is proposed to use pretreated rubber crumb from old car tires, to involve polymer waste in the process of producing asphalt concrete mixtures, which until now are not sufficiently utilized, accumulating at unauthorized dumps and landfills. [19-22]. The authors of this work, on the basis of many years of research [17–19], have developed a technology for dispersed reinforcement of an asphalt concrete mixture using polymer fibers. At the same time, a solution to environmental and technical problems is achieved: the disposal of waste of artificial fibers and plastics and, at the same time, an increase in the durability and reliability of the road surface. In accordance with the author's technical solution [19], the traditional technological scheme for the production of asphalt concrete is equipped with an additional workshop (section) that provides the introduction of fibrous materials into the mass of asphalt concrete, creating the effect of reinforcement and imparting shear resistance and crack resistance to a road surface made of modified asphalt concrete mixture. A distinctive feature of the development is the strengthening of the pavement structure throughout the entire volume, and not within a small layer (as, for example, when using geotextiles and geogrids).



Fig. 2. Violation of the natural regime of the reservoir.

ODM 218.3.087–2017 “Recommendations for the use of asphalt-concrete mixtures based on metallurgical slag materials for the conditions of the Central Federal District” substantiates the involvement of slag materials in the process of producing asphalt concrete. These include granulated blast-furnace slags, slag and cinder pum sands, cupola slags, the use of which helps to save natural raw materials when creating road surfaces.

3 Results

Based on the analysis of scientific publications, oral reports and speeches, information on the progress of the implementation of the national project "Safe and High-Quality Automobile Roads" on professionally oriented sites, the authors compiled a table in which the main reasons for the fragility of the roadway are systematized and analyzed. Negative consequences and proposed methods for suppressing the influence of factors that reduce the durability of the AD sheet.

The carried out assessment shows the complexity and multidimensionality of the problem of road durability. Turning again to the materials of the national project "Safe and high-quality highways", we note its relevance and the interest of a wide range of Russians (representatives of government, business, society) in the strict fulfillment of the tasks set in it.

Unfortunately, while in our country there are roadmaps in "green" construction, there is still no understanding of the need to develop "green" road construction.

4 Discussions

No federal program has been created to support "green" road construction, no system of incentives has been developed for organizations willing to implement innovative "green" projects, as a result of which they are practically not applied. The population, environmental organizations (state and public), as well as progressive construction firms are interested in the implementation of the state program to support green road construction technologies, but investors and contractors do not yet understand the importance of environmental orientation at a deep level. The main reasons are the perception that the construction and operation of a "green" road is 20-50% more expensive than a conventional one; unwillingness to complicate the technological process; and underdevelopment of a publicly available data bank on waste suitable for utilization in road construction (their types, quantities, suppliers, etc.). There are certainly prospects for the development of "green" road construction technologies. Let with a delay, in comparison with environmentally oriented countries, "green" urban planning is confidently gaining its positions. Examples of this are the buildings of the Sochi Olympics, the World Cup, Skolkovo. There are still few technologies for "green" road construction, only some foreign samples can be adapted to Russian conditions, in particular [20, 23].

Undoubtedly, there is a problem of lack of specialists who are able to design and build an AD taking into account environmental technologies. Obviously, it is necessary to improve curricula and educational programs, as well as a constant exchange of experience between builders from different countries.

5 Conclusions

In conclusion, we note that over the past 20 years, business structures in Russia have shown an interest (albeit weak) of business in the construction of high-quality environmentally friendly roads. However, its implementation is slowed down for a number of reasons, and most importantly, because of the lack of a systematic approach to this problem. It is necessary to improve the current legislation; government efforts to ensure cooperation between suppliers and waste recyclers, between representatives of large, medium and small businesses, a coordinating role and government subsidies to subsidize unprofitable technological stages; business motivation through tax relief; creation of programs to ensure

environmental safety when handling waste intended for processing as components of road building materials.

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