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Analysis of Environmental Compliance Violations on Roads Causing Threats of Occurrence of Emergencies

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ABSTRACT

The relevance of environmental safety problems in the process of reconstruction, repair, and maintenance of public roads is predetermined by the presence of many transport accidents, as well as dangerous events with extremely negative environmental and socio-economic consequences for safety and well-being of the population.

The objective of the study is to determine the parameters of environmentally safe operations during reconstruction, repair, and operation of roads. The main purposes of the work focused on a comprehensive survey of work sites on public roads; assessment of compliance with environmental safety requirements when carrying out various types of operations; analysis of violations of environmental laws, of causes, conditions for their occurrence, potential threats of occurrence of man-made emergency situations following violation of environmental compliance; development of a set of measures to ensure respect of environmental safety requirements, prevent emergency situations and their dangerous consequences for the environment and life safety of the population.

The study has resulted in a list of measures substantiated as a result of an analysis of the environmental situation and intended to ensure environmental safety requirements during repair, reconstruction, and maintenance of roads.

The results of the work were reported on August 29, 2023, in Vologda at the scientific section of the theoretical part of the annual Federal road agency's exercises to ensure transport safety and prevent emergency situations.

Keywords: environmental safety, transport accidents, roads, highways, repairs, maintenance, emergency situations.

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INTRODUCTION

Ensuring the environmental safety of the transport system and of road transport infrastructure is of paramount importance for ensuring sustainable socio-economic development of the country.

The national importance of these issues is reflected in the National Security Strategy of the Russian Federation, the Transport Strategy of the Russian Federation until 2030 with a forecast for the period until 2035, and the Environmental Safety Strategy of Russia for the period until 2025.

Road transport and road infrastructure serve as a massive source of negative impact on the environment. The problems of pollution of the natural environment with industrial and municipal waste, untreated wastewater, emissions of various aerosols of solid particles, and gaseous compounds into the atmospheric air deserve the closest attention.

To comprehensively study the state of activities in the field of monitoring and forecasting man-made emergency situations with adverse environmental consequences, compliance with environmental safety requirements during repair and operation of public roads, in the summer of 2023, on-site interdepartmental activities were carried out to examine the state of environmental safety of road reconstruction, operation and repair facilities, stocks of road equipment and storage of materials, to prevent accidents and emergencies of an environmental nature, their adverse consequences for the life of the population, economic entities, environment.

Based on the results of a field study of the state of environmental safety on public roads, the question arose about the relevance of developing a set of measures to prevent possible man-made emergencies caused by environmental threats due to violations of environmental and sanitary requirements, norms, and rules during reconstruction, repair and maintenance of facilities of road transport infrastructure, and that is the *objective* of the study.

MATERIALS AND METHODS OF RESEARCH

The materials for the research included published works of scientists, specialists, and researchers in the field of environmental safety in transport industry [1–5], transport safety, prevention of transport accidents and of related man-made emergencies, analysis of environmental violations during reconstruction, repair, and operation of highways [6–10], the results of our own research in the field of ensuring environmental safety and environmental protection in transport sector, resource saving, safe handling of waste and secondary resources in transport and other enterprises [11–15].

The concept of this study is based on the priority directions of state policy in the field of waste management, as well as of monitoring, forecasting, prevention and timely response to emergencies of a natural and man-made nature, principles generally accepted in the world community, i.e., Zero waste and Circular Economy [16–20].

The research *methodology* includes system analysis, statistical processing of data on the environmental situation of transport facilities obtained as a result of systematisation and generalisation.

RESULTS

At the first stage of the study, materials from comprehensive surveys of reconstruction, repair, and operation sites of highways, obtained during the survey using a specially developed form, were summarised and systematised (Table 1).

After systematising and summarising the materials from the survey of road transport infrastructure, the authors carried out an analysis of violations of the requirements of environmental laws during operations on highways leading to dangerous accidents, man-made emergencies (based on collection and systematisation of data on repair and operation of road transport infrastructure and maintenance of auxiliary objects).

During the event, a number of environmental violations were identified, primarily those, characteristic of operation of road equipment parking sites, storage of materials and structures, and mini-towns for repair and maintenance personnel. Most of these types of facilities are operated by contractors who carry out various types of repairs and maintenance of road transport infrastructure.

Most of these violations (separately or in combination), in case of unfavourable weather

Table 1

Form for survey of facilities regarding compliance with requirements of sanitary and environmental laws (fragment)

Contents of the requirement
1. Hazardous waste management
Accumulation of waste is allowed only in places (sites) of waste accumulation that meet the requirements of legislation in the field of sanitary and epidemiological welfare of the population and the laws of the Russian Federation.
Special sites for temporary storage, accumulation of materials, raw materials, semi-finished products, waste are embanked, equipped with anti-filtration screens, protective waterproofing, have a fence around the perimeter of the site, are located outside the drainage areas of surface and underground water bodies, land plots covered with a soil vegetation layer.
Storage of bulk and volatile materials, substances, waste is not allowed in open form (in bulk) in premises, on construction sites without the use of dust suppression agents.
Loading and unloading of liquid raw materials and materials is carried out through closed paths using gravity flow and pumps. Storage, movement of bulk materials, waste is carried out in securely closed, moisture-proof, chemical-resistant bags. The process of filling containers, collectors, measuring vessels with toxic liquids is equipped with alarm systems about the maximum permissible level of their filling, monitoring their content using level meters.
Cleaning and washing of contaminated containers and vehicle wheels are carried out at sites specially equipped with a system for collecting contaminated wastewater with its subsequent treatment and with storm drainage.
It is prohibited: dumping of production and consumption waste, including radioactive waste, into surface and underground water bodies, into drainage areas, into the subsoil and onto the soil.
Organisation of waste transportation is carried out under the following conditions: availability of a waste passport of I–IV hazard class; availability of documentation for transportation and transfer of waste, drawn up in accordance with the rules for transportation of goods, indicating the amount of transported waste, the purpose and destination of their transportation; compliance with safety requirements for transporting waste by vehicles; the presence on vehicles, containers, tanks used for transporting waste, of special distinctive signs indicating a certain hazard class of waste.
2. Water conservation
Within the boundaries of water protection zones the following is prohibited: – placement of production and consumption waste disposal facilities, chemical, toxic, poisonous substances; – movement and parking of vehicles, with the exception of their movement on roads and parking on roads and in specially equipped places with hard surfaces; – construction and reconstruction of gas stations, warehouses for fuel and lubricants, service stations used for technical inspection and repair of vehicles, washing vehicles; – discharge of wastewater, including drainage water.
Discharge of production and consumption waste into water bodies and burial therein is prohibited.
Within the boundaries of flood zones, flooding are prohibited: 1) construction of capital construction projects that are not provided with structures and (or) methods of engineering protection of territories and objects from the negative effects of water; 3) placement of production and consumption waste disposal facilities, chemical, explosive, toxic substances.
3. Protection of land resources
Owners of land plots and persons who are not owners of land plots are mandatorily obliged to: carry out measures to protect lands, forests, water bodies and other natural resources, fire safety measures; prevent pollution, depletion, degradation, damage, destruction of lands and soils, and other negative impacts on lands and soils.

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conditions or other violations of the rules of operation and repair, can lead to the occurrence of man-made emergencies in the format falling under the criteria for classifying events as natural and man-made emergencies, approved by the Order of Ministry of the Russian Federation for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters (EMERCOM), dated 05.07.2021 No. 429 «On establishing criteria for information about emergency situations of a natural and man-made nature».

Some of the most common violations of environmental and sanitary requirements at reconstruction, repair, and maintenance sites of highways are:

– local littering of the territory with construction, industrial and municipal waste;

– contamination of land on the territory of the facility with oil products;

– repair of equipment in open areas with spills of oil products;

– storage of containers with used oils without a pallet in an open state on unpaved surfaces or on the soil cover;

– storage in an open area without embankment or shed of scrap metal, polymer products, components and parts contaminated with oil products, other chemical compounds, as well as removed contaminated asphalt concrete pavement in the form of lump residues, crumbs, dust.

The listed wastes are classified as hazard class 3–4, i.e., pose a danger to the environment if it enters with surface (storm, melt) wastewater along the slopes of the territory and through the system of drainage ditches, or under the influence of wind on the drainage areas of water bodies and on the soil cover.

No technical measures have been taken to embank the territory, organise collection and purification of surface wastewater to prevent contamination of the natural environment (soil cover, water bodies) with suspended substances, metal salts, organic compounds, oil products, and surfactants.

In these cases, there is a potential threat of exceeding the maximum permissible concentrations of hazard class 3–4 pollutants entering water bodies and soil with runoff by more than 50 times.

Environmental hazards may also occur in case of partial flooding of property areas during heavy rain or during spring floods as a result of active snow melting. If the MPC is exceeded, the unfavourable situation, in accordance with the criteria for classifying events as an emergency, is characterised as an emergency with release and discharge of pollutants into the environment at road and transport infrastructure facilities.

Other identified violations that pose a potential environmental hazard include:

– contamination of the vehicle washing station with solid sediment and oil products (film), irregular pumping of wash water;

– lack of wheel washing stations with waste collection and removal under contract or cleaning during repair work on roads;

– contamination of roadside drainage ditches;

– violation of the rules for separate collection and temporary accumulation of used motor oils, batteries, scrap metals, cut down and uprooted trees and shrubs, stumps, tree trunks, oily sand;

– – irregular waste removal, which contributes to overfilling of containers and contamination of facility areas;

– unsecured water drainage (stagnation of water, formation of local zones of water accumulation) during and after completion of repair work along the right of way,

– lack of data on studies of untreated surface wastewater entering watersheds and soil;

– storage of removed vegetation soil cover without taking technical measures to protect against spraying and leaching.

In a number of cases, on the border of the sanitary protection zone of the location of production bases for repair and operation of road equipment, temporary camps for repair workers, the grass stand exceeds 25 cm. Subject to hot weather, careless handling of fire and taking into account the presence of scattered flammable wood, polymer, cardboard and paper waste, insufficient insulation of warehouses of flammable materials, non-compliance with fire safety rules, local fire of objects is theoretically possible with the transition of an unfavourable fire situation into an emergency man-made one.

Explanatory work on prevention of emergency situations and their dangerous consequences for life and the environment with employees is not properly carried out. Based on the results of sociological surveys and analysis of regulatory and technical documentation, it was revealed that an environmental action plan had not been developed and was not communicated to employees, there is no sufficient understanding of either departmental environmental control, monitoring of natural and man-made emergencies, or production control in the field of waste management. There are no employees responsible for environmentally safe separate collection and isolated storage of hazardous production and consumption waste.

DISCUSSION AND CONCLUSIONS

Thus, the study revealed the prerequisites and causes for the occurrence of environmental hazards at sites of reconstruction, repair, and maintenance of public roads. Failure to take proper preventive measures to reduce them may lead to the occurrence of man-made emergencies.

To ensure the environmental safety of these technospheric territories, a set of organisational and technical measures is proposed.

1. Development of a comprehensive plan of environmental protective measures with a section on emergency prevention during waste management, as well as during operation of facilities associated with a negative impact on the environment, indicating deadlines and those responsible.

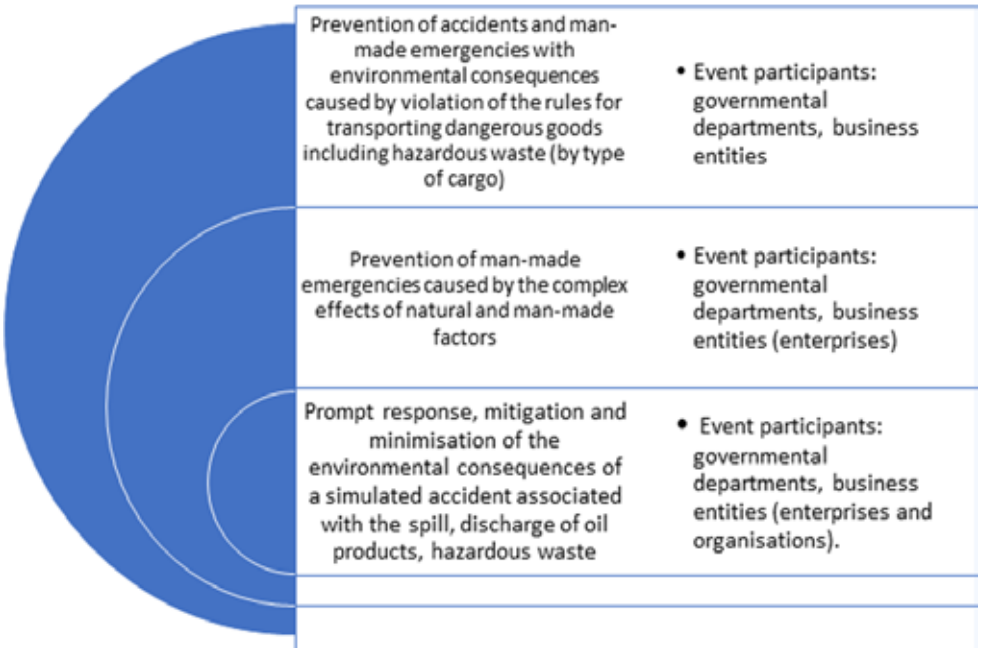
2. Analysis of the issue of draining contaminated surface runoff with subsequent treatment or accumulation in settling tanks with subsequent removal to special processing enterprises licensed to dispose these types of waste.

3. Organisation of a system of industrial environmental control and monitoring, including industrial control and monitoring of the management of hazardous waste from production and consumption.

4. Conduct of periodical independent environmental surveys of road transport infrastructure, considering potential environmental threats and transport accidents (summer – hot weather, summer-spring – heavy rains, spring – snowmelt, winter – slipperiness).

5. Development of appropriate recommendations on undertaking of specific sanitary and environmental measures in work projects, which are subject to control at the stages of construction, reconstruction, repair and, upon completion, at the stage of commissioning of facilities.

6. Analysis of the issue of consolidation and unification of the system of environmental requirements within the framework of the current environmental laws into a separate section of standardisation documents, methodological documents regulating the



Pic. 1. Proposed simulated situations while developing measures to prevent emergency situations on highways [performed by the authors].

processes of reconstruction, major and current repairs, and maintenance of road transport infrastructure facilities.

7. Involvement of research institutions into solving problems of ensuring environmental safety and preventing man-made emergencies.

As a proposal for development of intersectoral, interdepartmental cooperation in the field of preventing accidents and emergencies with dangerous environmental consequences on highways, it is considered appropriate to organise and conduct interdepartmental exercises on issues of ensuring environmental safety and preventing man-made emergencies with environmental consequences on highways.

As the main objectives of such exercises the most typical ones are identified that lead or can lead to accidents, man-made emergencies with dangerous socio-economic, environmental and other consequences (Pic. 1).

The first task being worked on is prevention of accidents and man-made emergencies with environmental consequences caused by violation of the rules for transportation of dangerous goods, including hazardous production and consumption waste, includes subtasks by type of transported goods:

a) oil products;

b) chemical hazardous liquid substances;

c) chemically hazardous gaseous compounds;

d) liquid toxic waste;

e) municipal solid waste;

f) construction waste;

g) bulk mineral waste;

h) waste of electronic and electrical equipment;

i) battery waste.

The implementation of the second task covers prevention of man-made emergencies caused by the complex effects of natural (hazardous hydrological and meteorological phenomena and processes: floods, inundations, flooding, strong winds, etc.) and man-made factors (violation of environmental and sanitary requirements for repair, maintenance, operation: pollution of territories of production and repair bases with chemicals, oil products, waste).

The fulfilment of these tasks, according to the authors, on the one hand, will help to increase the level of protection of the natural environment and the life of the population from environmental threats, on the other hand, will help strengthen interdepartmental, intersectoral, interregional interaction to resolve these pressing issues of our time.

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