Is it safe to transport dangerous goods by road?  
(Environmental safety associated with dangerous goods transportation by road)

A V Kuzmin¹, T Yu Freze²

¹Department of Industrial and Environmental Safety, Kazan National Research Technical University Named after A.N. Tupolev-KAI, 10, K. Marx St., Kazan 420111, Russia
²Department of Industrial and Ecological Safety, Federal State Budgetary Educational Institution of Higher Education Togliatti State University, 14, Belorusskaya St., Togliatti 445020, Russia

E-mail: avkuzmin16@gmail.com

Abstract. The article introduces a point of view on the following matter: the likelihood of occurrence of a road traffic accident, when a vehicle carrying dangerous goods is involved, is the same as the likelihood of a local environmental disaster. The problems and gaps in the system of the state monitoring and control over this type of environmentally degrading activity are indicated. By incident or accident is meant here any event due to accidental circumstances which might place users of the tunnel in danger: incidents having a serious effect on the tunnel's technical systems, road traffic accidents, fire, release of dangerous substances, etc.

1. Introduction

Amid the existing and growing man-caused threats, one of the tasks of ensuring the national security of the Russian Federation is to increase the environmental safety level to protect the population and territories from these threats. This article discusses the problem of ensuring environmental safety en route of dangerous goods transportation by road [1].

Human activity is characterized by a continuous process of implementation of new potentially dangerous technologies. As a result, hazardous substances, which pose a real threat to both humans and the environment, are used increasingly more extensively in industrial production. At the same time, numerous enterprises are daily supplied with dangerous goods for the continued operation of economic entities.

For example, construction processes require technical gases, acids are necessary to maintain the activities of hospitals, gasoline and gas are required for petrol stations, and kerosene and other fuels and lubricants are necessary for the operation of airports and airfields.

Transport flows are not only an integral part of the logistics processes bound with the reality of everyday life, but they are also associated with different places of accumulation, storage, distribution, concentration and processing of environmentally hazardous substances [2].
2. Results

Today, the transport of dangerous goods accounts for more than 51% of the global movement of goods, according to the UN.

In Russia, the volume of dangerous goods transported by all modes of transport is about 20%, which is about 800 million tons per year. Of these, up to 65% is accounted for by motor vehicles, and these figures unfailingly increase.

In the Russian Federation, the following are the main trends affecting the increase in the share of transportation of dangerous goods by road: the expansion of a fleet of trucks of various purpose, growth of the road network, and competitiveness of motor transportation over short distances.

It is important to note that the transportation of dangerous goods by road should be carried out according to the special REGULATIONS. The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), which came into effect in 1968, is a single document used by the European countries that sets out the procedure for processing and transporting dangerous goods [7]. In the Russian Federation, the procedure for the transport of dangerous goods by road is also governed by a set of regulatory legal acts [3, 4].

Based on the total tasks being solved, the REGULATIONS for the transport of dangerous goods provide certain measures aimed at preventing or reducing the adverse effects of the hazardous properties of the said goods on the ecosystems in the event of an accident. That being said, special consideration is given to the cargo classification according to the types of environmental hazard and, as a result, to the relevant conditions of transportation, as well as personnel training to ensure safety of the transportation process.

However, transportation of dangerous goods by road is a complex and time-consuming process, associated with a significant risk of human-made emergencies. This is because motor vehicles carrying dangerous goods may be involved in road traffic accidents. That is, in spite of all the measures taken to ensure safety of dangerous goods, there is a risk of loss of cargo, since a vehicle transporting dangerous goods, may go over (overturn) for a number of reasons or be subject to a physical impact (collision) from another vehicle [5, 6].

This is clearly illustrated by the statistics of the RF Ministry of Internal Affairs. Reportedly, over 2016, in 97% of the total road traffic accidents that occurred with vehicles carrying dangerous goods, tank trucks were involved. According to the types of accidents, in 44.3% of the cases, a vehicle overturned, and in 40.6%, there was a collision. Every third overturning occurred on curved road sections, 15% of all accidents occurred in settlements [5]. The result of such events is usually a loss of dangerous goods and, consequently, a dramatic increase in the risk of human-made emergencies. It is important to note that extinguishing of fires associated with the loss (spill) of dangerous goods, such as flammable liquids, comes with a severe damage to the environment. When dangerous goods are burning, the escaping highly toxic volatile substances, such as hydrogen fluoride, nitrogen dioxide, sulfur dioxide, carbon monoxide, hydrogen sulfide, hydrogen chloride, hydrogen cyanide and others, cause significant damage to the environment. When water is used to extinguish a fire, it transitions into a vapor with saturated toxic substances and reaches the soil and water bodies in the form of precipitation, remaining in the biosphere for a long time [7].

Such accidents, especially those occurring within the populated areas or natural protected areas, may and do lead to local environmental disasters, involving, among other things, human deaths.

A striking example of such an incident is a road traffic accident involving a tanker truck carrying liquefied petroleum gas, which took place on August 7, 2018 in the suburbs of Bologna (Italy). An emergency occurred on an overpass near the airport, when a tanker truck involved in a road traffic accident exploded. The fire spread to the cars in the dealership centers located on both sides of the road. They also began to explode, and the raised highway partially collapsed. Two people were reported killed and more than 70 were injured [8-10].

Therefore, it is conceivable that the probability of a risk of a local environmental disaster is the same as a risk of a road traffic accident involving a motor vehicle carrying dangerous goods. In other
words, the risk level of an environmental disaster during the transportation of dangerous goods by road depends on the safety level of the transportation route [11].

The current legislation provides rather strict requirements, which apply to the carrier, cargo owner, container manufacturers, rolling stock, as well as to the traffic control administration. At the same time, the existing requirements for the route of transportation of dangerous goods are general and declarative, and the compliance with these requirements has little to nothing to do with minimizing the risk of an environmental disaster en route of transportation in case of a road traffic accident [12].

Moreover, a study of the regulatory legal acts [8-10] prescribing the order of transportation of dangerous goods by road in the Russian Federation made it possible to identify some gaps and faults in the system of the state monitoring and control over this type of environmentally hazardous activity [13]:

- for example, there is no access to the information on the number of operators who manage the transport of dangerous goods, or the vehicle specifications and number of units used for this type of activity, or the traffic volume and framework of transportation of dangerous goods;
- there are gaps in the terminology and legal meanings of such concepts as “a route of transportation” and “(in) coordination of the route of transportation of dangerous goods”;
- there is no technique and criteria to estimate safety of the route for the transport of dangerous goods, which is submitted for approval (study);
- rates of the incidents involving motor vehicles carrying dangerous goods do not correspond to the facts and are significantly underestimated (approximately 100 times lower), since the State statistical reporting includes data only about road traffic accidents, in which people died or were injured. Incidents, resulting only in a damage to a vehicle or loss of dangerous goods (a local environmental disaster) are not included in the State statistical reporting [14].

These circumstances show that there are the following contradictions: on the one hand, the authorities have specified the obligations of all participants of this type of economic activity to ensure the safety of transportation of dangerous goods by road in order to minimize and prevent environmental disasters and harm to the technosphere in emergency cases. On the other hand, there is no methodology of arranging an itinerary or choosing a safe route for the transportation of dangerous goods [15].

That is, the route with the minimum risk of a road traffic accident involving motor vehicles carrying dangerous goods, or the minimum risk of a local environmental disaster [16].

The best way to resolve this contradiction would be to develop a scientific and methodological framework to assess the likelihood of road traffic accidents on the route under study, taking into account physical and geometric properties of a road, traffic flow conditions and other factors contributing to the road traffic accidents and, as a consequence, to the man-made emergencies. The use of this approach will reduce the risk of human-made emergencies when transporting dangerous goods by road [17,18].

3. Conclusion
Summarizing the above, we should identify the priority measures, which would improve the safety of transportation of dangerous goods by motor vehicles:

- development of a system for collecting, storing and consolidating of data on the transportation of dangerous goods at the state level in the Russian Federation;
- arrangement of tracking of special vehicles intended for carriage of dangerous goods in accordance with the regulated route using GLONASS system;
- carrying out relevant surveys to develop a scientific and methodological framework to validate a rational route for motor vehicles during the transport of dangerous goods, taking into
account the physical and geometric properties of a road, traffic flow conditions and other factors contributing to the man-made emergencies.

- use of the developed scientific and methodological framework in the activities of agencies, municipal structures and organizations when considering an order (application) for the transport of dangerous goods [19, 20].

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