

Management of transport of hazardous materials

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Abstract: Transportation of hazardous goods is a demanding and risky job. The greatest risks, dangers and consequences for the population and the environment are associated with the transport of hazardous goods. Today, numerous systems and software packages have been developed, the aim of which is to improve the performance of this type of transport and mitigate the consequences of possible accidents. By monitoring and adaptive management of the transport of hazardous goods in road traffic, the consequences of traffic accidents can be repaired more quickly and the movement of vehicles with hazardous goods can be directed to safer routes.

Keywords: hazardous substances, transport, risk, consequences.

INTRODUCTION

Hazardous substances are considered to be all those substances which, during production, transport, storage or handling, can cause consequences harmful to health and the environment [1]. Hazardous materials are regulated by the European Agreement on the International Carriage of Hazardous Goods by Road (ADR) and the International Regulations on the Carriage of Hazardous Goods by Rail (RID) [2]. ADR contains provisions for road traffic regarding packaging, cargo insurance and labeling of hazardous goods. ADR is so widespread in transport that almost everyone in every country understands it. It is adapted every two years to the latest technical and legal knowledge and changes [3].

In the total transport of cargo, a very significant share of hazardous materials. These are substances that, due to their characteristics (danger from radiation, toxicity, corrosive properties, flammability) or chemical reactions (flammability, volatility, explosiveness, corrosiveness, solubility) during production, handling, storage or transport, can endanger the health and life of people, pollute the environment or cause damage to material goods [4]. Hazardous substances are increasingly used in various economic activities: chemical industry, agriculture, pharmacy, military industry, as a source of energy, etc. Therefore, although they represent a risk for man and his environment, their transportation is present and unavoidable every day. Due to the aforementioned negative impact of such substances, their transport must be organized according to certain rules in order to mini-

mize the risk of accidents, that is, to minimize the consequences of accidents that have already occurred [1].

HAZARDOUS SUBSTANCES

Based on the Law on Transport of Hazardous Goods (Official Gazette of RS, No. 15/2016), hazardous substances are classified as follows:

- Class 1 - explosive substances and objects with explosive substances,
- Class 2 - gases,
- Class 3 - flammable liquids,
- Classes 4.1 - flammable solids, self-reactive substances and desensitized explosive solids,
- Class 4.2 - self-igniting substances,
- Class 4.3 - substances that in contact with water develop flammable gases,
- Class 5.1 - oxidizing substances,
- Classes 5.2 - organic peroxides,
- Class 6.1 - toxic substances,
- Class 6.2 - infectious substances,
- Class 7 - radioactive substances,
- Class 8 - corrosive (corrosive) substances, and
- Class 9 - various hazardous substances and objects.

Hazardous goods are classified according to the European Agreement on the International Carriage of Hazardous Goods by Road (ADR), the Convention on International Carriage by Rail (COTIF), the Regulations on the International Carriage of Hazardous Goods by Rail (RID) and the European Agreement on the Interna-

tional Carriage of Hazardous Goods by Inland Waterways (ADN).

CHARACTERISTICS OF ACCIDENTS WITH HAZARDOUS GOODS

Traffic accidents in road traffic have long been a global problem that is being tried to be solved by implementing systematic measures and taking appropriate actions. The potential danger of a vehicle increases if it is transporting a hazardous substance. Some of these substances, even without traffic accidents, are inherently hazardous and can injure people or cause material damage (self-igniting). Therefore, when transporting such materials in road traffic, it is necessary to comply with special regulations. Certain UN bodies deal with this area, and the European Agreement (ADR) defines in detail the issue of the transportation of hazardous goods, on which our regulations are based [5].

The economic development of any society is undoubtedly related to the movement of various types of goods. More than 3300 goods and their products are included in the list of hazardous goods. Their number is constantly growing in various areas because there are more and more goods that exhibit the characteristics of hazardous substances [5].

In order to reduce the risk in road traffic when transporting hazardous goods, it is necessary to develop a system for managing the transport of these goods. The main goal should be to reduce the probability of traffic accidents involving vehicles transporting hazardous goods. The following is the reduction of consequences in the event of traffic accidents.

In order to reduce the probability of an accident, preventive measures should start already in the process of production, packaging and storage of hazardous goods. Later, all risk factors, which are a consequence of human error or lack of infrastructure, should be minimized. The reduction of the consequences of traffic accidents in which a vehicle transporting hazardous materials was involved is achieved by applying the appropriate regulations, which aim precisely to minimize the damage caused by a possible accident.

During the transportation of hazardous materials, an unwanted event is called an accident, and the consequences of that event an incident (explosion, release of material, fire, etc.). Incident statistics show that 40% of them occur in production facilities, 35% during transportation and 25% during storage of goods. Every transport carries a certain risk of accidental events. In the event of an accident, there is a danger of an ecological disaster with unforeseeable consequences. An accident most often results in the uncontrolled release of hazardous and harmful substances into the environment and pollution on a significant scale. The consequences are huge: injuries (victims), material damage, destruction and degrada-

tion of the environment, with huge consequences for a long period of time. Analyses so far show that the most common causes of accidents in road traffic are: defective means of transport, irregularities when loading cargo (most often exceeding the useful carrying capacity of the vehicle) or unloading it, as well as traffic accidents involving vehicles transporting hazardous goods.

MONITORING AND MANAGEMENT OF THE TRANSPORT OF HAZARDOUS MATERIALS

In order to influence the reduction of the risk of accidental events during the transport of hazardous goods, the management of this type of transport is applied today. The application of various software solutions leads to the automation of the process of working with hazardous materials, increasing their transport speed and reducing risks. Such solutions offer assessments and forecasts of difficult situations in traffic that have arisen as a result of accidents with hazardous substances. An accident is defined as a sudden and uncontrolled event that occurs due to the release, spillage or spillage of hazardous substances, the performance of activities during production, use, processing, storage, disposal or long-term inadequate storage [6].

Incidents or traffic accidents involving hazardous materials can happen anytime and anywhere. In particular, the peripheral parts of cities, where large chemical plants and their warehouses are located, are potential sites of accidents, with incalculable consequences for human lives and their environment. Often the consequences go beyond the crash site and affect many more people than were directly involved. That is why accident management is a very complex and complex process, which requires a lot of expertise and maximum involvement in all phases [7]. The use of appropriate software packages provides multiple benefits: quick access to data on hazardous materials is enabled, their use for assessing a specific emergency situation and transmission of information to competent authorities, if necessary in the event of an adverse event [7]. In this way, accident management is raised to a higher level.

Program packages are upgraded and developed every day, the goal of which is to reduce the risk of any type of accident and increase the level of safety during the transportation of hazardous goods. However, the application of developed models often remains difficult to achieve in practice.

As an active participant in traffic, a vehicle with a hazardous substance must comply with the regulations adopted in the Law on Traffic Safety and Transportation of Hazardous Substances. Failure to comply with traffic regulations can cause accidents, regardless of the fact that other measures related to proper packaging, handling and storage have been observed. This is especially present in road traffic and is especially hazardous if it

happens in a populated place. Easier tracking of transport is made possible by equipping all transport vehicles with appropriate digital devices for global positioning [8]. In this way, one can gain insight into the complete transport of hazardous materials, which should certainly be directed as far as possible from kindergartens, schools, residential areas and parks. In this way, possible unwanted events are moved away from sensitive places and objects. When managing the transport of hazardous materials, the condition of the roadway on the sections of the road over which the vehicle moves should not be neglected. The poor condition of the road and the potholes on it can threaten the safety of transport.

ELEMENTS OF SAFE TRANSPORT OF HAZARDOUS MATERIALS

Every vehicle that transports hazardous material becomes an active participant in traffic, surrounded by other vehicles.

Motor vehicles and trailers used to transport hazardous goods must be subjected to a special inspection in terms of meeting the conditions stipulated by the Law and ADR, for the transport of certain hazardous goods. This implies the determination of reliability and safety from the aspect of operational conditions in road traffic. Examination of vehicles for the transport of hazardous materials includes: vehicle performance, determination of functional characteristics, from the aspect of special requirements for the transport of certain hazardous materials, i.e. determination of the structural characteristics of devices and equipment, as well as the structural performance of the vehicle as a whole, from the aspect of special requirements defined for the transport of hazardous materials [9].

The vehicle testing methodology is based on the characteristics of the hazardous material that will be transported. When testing a vehicle, one should take into account all applicable regulations, recommendations and requirements [9].

The volume of traffic flow affects the speed of movement of vehicles transporting hazardous materials. Optimum organization of this type of transport implies the movement of vehicles in calmer, less burdened traffic conditions. Due to the constant increase in the number of motor vehicles on the total road network, this is not always possible. If a vehicle transporting hazardous materials finds itself in a saturated or forced traffic flow, the potential danger of an undesirable event increases. The effort is made to ensure that vehicles transporting hazardous materials spend as little time as possible on the road network, and at least in densely populated areas. Determining the optimal routes for the transportation of hazardous goods represents a significant step in increasing the level of safety of their transportation, and this should always be kept in mind.

Vehicles transporting hazardous goods are subject to general regulations related to stopping and parking places. They are allowed to park in specially designated areas. These areas in the open space are generally far from large traffic jams, settlements and gatherings of people.

In the event that such vehicles transport characteristically hazardous substances or hazardous substances in excess of the determined quantity, they are also subject to special regulations regarding supervision during transport.

Drivers participating in the transport of hazardous goods must have a license for the transport of hazardous goods, and the vehicles must have special equipment. These include folding and unfolding orange warning signs, a helmet and goggles, as well as two fire extinguishers.

In addition to the vehicle crew and drivers who must undergo appropriate training, other persons who directly participate in the transport of hazardous goods and are employed in a company dealing with the transport of hazardous goods must have appropriate training in this field. Training implies determining their duties and obligations during work with hazardous substances. The training of persons must be regularly adjusted to changes in legal regulations. Companies that regularly transport hazardous materials employ at least one person responsible for transporting hazardous materials. It is their duty to take care of the transportation in accordance with the regulations and requirements for hazardous materials [10]. The responsible person initiates the approach to risk management during the transportation of hazardous goods.

Risk management requires a multidisciplinary approach to the organization of transport, which should ensure: the implementation of prevention, preparedness, response to an accident and remediation, that is, elimination of the resulting consequences. This implies a set of measures and procedures aimed at reducing risk and creating conditions under which risk can be acceptable. A management system based on good analysis, with computer support, can contribute to a much more efficient system of protection during the transportation of hazardous goods.

It is of particular importance that through the continuous professional training of all persons participating in the organization and carrying out of the transport of hazardous goods, the possibility of accidental situations is reduced to a minimum.

All those who participate in the transport of hazardous goods should responsibly take all necessary protective measures in order for the transport to take place safely and to avoid possible irregularities or accidents that could endanger people's lives or have consequences for the environment.

Regular checks on the application of preventive protection measures increase the safety of all participants in the transport of hazardous goods.

CONCLUSION

Organizing and safely managing the transportation of hazardous goods today is a very demanding and complex job. If it is not approached responsibly and on time, the consequences can have enormous proportions. People getting sick or dying, environmental pollution, destruction of natural wealth, damage to technical equipment, are just some of the possible consequences.

Traffic accidents involving vehicles transporting hazardous goods follow the development of society. Today, we encounter a large number of traffic accidents involving vehicles carrying out this transport. The degree of risk and consequences is much higher if the vehicles transport matter that can cause deaths and unfathomable environmental disasters.

Looking at the effects and consequences of hazardous materials, with a large number of victims, injuries and illnesses, as well as material damages and other consequences, initiates the need for improvement in this area of transportation. As a result of the improvement, various software solutions were applied in managing the transportation of hazardous goods.

Appropriate program packages increase the speed of transportation of hazardous goods and reduce risks. The use of software packages in the function of risk reduction is useful in many ways because it enables quick access to data on hazardous substances and their use in specific situations. Such solutions also offer assessments and forecasts of difficult situations in traffic that have arisen as a result of accidents involving hazardous substances.

A detailed analysis of all types of risk is the starting point for determining the level of risk and determining the guidelines for action in order to reduce it to an acceptable level. Then it is possible to start taking measures for prevention, preparedness and responding to a possible accident.

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