

## **Transport of Dangerous Goods in Defined Areas of Slovak Republic from the View of Environmental Burdens**

Marek Halenár, Ľubomír Hujo, Ivan Beloev, Ján Kosiba, Vladimír Hajdák

**Abstract:** *The paper is focused on possible solutions of road transport on a defined territory of the Slovak Republic in terms of potential environmental pollution in case of ADR vehicles crash. The article illustrates the seriousness situation related transport of dangerous goods effecting significant damage of the ecosystem because the utilized roads are not suitable for the transport of dangerous goods. At the monitored section of the road, we described the risks affecting vehicle crash and then proposed solutions to reduce its. These solutions will increase the safety of ADR transport and eliminate adverse effects on the environment and population.*

**Key words:** *road transport, ADR agreement, dangerous goods, environment*

### **INTRODUCTION**

ADR Agreement is an international agreement on the transport of dangerous goods, categorized into nine classes with a corresponding degree of hazard. Part of the agreement are two subclasses, which deals with all elements directly related to the transport of hazardous materials. Transport of dangerous goods are mainly chemicals, which by their toxicity, flammability and infectivity threaten the environment and in direct contact have a negative impact on public health, but any accident transport unit carrying harmful substance has a disastrous impact on the environment in which we live. (Zákon č. 56/2012 Z.z. o cestnej doprave).

Transport in each country is influenced by a variety of socio - economic factors, among which may be included demographics, urban planning, standard of the population and ultimately the country's integration into international trade. (Hujo et al., 2013). Difficulty of road transport has long been an important topic of various economic and environmental debates, and in fact the starting point for determining the amount of emissions produced by transport and calculating the energy performance of transport. (HEGEDŮŠ, et al., 2012; Janoško et al., 2014).

We see the problem with the transport of dangerous goods in an increase in the international transport of dangerous substances, more dense and congested roads, the quality of crews transporting dangerous materials, in dealing with emergency situations in case of accidents. Currently ADR transport makes up 30% of the total transport on roads in Slovakia, where it is foreseeable, that the percentage share of dangerous goods will go up with the increase in production of the chemicals. (Žitňák, M. ; Korenko, M., 2011). The total amount of dangerous goods in the European Union is about 110 billion tonne-kilometers per year, of which 58% is by road, 25% by road and 17% by inland waterway. The trend for road and inland waterway transport of dangerous goods is increasing, but decreasing for rail transport. The share of dangerous goods transport in total freight transport is about 8%. (Statistic of transport ADR, 2014)

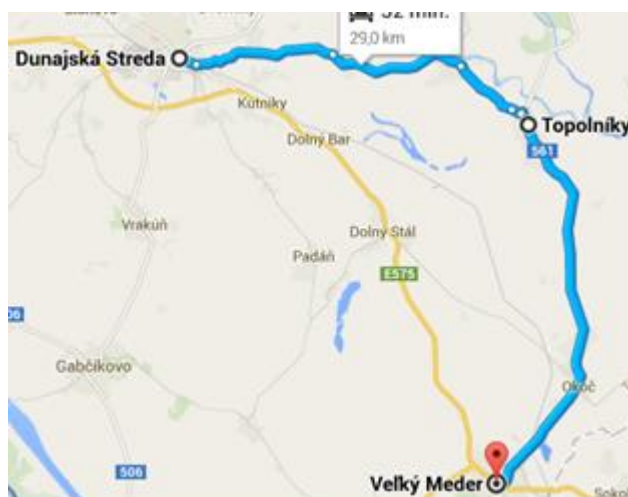
The goal of this paper is to assess the risks of the damage to the ecosystem due to the transport of ADR in emergency situations based on available input data and to propose solutions to eliminate damage to the environment by establishing an appropriate transport corridor.

## **MATERIAL AND METHODS**

The term optimization of transport routes is understood to create a structure of the transport corridors in road transport, which will be designed in accordance with the terms of the ADR and the applicable local laws of the road and the road. By optimizing the transport corridors of transportation of dangerous goods, creating a case study in dealing with bottlenecks we minimize adverse impacts in a traffic accident on the environment. Preparatory studies have been described in the risk segments in the defined territory of the Slovak Republic, focusing on the protection of groundwater reservoirs on the Žitný ostrov, analyzing the passage of roads across the river Hron. The last described risk section is the field of mineral resources of major spa town Piestany, whose solution is used as a case study set out to circumvent a city with resource-rich mineral springs.

### **ADR analysis on Žitný ostrov**

Žitný ostrov belongs to the largest groundwater reservoir in Central Europe. Therefore, there is increased attention on the quality of the groundwater. The area is almost impassable with substances that may cause pollution of groundwater, soil and waterways. The trucks wittingly use traffic diversion coming through the area mentioned above to pay no road fee however it is not excluded that some trucks transport hazardous materials. Figure 1 shows the corridor: Dunajská Streda – Topolníky – Veľký Meder with a total length 29 km.



**Fig. 1** Dunajská Streda – Veľký Meder

### **Analysis of crossing the river Hron**

A crossing the river Hron is a problematic road section on the territory of Slovakia. The road has become a risk due to exceed the clearance limit because trucks use it instead the fee international communication. Road communication of II. class path is also used by carriers for the transport of dangerous goods. Bridge over the river Hron is not equipped with sedimentation tanks and thus creates a risk area in extenso. Comparing the distance passing through the point it is clear that truck drivers in the use of lines outside the R1 in FIG. 2 Scroll to a greater distance, but also to avoid paying tolls. This II. Class road is not ensured sedimentation tanks and drainage canal retaining leak of hazardous substances getting into in the groundwater and the river Hron during an accident.





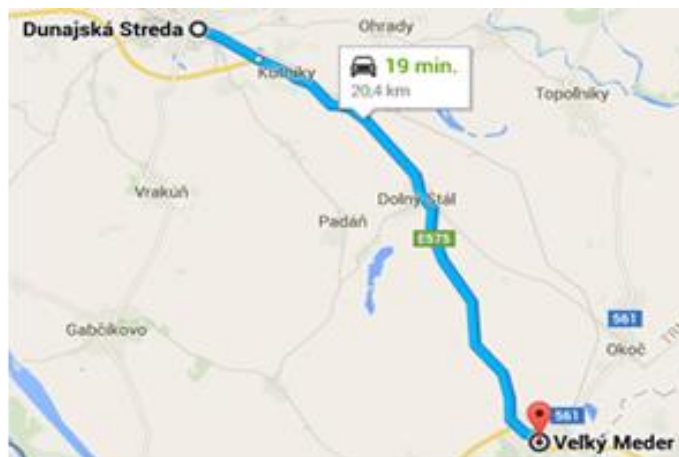
Fig.4 Traffic signs B22 and C19 near the town of Piestany (Gnap, Jagelčák, 2009)

## RESULTS AND DISCUSSION

In the first part we analyzed transport corridor Dunajská Streda - Veľký Meder, where shippers of dangerous goods by truck deliberately bypass the tolls, thus creating a risk area for the environment. Given the state of the communication section, the communication status (route II. Class), and in particular the position of the Transport Corridor (Žitný ostrov), we propose a complete ban on entry of trucks carrying hazardous materials vehicles and vehicles, whose gross weight exceeds 7.5 t. Proposed a narrowly defined transport route, suitable for the transport ADR see Fig. 5, passings Dunajská Streda - Kútniky - Dolný Stal - Veľký Meder with a total length of 20.4 km. The proposed alternative will contribute to the security environment since the routes leading first-class roads. We further propose the given road to equip with sedimentation tanks, which will minimize the percentual risk of pollution in case of leakage of hazardous substances.

In the next section we paid attention especially to passages through a river flows, specifically analyzing the crossing of the river Hron. The road is excessively overloaded and inadequate. Carriers use the given communication mainly to circumvent the toll section along expressway R1. We propose a prohibition for trucks to enter this road, whose gross weight exceeds 7.5t and completely divert transport of dangerous goods on the expressway. Consequently, we propose an overall reconstruction of the bridge. An important factor is a detailed analysis of individual road sections circumventing due to charging and thus generate hazard areas from the perspective of a possible dangerous situation. In the last section, we used as an example a solution to transport hub of the town Piestany, which by their scope may serve as a model for various spa towns in different countries. Based on the current development of the carriage of dangerous substances it can be assumed, that the amount of dangerous substances will continue to rise and risks for the environment by dangerous substances in the transport of ADR will grow.





**Fig. 5** Dunajská Streda - Veľký Meder

## **CONCLUSION**

In the present paper, we analyzed the three problem areas in terms of transport of dangerous goods and provided alternative solutions to ensure ADR transport. In the first part of the scientific article, we drew attention to the problematic area of Žitný ostrov, where is increased attention to the transport of dangerous goods, especially in the use of groundwater. For these reasons, a detailed analysis of transport corridors is necessary, Long-term monitoring of trucks carrying dangerous materials and the consequent draw changes in traffic, leading to an increase in environmental safety. Next, we analyzed transport corridor, which creates a bottleneck across the river Hron, where we designed the reconstruction and individual no entry. In the last part of the paper, we paid attention to the spa town Piestany, from the view of and diversion of traffic, because of significant sources of healing springs in this area. A solution of individual analyzes serves as a model for a similar bottlenecks.

Development of transport in the monitored area must comply with safety and environmental protection. The transport sector makes economic growth, contributes significantly to the functioning of the Slovak economy, the various regions, thus creating conditions for optimal economic potential. (Hujo et al., 2014; Majdan et al., 2014)

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