The Importance of Dangerous Goods Transport by Rail
Važnost željezničkog prijevoza opasnih tereta

Marek Šolc
Technical University of Kosice
Faculty of Metallurgy
Department of Integrated Management
Slovakia
e-mail: Marek.Solc@tuke.sk

Michal Hovanec
Technical University of Kosice
Faculty of Mechanical Engineering
Department of Safety and Quality Production
Slovakia
e-mail: Michal.Hovanec@tuke.sk

DOI 10.17818/NM/2015/SI17
UDK 656.2:347.7
Review / *Pregledni rad*
Paper accepted / *Rukopis primljen:* 27. 4. 2015.

Summary

Continuously growing needs of society brings with it the development of industry, new technologies and use of new types of hazardous substances. Each transport of hazardous substance entails some risk of incident. This article deals with problems of transporting of dangerous goods by rail. The paper describes the Directive, which forms the basis of the transport of dangerous goods. In the next chapter, article describes of procedure for international rail transport of dangerous goods (RID) and the system of risk identification for railway transport. The conclusion of the article describes the advantages and disadvantages of transporting of dangerous goods by rail.

KEY WORDS
transport
hazard
assessment
management
risk
rail

Sažetak

Rastuće potrebe društva sa sobom nose razvoj industrije, nove tehnologije i upotrebo novih vrsta opasnih supstanci. Svaki prijevoz opasne supstance uključuje rizik od incidenta. U ovom radu govori se o problemima željezničkog prijevoza opasnog tereta. Rad opisuje Direktivu, koja je temelj prijevoza opasnih tereta. U sljedećem poglavlju članka opisan je postupak međunarodnog željezničkog prijevoza opasnih tereta (RID) i sustav identifikacije rizika u željezničkom prijevozu. U zaključku su opisane prednosti i mane željezničkog prijevoza opasnih tereta.

KLJUČNE RIJEČI
prijevoz
opansnost
procjena
menadžment
rizik
željeznički

INTRODUCTION

Currently large quantities of different types of dangerous goods are transported by rail. The influence of random factors and events can lead to an accident resulting in a leakage of hazardous substances. Incidents of this kind not only threaten the safety of rail transport, but also life, and health, and are particularly damaging to the environment. It must be said that to prevent the occurrence of incidents in rail transport needs must adhere to the rules of the Regulations for International Carriage of Dangerous Goods by Rail (next RID). These rules must be primarily respected by the shipper and the transporter. It is not possible to ensure sufficient protection of the population and the environment without the population's active participation and responsibility.

THE LEGAL FRAMEWORK CONCERNING RAILWAY TRANSPORT

- Directive 2004/49/EC, of the European Parliament on safety on the Community's railways and amending Council Directive 95/18/EC on the licensing of railway undertakings and Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification,
- Directive 2004/50/EC, of the European Parliament amending Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system and Directive 2001/16/EC of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system,
- Directive 2004/51/ES, of the European Parliament amending Council Directive 91/440/EEC on the development of the Community's railways,
- Directive 2008/68/ES of the European Parliament on the inland transport of dangerous goods,
- Directive 2010/409/EU Commission Decision on Common Safety Targets as referred to in Article 7 of Directive 2004/49/EC of the European Parliament and of the Council (2010/409/EU),
- Commision Regulation (EU) No. 1158/2010 on a common safety method for assessing conformity with the requirements for obtaining railway safety certificates,
- Commision Regulation (EU) No. 1169/2010 on a common safety method for ass essing conformity with the requirements for obtaining railway safety authorisations,
- Commision Regulation (EU) No. 445/2011 on a system of

certification of entities in charge of maintenance for freight wagons and amending Regulation (EC) No 653/2007,
- Commision Regulation (EU) No. 1077/2012 on a common safety method for supervision by national safety authorities after issuing a safety certificate or safety authorisation,
- Commision Regulation (EU) No. 1078/2012 on a common safety method for monitoring to be applied by railway undertakings, infrastructure managers after receiving a safety certificate or safety authorisation and by entities in charge of maintenance,
- Commission Implementing Regulation (EU) No 402/2013 on the common safety method for risk evaluation and assessment and repealing Regulation (EC) No 352/2009,
- Directive 2003/105/ES of the European Parliament on amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances,
- Annex 2 to SMGS- Rules for the transport of dangerous goods (the international rail transport of Goods),
- ISO 2859-1: Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection [7],
- RID – Regulations for international railway transport of hazardous goods,
- The Convention concerning International Carriage by Rail (COTIF) [16].

REGULATIONS FOR INTERNATIONAL RAILWAY TRANSPORT OF DANGEROUS GOODS RID

The process of determining the conditions of dangerous goods carriage by rail and their (conditions) practical use in an international environment is in some cases lengthy and very challenging. The main factor influencing this process is gaining experience from actual practice of dangerous goods transport system not only in the European Union (next EU) environment. An important phase is the acquisition of knowledge, particularly arising from incidents or accidents during handling and transport of dangerous goods and subsequent analyses. By such analysis, it is possible to anticipate and consequently avoid repeating of errors, or individual missteps, throughout the whole process of dangerous goods transportation in all countries participating in the transport [2].

The output of the recommendations of the United Nations Organisation (next OSN) and individual incident and accident analyses in a European environment for the transport of dangerous goods by rail is represented by Regulations for International Railway Transport of Dangerous Goods. It is commonly referred to as RID (Réglement concernant le transport international ferroviaire marchandises dangereuses). This Regulation specifies all the necessary requirements that carriers must meet and is periodically updated. If there is compliance with the conditions of transport according to RID by individual participants, the possibility of an accident or incident, with a consequent threat to human life and health, the environment and property is largely eliminated. It will subsequently reduce the threat to human life and health, the environment and property. Legal framework for international transport provides conditions for the transport of dangerous goods with regard to [19]:

- classification of goods, including their classification criteria and relevant test methods; use of packagings (including mixed packing),
- use of tanks (including filling),
- consignment procedures (including their labeling and placing stickers on outgoing pieces, applying large label on the means of transport, marking means of transport, necessary documents for carriage),
- requirements concerning the construction, testing and approval of packages and tanks,
- the use of means of transport (including loading, mixed loading and unloading).

For transports according to RID in addition to Appendix C, also relevant provisions apply of other The Convention Concerning International Carriage by Rail (next COTIF) Appendices, especially Appendix B according to contractual conditions of carriage. During transport specific national or international regulations for the transport of dangerous goods by road or waterway transport, are also taken into consideration, if they are not inconsistent with the provisions of RID. Furthermore, it is necessary to pay attention to the customs regulations or specific regulations issued by government bodies. Special care must be taken to the confirmation referred to in the consignment note as well as whether they are attached accompanying documents required regulations of state administration. The participating member states of COTIF may agree that on the section of route at which a wagon is carried otherwise than on rails the provisions of RID will be applied. In such case, the conditions for transport will be indicated in the supplementary regulations, unless such agreements between the COTIF member states do not contradict the rules of international agreements on transport of dangerous goods in wagons on the relevant part of the route used by the carrier. A Member State which initiated the conclusion of such an agreement shall notify these agreements to the Secretariat OTIF (The Convention Concerning International Carriage by Rail) and OTIF subsequently notified to the other Member States. For inspection are given on the home page OTIF [16].

The structure of Regulations RID (figure 1) is divided into seven parts, each of witch is divided into chapters and then sections and paragraphs. Each part and each chapter has its own serial number. This number is bound to serial numbers of sections and subsections which are part of the chapter. In accordance with the conditions laid down in the RID dangerous goods are divided into nine hazard classes (table 1).

Table 1 Break down of dangerous goods

Class	The characteristics of substances
1	Explosives
2	Gases
3	Flammable Liquids
4.1	Flammable Solids
4.2	Spontaneously Combustible Solids
4.3	Dangerous when Wet
5.1	Oxidizing Agent
5.2	Organic Peroxide Oxidizing Agent
6.1	Poison
6.2	Biohazard
7	Radioactive
8	Corrosive
9	Miscellaneous

Source: Authors

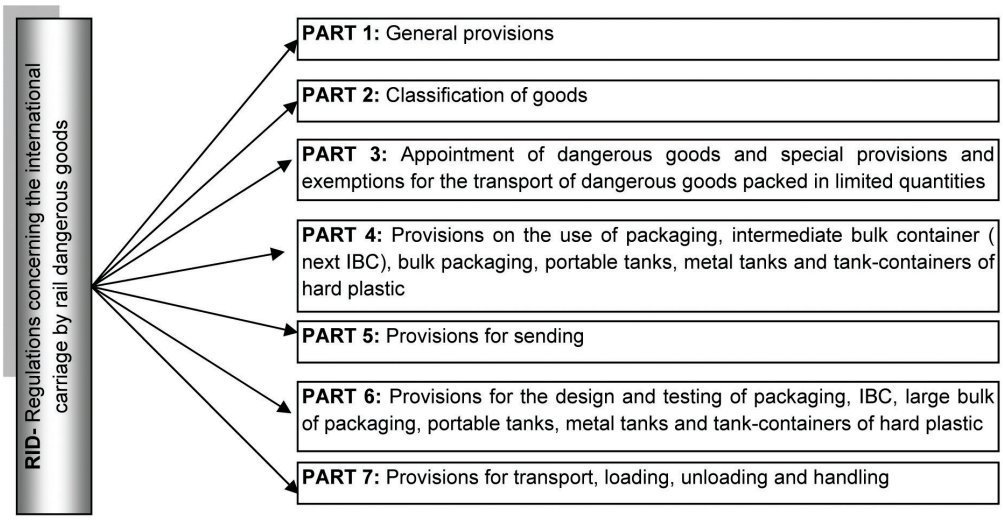

Figure 1 Structure of regulations RID - breakdown by chapters

Source: Authors [14]

THE SYSTEM OF RISK IDENTIFICATION FOR RAILWAY TRANSPORT

Since risk management is not strictly tied to a specific system or activity, it can be combined with other necessary and appropriate methods and used also for rail transport. In accordance with the risk management the Commission of Experts OTIF (Working Group on Standardization of Risk Analysis) developed Generic Guideline for the Calculation of Risk due to Railway Transport of Dangerous Goods. This guidelines is intended to assist in the implementation of basic principles that are used for risk assessment in Chapter 1.9 of the RID Regulations, " Transport restrictions by the competent authorities". At the present guideline uses widely known and utilised procedures for analysis and risk evaluation (for example method Fault Tree Analysis FTA, Event Tree Analysis ETA or Quantitative Risk Analysis QRA). Basic procedures of the risk assessment according to this guideline are shown in figure 2.

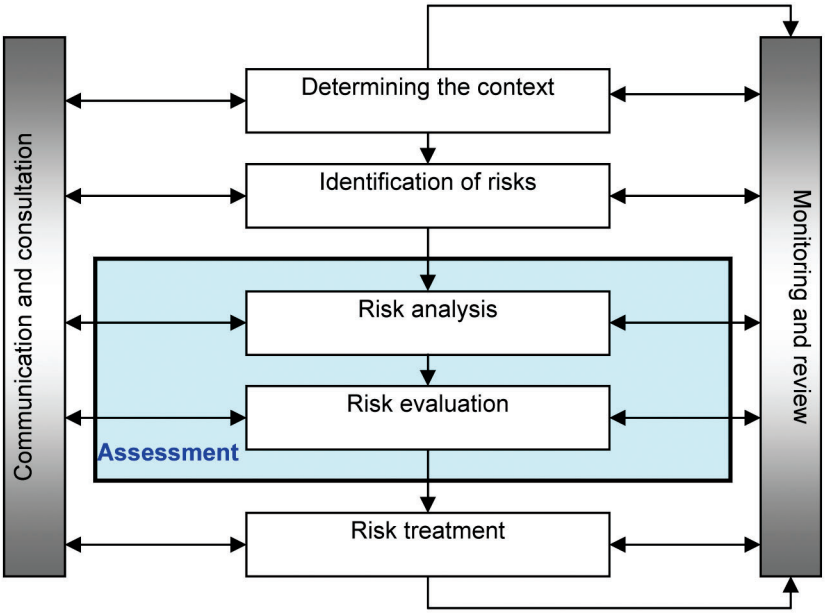

Figure 2 The main elements of risk management

Source: STN 01 0380:2003, p.10

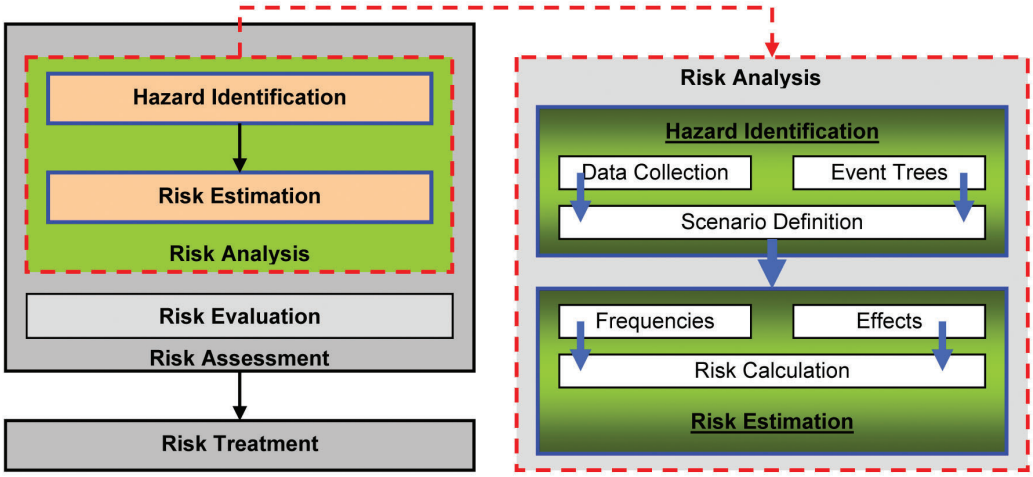

Figure 3 The procedure for the assessment of risk based on guidelines

Source: Čizlák [1]

The processing of particular steps of risk assessment presented in figure 2 requires the following detailed information [3] , [10]:

- the track section (trackage, safety devices, etc.),
- vicinity of railroads (constructions, population and others),
- dangerous goods transported to a given place,
- other information which may have an impact on evaluation and risk assessment (security systems, types of used wagons and tanks, composition and train formation, transport time night day, seasons, transmission speed and other).

The dominant aspekt of risk assessment in rail transport is safety in tunnels, on the one hand, and the choice of the appropriate method of transport of dangerous goods on the other [15], [18]. Situation for the security solutions in tunnels was more or less forced by the situation in the road transport of dangerous goods.

ADVANTAGES OF RAILWAY TRANSPORT OF DANGEROUS GOODS

SAFETY

Reliable transportation of goods is the primary and determining precondition for transport quality. Comparing rail traffic with other traffic modes, we find out the rail traffic is undoubtedly the most reliable traffic mode. This reliability does not result from a lower number of traffic accidents, but also lesser losses incurred from these accidents. Making use of the rail traffic we prevent dozens of casualties, hundreds of injuries and tens of millions of losses each year [6], [8], [17]. Accident rate of rail traffic participants is almost zero, which is not true for automobile, neither air transport [20]. The road transport carries along a direct danger for participants' safety in every accident. In the railway transport are represented negative events (by inetrnal laws) all accidents and incidents. According to available statistics, the results of the investigation of accidents and incidents, the most common causes of developing these negative events are human error and equipment failure. The influence of surroundings is also not negligible [6], [8]. Grouping these internal and external influences (sources of threats) which are the causes of accidents and incidents in rail transport is shown in figure 4.

Figure 4 shows that the causes of accidents can be identify by virtue of the identified threats.

At the same time, rail traffic disburdens overburdened network of highways and primary roads, which contributes to a smooth and safe road transport, which ensures better

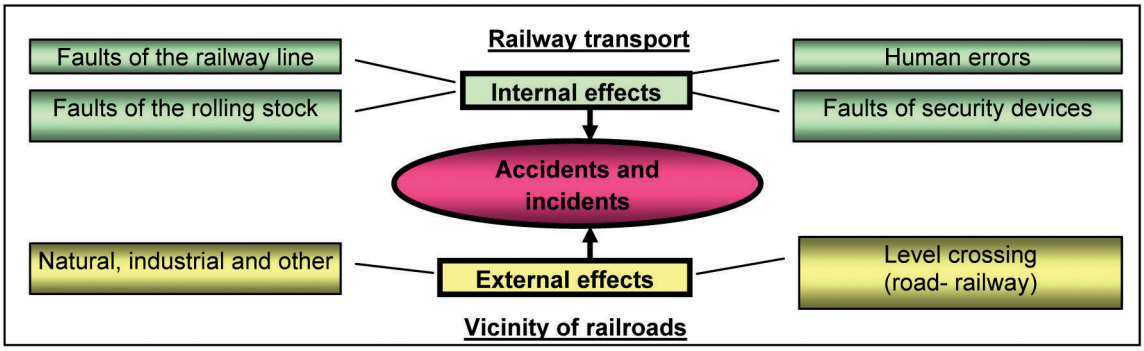

Figure 4 Underlying causes of accidents and extremly events in railway transport

Source: Čizlák

prevention from damages and losses on transported goods [9], [13], [20].

RESPONSIBILITY FOR ECOLOGY

Human activities do not recognize borders of countries and continents; we are continuously observing a growth of production as well as consumption. The growth accompanies us on each step, including transport. Number and volume of transportations are growing and requirements on speed, punctuality, reliability and flexibility of transportations are increasing day by day. Millions of tons of goods transported each day by various traffic modes have an impact on quality of environment. Responsibility for its maintenance is a duty of all men and organizations. Regardless of the more and more perceptible appeal to environment protection. Ability of meeting customer's requirements in an environment-friendly manner has therefore become one of the basic criteria for quality of transport services, as well as a significant competitive advantage of railway carriers [14], [15], [20].

Railway traffic is an efficient and environment-friendly transport system in many cases, whereas large volumes of goods can be transported on long distances quickly and with a minor impact on environment. Compared with automobile or air transport, railway transport produces the lowest amount of emissions and requires much lower costs on regeneration of damaged environment. From the total amount of costs on reduction of negative impacts of transport industry on environment, only 8% comes from railway transport, while up to 90% comes from road transport, even though its traffic performance is by 50% lower than the traffic performance of railway transport [17]. Also noise strain produced by the railway transport on environment is lower than by the road transport. Intensity of rail traffic results from time tables and railway network is mostly built up out of urban zones, while several strong road traffic streams are also directed to urban zones [20].

The most serious problem in the vicinity of railway lines is noise [12]. The intensity and distribution of the noise is influenced by several factors. Among the most significant factors are means of propulsion of locomotives, inequalities of rails, base of ballast, speed, and different kinds of trains. Measures to reduce noise can be implemented actively, i.e. by means of suitable design of railway track and bearable construction of railway subgrade, including the imposition of tracks or construction of noise barriers. A very good solution is to lead the railway tracks parallel with the roads, motorways, i.e. to create transport corridors, and to protect the surrounding environment by ground mounds with higher vegetation.

TRANSPORT CAPACITY AND PRICE CONDITIONS

In national economy, the railway traffic has its specific and irreplaceable position. It enables and facilitates transportations of goods, transportation of which by a different traffic mode would be too expensive and therefore inefficient. It enables transportation of bigger quantity of goods on long or medium distances at relatively low costs [17], [20].

LOWER TRANSPORT RESTRICTION

In comparison with road carriers, the important advantage of railway transport can also be lower transport restrictions. The road carriers must respect several regulations, such as limitations in utilizing highways and primary roads, limitations in traffic peaks, or obligations to keep safety breaks. Advantage of railway transport out of the EU countries is also shorter waiting times on border crossings [17], [20].

OPTIMALIZATION OF TRANSPORT PROCESSES

Considering all transport claims a new trend of a combined transport is coming to the sphere of transportations. This transportation system lays stress on utilizing of railway transport supplemented by advantages of other traffic modes. It combines flexibility and fast transposition of goods with a reasonable consumption of energy and positive ecological aspect, minimizes impacts on environment and that way charges the society with rational ecological costs [17], [20].

DISADVANTAGES OF TRANSPORTING DANGEROUS GOODS BY RAIL

Today probably the greatest disadvantage of rail transport is the restriction imposed by the fixed routes of railway lines [4], [5]. The result of this restriction is the fact that in most cases rail transport requires connection to and support of road transport. Regarding time and the economic aspect, there is often the case that given transport is carried out only by road. We meet this especially when transport is realized over short distances. Other possible cause of rail transport ineffectivity, in time and economic terms, can be attributed to a limited capacity of railway border crossings, mainly in the NORTH - SOUTH direction transport (Slovakia). This increases the distance and, of course the transportation time. In the context of this perspective is the best to use of block trains. Not using block trains results in increasing the transit time and the risk when sorting wagons to particular trains. Currently, terrorism also represents a significant threat for the rail transport [6], [9]. This is mainly because of the ready availability and vulnerability of transport routes, and thus the transported goods. There is a real danger that the system of freight transport, in particular transport of dangerous goods may become the target of a terrorist. Dangerous goods present a serious risk due to their characteristic properties. This danger is particularly serious to the traveling public, but also to the population in the area, and last but not least, to the environment and property, where the attack may occur.

RESULTS, DISCUSSION AND CONCLUSIONS

Each process, system or human activity is influenced by a number of risks whitch can have negative impact. In the railway transport there are a number of risks and threats, which should be given due consideration. Special attention must be paid to the transport of dangerous goods, which is very risky and in the case of an emergency, it could have disastrous consequences on people, as well as the environment. Safety, whitch is very important for the transport of dangerous goods is reduced by the increasing the level of risk. Risk management allows to know the areas of greatest risk, identify individual risks, to express their value and assess them using different methods and procedures. They enable proposing measures to minimize the risks to acceptable levels. One of methods is the

risk matrix. It is used to assess risk, to identify the areas where there are non-acceptable risks but also to locate the risks that can be neglected (acceptable risk).

REFERENCES

[1] Čižlák, M. (2007). Znižovanie a eliminovanie rizík v železničnej doprave, FŠI ŽU Žilina, 2007.

[2] Daloš, A. et al. (2013). Nebezpečné látky a ekologické havárie. Žilina: Fakulta špeciálneho inžinierstva Žilinskej univerzity v Žiline, 2003.

[3] Dvořák, Z., Čižlák, M. (2008). Metodika identifikácie a hodnotenia rizika v železničnej doprave, Perner s Contact, ročník 3., číslo 4/2008, Pardubice, p. 32-41., ISSN 1801-674X.

[4] Fuchs, P., Novák, J., Čermáková, H. (2005). Optimalizace transportu nebezpečných látek na základě hodnocení rizika. In: Teorie a praxe v krizovém řízení: Odborná konference. Pardubice: Universita Pardubice, 2005.

[5] Hittmár, Š. (2000). Rozhodovanie v krízových situáciách. Riešenie krízových situácií v špecifickom prostredí: Zborník prednášok - II. časť. z 5. vedeckej konferencie s medzinárodnou účasťou. Žilina: Fakulta špeciálneho inžinierstva Žilinskej univerzity v Žiline, 2000.

[6] Ingaldi, M., Lestyánszka, Š., K. (2013). Environmental management in polish companies, Manažérstvo životného prostredia 2013, Zborník príspevkov z 13.medzinárodnej vedeckej konferencie Bratislava, 18. - 19. apríl 2013, Žilina: STRIX, 2013, p. 16-19.

[7] ISO 2859-1: Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection. ISO Geneva.

[8] Majlingová, A. (2010). Základné pojmy z oblasti manažmentu rizík prírodných pohrôm a katastrof, vedecko-odborný časopis Katedry protipožiarnej ochrany, TU Zvolen, Roč. 4, č. 7 (2010), p. 18-22., ISSN 1337-0863.

[9] Píľa, J., Adamčík, F., Korba, P., Antoško, M. (2014). Safety Hazard and Risk in Slovak Aviation Regulations, Our Sea, International Journal of Maritime Science and Technology, Vol. 61, no. 1-2 (2014), p. 27-30., ISSN 1848-6320.

[10] STN 010380, Manažérstvo rizika, SÚTN.

[11] Ščurek, R., Švec, J., Švec, P. (2011). Využití fyzikálních poznatků v bezpečnostním inženýrství, Communications, Žilinská univerzita, 2011, p.114-117.

[12] Šimák, L. (2001). Krízový manažment vo verejnej správe. Žilina: Fakulta špeciálneho inžinierstva Žilinskej univerzity v Žiline, 2001.

[13] Šofranko, M., Seňová, A., Lištiaková, V. (2012). Špecifiká banského prostredia z pohľadu hodnotenia bezpečnostných rizík, Aktuálne otázky bezpečnosti práce: 25. medzinárodná konferencia: Štrbské Pleso - Vysoké Tatry, 06.-08. 11.2012. – TU Košice, 2012, p. 1-8.

[14] Šolc, M. (2013). Analýza právnych predpisov v EÚ a SR v oblasti cestnej prepravy nebezpečných vecí, Odpady, Roč. 13, č. 2 (2013), p. 27-31.

[15] Šolc, M., Bereš, R. (2004). Integrované systémy riadenia bezpečnosti – podpora, Bezpečnosť práce, Roč. 4, č. 3 (2004), p. 13-16.

[16] The Intergovernmental Organisation for International Carriage by Rail, OTIF, homepage [online], url: www.otif.org.

[17] Výhody železničnej dopravy, ZSSK Cargo, homepage [online], url: http://www.zscargo.sk/sk/pre-zakaznikov/preco-prepravovat-s-nami/vyhody-zeleznicnej-dopravy/.

[18] Žitná, C., Bujna, M. (2012). Aplikovanie analýzy ohrozenia na výrobný proces. Najnovšie trendy v poľnohospodárstve, v strojárstve a v odpadovom hospodárstve. SPU Nitra, p. 244-249.

[19] Van Tienen Milieuad vies B.V., ADR, homepage [online], url: http://www.gasmetingen-ontgassing-limburg.nl/EN/ADR.html

[20] Transportation, [online], url: http://www.academia.edu/4372523/Transportation.