
Risks of Transporting Dangerous Goods by Rail: The Case of Poland

Submitted 05/09/22, 1st revision 23/09/22, 2nd revision 18/10/22, accepted 30/10/22

Tomasz A. Karkowski¹, Natalia Przytuła²

Abstract:

Purpose: The aim of the article is to present the topics related to the implementation of transport processes, in particular the transport of dangerous goods by rail in Poland.

Design/Methodology/Approach: The article presents an in-depth analysis of the literature on the subject and international and Polish legal acts, as well as internal documents of PKP Polskie Linie Kolejowe SA (Polish State Railways JSC).

Findings: The article is devoted to the analysis of threats resulting from the transport of dangerous goods by rail transport, their significance as well as the opportunities and dangers resulting from it for Poland. In addition, the empirical part focuses on the issue of the potential occurrence of the phenomenon of terrorism due to Polish-Ukrainian economic relations during the armed attack on the Ukrainian population by Russia.

Practical Implications: Dangerous goods are a specific group of goods transported by rail in Poland. Due to the particularly high risk to property, health, human life and the natural environment that this type of transport entails, its organization is strictly defined by law. The basic legal act regulating the transport of dangerous goods in various modes of transport in Poland is the Act on the transport of dangerous goods. Additionally, the transport of dangerous goods by rail is subject to the Regulations for the International Carriage of Dangerous Goods by Rail (RID), which is one of the annexes to the Convention on International Carriage by Rail (COTIF). The implementation of various solutions and provisions of European law into Polish law should be assessed as definitely positive.

Originality/Value: Moreover, rail, as the safest inland mode of transport, is a natural candidate for the transport of dangerous goods. However, so that the transport of this type of goods is not equated with an increase in risk and the occurrence of negative events, it is necessary to monitor and strictly enforce compliance with the provisions in transport practice. However, the main threats adversely affecting the course of transport processes include, inter alia, terrorist acts or cybercrime.

Keywords: Transport, dangerous goods, railway.

JEL codes: R41, L92.

Paper type: Desk -type analysis research.

¹PhD, University of Lodz, Faculty of Economics & Sociology, Department of Logistics & Innovations, ORCID ID: 0000-0002-0526-5863, e-mail: tomasz.karkowski@uni.lodz.pl;

²BA, PKP traffic dispatcher, ORCID ID: 0000-0001-8701-4381, e-mail: natalia.przytula@edu.uni.lodz.pl;

1. Introduction

Rail transport is one of the most important transport branches in Poland. It is second only to road transport in terms of the size of transport. It is used for passenger and freight transport, which makes it a very important element of the logistics system in Poland (Jaworska and Nowacki, 2019, pp. 46-52).

In Poland, about 225-230 million tonnes of goods are transported each year using the railway infrastructure, which translates into a second position in rail transport among other European countries in terms of the volume of goods transported by this type of transport (Jaworska and Nowacki, 2017, pp. 74-78).

Dangerous goods are a specific group of goods transported by rail in Poland. Annually, about 23 million tons of dangerous goods are transported by rail, which accounts for nearly 12% of all types of transport in this group of goods. Due to the particularly high risk to property, health, human life and the natural environment that this type of transport entails, its organization is strictly defined by law. The basic legal act regulating the transport of dangerous goods in various modes of transport in Poland is the Act of August 19, 2011 on the transport of dangerous goods. Additionally, the transport of dangerous goods by rail is subject to the Regulations for the International Carriage of Dangerous Goods by Rail (RID), which is one of the annexes to the Convention on International Carriage by Rail (COTIF).

The basic legal act regulating the functionalities of the railway system in Poland is the Act of March 28, 2003 on rail transport, specifying, among other things, the rules of using the railway infrastructure, railway infrastructure management and its maintenance, guarantees of independence and impartiality of the railway infrastructure manager, rules of railway traffic management and performance of railway transport, technical conditions for the operation of railway vehicles, conditions for ensuring interoperability on the territory of the Republic of Poland, rules and instruments of rail transport regulation.

2. Act on the Transport of Dangerous Goods

The act on the transport of dangerous goods defines the rules on the basis of which transport activities related to national and international road, rail and inland transport of dangerous goods are carried out, with the specification of the authorities and units implementing it (Act of August 19, 2011). Also, each of the modes of transport additionally has its own regulations governing the organization and transport of dangerous goods. Regarding rail transport, it is the Regulations for the International Carriage of Dangerous Goods by Rail (RID), which defines 13 classes of dangerous goods and is an integral part of the COTIF regulations (ADR), (RID), (COTIF).

Due to the fact that in the territory of the European Union the amount of transport of dangerous goods by rail is increasing, which is also noticeable in Poland, as the

volume of transport of such loads is about 20 million tons per year, in January 2019 major changes in the provisions of the RID Regulations came into force (Jałowiec, 2021, p. 156). Member States were obliged to implement the changes by June 30, 2019 (UTK 2022a). Currently, the amended Regulations for the International Carriage of Dangerous Goods by Rail (RID) are in force from January 1, 2021 and consist of 7 parts, which contain the following information (RID):

Part I - General provisions on the scope and application of the regulations, exclusions from transport, definitions, obligations of persons participating in the transport, their training, provisions on radioactive materials, transport restrictions;

Part II - Classification of dangerous goods with approval for transport;

Part III - Special provisions for dangerous goods, excluding the carriage of certain quantities;

Part IV - Packaging regulations - wagons, containers and tanks;

Part V - Marking, warning placards and documentation provisions;

Part VI - Rules for the construction and testing of packaging;

Part VII - Regulations concerning the conditions of carriage, unloading and cargo handling.

Rail freight services should also cover the transport of dangerous goods. However, a distinction should be made between the purpose of Directive (EU) 2016/798 of the European Parliament and of the Council of May, 11 2016 on railway safety (recast) (text with EEA relevance) (OJ EU L.2016.138. 102), which is to maintain and - if possible - improve the safety of the EU rail system, and the purpose of Directive 2008/68 / EC of the European Parliament and of the Council of September, 24 2008 on the inland transport of dangerous goods (text with EEA relevance) (OJ EU.L.2008.260.13), which is mainly to regulate the classification of materials and the requirements for loading units used for their transport, including the safe loading, unloading and use of loading units within the existing railway system.

Therefore, without prejudice to Directive 2008/68 / EC, the safety management system of railway undertakings and infrastructure managers should take due account of the potential additional risks related to the transport of dangerous goods.

3. Dangerous Goods - Characteristics and Classification with Labeling

The Act of August 19, 2011 on the transport of dangerous goods precisely defines a dangerous goods as “material or object which, according to ADR, RID or ADN, is not permitted for road, rail or inland waterway transport, respectively, or is admitted to such carriage under the conditions laid down in these provisions (Act of August 19, 2011). “Dangerous goods have specific properties, such as explosiveness, toxicity or infectivity. They can show several dangerous features at the same time or only one (Semenov, 2008, p. 81). The individual classes of dangerous goods are

described in detail in the second part of the Regulations for the international carriage of dangerous goods by rail (RID).

The individual goods have additionally been assigned specific UN numbers in different 13 classes. Class 1 Explosives and articles with explosives, Class 2 Gases, Class 3 Flammable liquids, Class 4.1 Flammable solids, self-reactive substances and desensitized explosives, Class 4.2 Self-igniting substances, Class 4.3 Substances which, in contact with water, emit flammable gases, Class 5.1 Oxidizing substances, supporting combustion, Class 5.2 Organic peroxides, Class 6.1 Toxic substances, Class 6.2 Infectious substances, Class 7 Radioactive material, Class 8 Corrosive substances, Class 9 Miscellaneous dangerous substances and articles.

The codes are described in the form of letters, where A stands for asphyxiant gases, C - corrosive substances, D - explosive, F - inflammable, I - infectious, O - oxidizing, P - organic peroxides, S - self-igniting, SR - self-reactive, T - poisonous, W - emitting flammable gases upon contact with water, and M - other dangerous (RID). In addition to the warning stickers, the RID Regulations also contain other markings of dangerous goods in the form of, for example, orange boards with specific dimensions with appropriate numbering markings indicating the goods identification number (UN), hazard number and its intensity, signs for materials with increased temperature, maneuvering signs, belt orange or signs for environmentally hazardous materials (Kołdys, 2022).

4. High-risk Goods

Internal regulations of the managers of the national railway network additionally separate from the group of dangerous goods, the so-called high risk goods (TWR). These are goods which 'may be misused for terrorist purposes and which may cause serious consequences such as numerous victims, mass destruction or, particularly in the case of Class 7, massive socio-economic disruption (Instruction Ir-16, 2021). Employees working on the transport of high-risk goods by rail should receive appropriate training (Chmieliński, 2019, p. 44-49).

Due to the degree of risk resulting from the transport of dangerous goods, including high-risk goods, their transport should be carried out with the least possible number of stops, maneuvering works, in order to deliver the cargo to the destination station as soon as possible. Employees of technical posts are obliged to observe trains carrying the above-mentioned goods and ensuring increased vigilance, and each stop of a train with hazardous substances must be reported to the line dispatcher by displays and the duty service of the Regional Headquarters of the Railway Protection Service (Instruction Ir-16, 2021).

The group of goods with special transport procedures also includes non-standard loads, referred to as extraordinary shipments, which are described in detail in the Instruction on the Transport of Special Shipments (Ir-10) (Instruction Ir-10, 2022).

5. Packaging for the Transport of Dangerous Goods

In order to maintain the greatest possible safety when transporting dangerous goods, it is necessary to use appropriate packaging. As the packaging is to a large extent an integral part of the product, it should be versatile, adapting to the individual needs of the product, while fulfilling additional functions (Bieniek, 2019, pp. 155-164). One of the most important functions that packaging should fulfill when transporting dangerous goods in rail transport is protection against shocks and vibrations resulting from the condition of the infrastructure (Jałowiec, 2021, p. 99). However, in addition, the packaging should be (Bomba, 2014, pp. 602-620):

- made of plastic which, in contact with a dangerous material inside, will not cause any interaction (they will be resistant to its operation);
- impermeable;
- in good condition and quality, allowing to ensure the safety of the transported substance;
- constructed to protect against pollution and outdoor conditions;
- resistant to all forces acting on them during transport, as well as reloading.

In order for the transport of dangerous goods to pose the lowest possible risk, the following packing groups are classified (Tkaczyk, Banasiak 2004, pp. 129-139):

- Packing group I - X - includes goods that present high risk,
- Packing group II - Y - includes goods presenting medium risk,
- Packing group III - Z - includes low-risk goods.

When carrying out the transport of dangerous goods by rail, it is necessary to select the appropriate means of transport. The most commonly used for this purpose are typical covered wagons, large containers, battery wagons, demountable cisterns, portable cisterns or cistern wagons (Pilaszkiewicz, 2003, pp. 10-13).

6. Obligations of Entities Carrying out the Transport of Dangerous Goods

The entities involved in the implementation of the process of transporting dangerous goods bear a great responsibility to ensure safety at every stage, from preparation of the shipment, through transport, to final unloading. People particularly associated with this project are (Rogalski and Pyza, 2018, pp. 341-350):

- sender (manufacturer) - responsible for the entire process of preparing the shipment, its packaging and proper labeling of dangerous goods;
- carrier - responsible for the proper preparation and marking of the vehicle and the correct preparation of the transport document;
- train driver - responsible for the method of transportation and driving, adherence to speed limits and specific regulations and recommendations.

All persons involved in the loading, transport and unloading of dangerous goods are required to have the appropriate qualifications in accordance with the provisions of the RID regulations, and must undergo appropriate training. Entrepreneurs must additionally appoint a safety advisor in the transport of dangerous goods (Grabarek, Bęczkowska, 2010, pp. 1-8). The authority granting the above powers on the railways is the Transport Technical Inspection Director (UTK 2022a).

The RID regulations describe the obligations of entities such as: consignor, carrier, consignee, shipper, packer, filler, operator of a tank-container or portable tanker, operator of a cistern-wagon, railway infrastructure manager and unloader (RID).

7. Safety of Transport of Dangerous Goods by Rail

The transport of dangerous goods entails enormous risks. Contact with such substances poses a great threat to human life and health, as well as to the safety of the natural environment. This is why the transport of these substances is so strongly regulated by legal regulations. Every year, the transport of dangerous goods in Poland with the use of railway infrastructure amounts to approximately 20 million tons of goods. According to the RID (UTK 2022b) classification, the most frequently transported goods by rail are flammable liquids, i.e. gasoline and diesel fuels, followed by gases and corrosive substances.

A positive aspect is the fact that the number of accidents and breakdowns during this type of transport is reduced. Critical points on railway lines are viaducts and tunnels, as well as areas in close proximity, i.e. ecologically sensitive areas, areas inhabited by the population, and also used industrially (Jaworska and Nowacki, 2017, pp. 79-84). We hear about major disasters in rail transport less and less often, the current problem in the transport of dangerous goods is definitely more often failures related to the leakage of a substance or its volatilization.

In terms of the safety of the transport of dangerous goods, rail transport can be considered universal and reliable due to the possibility of transporting goods regardless of the season and weather conditions. In addition, it is possible to transport materials in much larger quantities and over longer distances than other modes of transport (Batarliene, 2020, pp. 1-12). The risk associated with the transport of dangerous goods relates primarily to the negative impact on the surrounding environment, as well as human health and safety. It can be both chronic, through increased emission of gaseous pollutants, noise or acute in the form of various types of accidents and incidents (Torretta *et al.*, 2017, pp. 1-9).

Compared to other means of transport, e.g. road transport, accidents involving trains occur much less frequently, however, the size of a single transport of cargo is much larger, so the consequences of incidents involving hazardous materials can be catastrophic. When considering this mode of transport, hazards can be considered on the basis of the potential domino effect. In the event that a fire breaks out in one car,

it can automatically spread the flames to an adjacent one, and ultimately the whole train may explode (Zarei *et al.*, 2022, pp. 1-21).

The railway technical rescue teams together with units of the State Fire Service are responsible for rescue on the railroad. The activity conducted by technical rescue is regulated only on the basis of internal regulations of railway line managers, namely the Instruction on technical railway rescue (Ir-15). They use Technical Rescue Trains (PRT) and Special Technical Rescue Trains (SPRT) to remove the consequences of the incidents (Jaworska and Nowacki, 2017, pp. 79-84). In addition to control, the transport of dangerous goods is additionally based on a monitoring system. Legal regulations have been created for the purpose of such transport.

One of them is the Act on the monitoring system for road and rail freight transport and trading in heating fuels (Act of 9 March 2017). Real-time monitoring of dangerous goods aims to increase safety. Its purpose is to protect the cargo, observe its condition, control the conditions of transport, storage or the location of the vehicle. Monitoring improves the activity of carriers and controllers (Kopczewski and Nowacki, 2019, pp. 64-73). In rail transport, the monitoring system is based on the operation of the GSM-R system. Its task is, among others, determining the location of the train or sending alerts about extraordinary situations and irregularities on the transport route.

The system is a multi-module system, consisting of, among others, a railway tachograph module, a wagon location module, a driver identification module, or a locomotive operation monitoring module. Additionally, each locomotive should be equipped with video recorders in front of the vehicle and sound recorders inside the cabin. Many hauliers are also starting to adopt RFID-based systems to improve vehicle formation, transfer, identification and tracking. To achieve this goal, it was necessary to build special RFID gates and equip the service with mobile RFID readers (Bęczkowska and Grabarek, 2017, pp. 31-39).

It should be emphasized that before the Safety Management Systems (SMS) entered the railway system, they were used in air transport, which adopted them on the basis of the Safety Management Systems developed for the needs of the nuclear energy sector (Pawlik, 2016, pp. 11-20). The first guidelines for building safety management systems in the rail transport system were published by the European Railway Agency in the form of assessment criteria used by national safety authorities (European Railway Agency, 2007).

It was not until December 2010 that common safety assessment methods were published with regard to compliance with the requirements for obtaining railway safety certificates (Commission Regulation (EU) No 1158/2010 of 9 December 2010) and safety authorizations (Commission Regulation (EU) No 1169/2010 of 10 December 2010), which enabled verification of the constructed safety management systems. The provisions of the directive also forced the establishment of a national

safety authority in Poland (the Railway Transport Office - UTK) and an investigative body investigating the causes of railway accidents and incidents (State Railway Accident Investigation Commission - PKBWK).

In Poland, after January 1, 2011, railway carriers and railway infrastructure managers could conduct their activities after receiving a safety certificate, or a safety authorization.

8. Transportation of Dangerous Goods in Poland

In Poland, the transport of dangerous goods in 2021 was carried out by 35 certified freight carriers, which means an increase by seven carriers compared to 2020. The share of the transport of dangerous goods in the rail market reached 12.1% in 2021 according to the weight transported (11.7% in 2020), and 17.4% according to the transport performance (17.0% in 2020). The transport of dangerous goods is carried out mainly in domestic transport. In 2021, domestic transport accounted for 68.1% (68.6% in 2020) according to the transported weight and 73.6% (71.6% in 2020) according to the transport performance.

Flammable liquid materials (class 3) remained the key class of cargo in 2021. Their market share by transported weight was 63.7% (61.7% in 2020), and by transport performance 69% (66.8% in 2020). According to the classification of dangerous goods, apart from liquid flammable materials, various dangerous materials and articles (class 9) had the largest share in the transport. Liquid flammable materials accounted for 63.7% of all hazardous materials by weight transported in 2021 (Report, 2022, p. 113).

9. Potential Threat of Deliveries of Dangerous Goods by Terrorist Activities

Part of this article presents an analysis of the problem of the possibility of terrorism occurring during the transport of dangerous goods. Due to the lack of specific quantitative data on the volume of transport of this type of cargo, since the launch of the armed attack by Russia on Ukraine, an analysis has been made from press articles, transcripts of interviews, books presenting international relations of Eastern European countries and showing the general security situation of Poland, internal documents of Polish Railway Lines, as well as largely from the participant observation of one of the authors of the article.

On January 20, 2022, shortly before the start of Russia's armed attack on the Ukrainian population, Ukraine blocked the transit of goods transported by rail, including from China, and announced a total ban on the export of goods from Ukraine to Poland by Ukrainian wagons. This event disrupted supply chains. Initially, the reason was the limited capacity of the railway lines and repairs, but

over time, the reasons were found in terms of road transport, for which bilateral permits are required.

The Ukrainian side concluded that Poland granted Ukraine too few permits for entry of Ukrainian drivers to Poland. The blockade of Polish railway border crossings means large financial losses for the state budget. Due to the growing tension on the part of Russia, the Polish and Ukrainian authorities decided to ease the dispute that threatened to weaken the alliance between neighboring countries.

At the meeting of state representatives, decisions were made to increase the permits for Ukrainian drivers to cross the Polish-Ukrainian border, to shorten the time for checking trucks and to resume rail transit (Publicystyka ngo.pl, 2022).

The main task for the Russian invaders in the initial phase of the war was to deprive Ukrainians of access to fuel, and thus prevent the movement and storage of fuels. They are trying to completely destroy Ukraine's energy infrastructure. During the shelling, 15 fuel depots were destroyed, as well as the largest refinery in Kremenchuk.

After the launch of the attack, Kiev stopped buying fuels from Belarus and Russia, which in 2021 accounted for an average of 56% of Ukraine's fuels, and was forced to obtain reserves from other sources (Potocki, 2022). In this situation, Poland has become a hub and relay for fuels from the West on the territory of Ukraine, but itself is also to supply 25,000 tons of gasoline from its reserves (e-petrol.pl, 2022).

As a result of the fuel deficit in Ukraine, the state authorities have abolished mutual licenses for all carriers in the transport of fuels. The rules have been greatly simplified. On the one hand, it greatly facilitates transport, on the other hand, it poses a terrorist threat. If, in the case of transport by lorries, the transport is less risky, the transport of fuels by rail transport from the refinery in Płock to the border crossing in Żurawica poses a much greater threat. Poland signed an agreement to supply fuel on the territory of Ukraine, however, implementation plans have not been properly specified.

Many key aspects were not taken into account, including: the size of the planned transport weights, the time horizon of the use of the Polish logistics channel, the appointment of an appropriate entity responsible for freight forwarding, lack of intermodal terminals at the border, insufficient border crossing capacity, track gauge difference, poor coordination of the work of services at the border, as well as insufficient number of drivers and train drivers. In addition to the above-mentioned aspects, special attention should also be paid to the limited capacity of the line along the entire route of transport of dangerous goods, and the risk resulting from their transport, as well as the increased risk at transit stations (Kiewlicz, 2022).

The issue of threats related to the transport of rail goods covers a wide range of aspects. The likelihood of terrorism occurring in Poland, despite the lack of terrorist attacks in recent years, is quite high due to military operations carried out in close proximity. The policy pursued by the neighboring countries has a great influence on the direction and scale of the Russian invader's actions. Russia is unpredictable, just as the actions of terrorist groups are unpredictable.

From the perspective of increasing crime, it becomes necessary to analyze the potential interests of established criminal groups, the correlation of the economic and social situation at the place where criminal groups operate, the impact of international ties, and the scale of applying preventive measures in the fight against crime (Łabuz, 2015, p. 31).

Tensions and fears of the threat of terrorism are growing among Polish citizens as a result of observing events taking place in a neighboring country. One of the acts of defense of the Ukrainians was to detonate a train carrying fuel for the Russian army. It is easy to imagine the scale of the damage caused by this practice, but it is more difficult to imagine the Russian retaliation situation, given the fact that Poland has become Ukraine's main supply hub for this raw material.

10. Conclusion

Ensuring the safe flow of energy resources is the overriding goal of the European Union countries. Energy security depends to a large extent on the uninterrupted supply chain of crude oil and natural gas. The main objectives of energy security are ensuring continuity of supplies, competitiveness on the energy market and environmental protection (Motowidlak and Motowidlak, 2016, pp. 7-17). The implementation of various solutions and provisions of European law into Polish law should be assessed as definitely positive.

Moreover, rail, as the safest inland mode of transport, is a natural candidate for the transport of dangerous goods. However, so that the transport of this type of goods is not equated with an increase in risk and the occurrence of negative events, it is necessary to monitor and strictly enforce compliance with the provisions in transport practice (Report 2022, p. 54). However, the main threats adversely affecting the course of transport processes include, inter alia, terrorist acts or cybercrime (Neider, 2019, pp. 294-295).

References:

- Act of 19 August 2011 on the transport of dangerous goods (consolidated text, Journal of Laws of 2022, item 2147).
- Act of 9 March 2017 on the monitoring system for road and rail freight transport and trading in heating fuels, consolidated text Journal of Laws of 2021, item 1857.

- Act of March 28, 2003 on rail transport (consolidated text, Journal of Laws of 2021, item 1984).
- Batarliene, N. 2020. Improving Safety of Transportation of Dangerous Goods by Railway Transport. *Infrastructures*, No. 5, 1-12.
- Bęczkowska, S., Grabarek, I. 2017. Wybrane zagadnienia monitorowania transportu towarów niebezpiecznych. *Prace Naukowe Politechniki Warszawskiej. Transport*, No. 117, 31-39.
- Bieniek, A. 2019. Rola opakowań transportowych w łańcuchu logistycznym. *Journal of TransLogistics*, 5.1, 155-164.
- Bomba, J. 2014. Transport ładunków niebezpiecznych. In: *Podręcznik spedytora: transport, spedycja, logistyka*. T.2 Marciniak- Neider, D., Neider, J. (ed.), Polish Chamber of Forwarding and Logistics, Gdynia, 602-620.
- Chmieliński, M. 2019. Bezpieczeństwo transportu towarów niebezpiecznych wysokiego ryzyka w portach morskich. *Autobusy, technika, eksploatacja, systemy*, No. 6, 44-49.
- Commission Regulation (EU) No 1158/2010 of 9 December 2010 on a common safety method for assessing compliance with the requirements for obtaining railway safety certificates, *Journal of Laws 2010*, No. L 326 of 10.12.2010.
- Commission Regulation (EU) No 1169/2010 of 10 December 2010 on a common safety method for assessing compliance with the requirements for obtaining a railway safety authorization, *Journal of Laws 2010*, No. L 327 of 11.12.2010.
- Directive (EU) 2016/798 of the European Parliament and of the Council of May, 11 2016 on railway safety (recast) (text with EEA relevance) (OJ EU L.2016.138. 102).
- Directive 2008/68 / EC of the European Parliament and of the Council of September, 24 2008 on the inland transport of dangerous goods (text with EEA relevance) (OJ EU.L.2008.260.13).
- Dziurdzińska, N. 2022. Ukraińcy wysadzili w powietrze pociąg z paliwem dla rosyjskiej armii. Na miejscu było morze ognia, the website of the Polish Press Agency. <https://www.pap.pl/aktualnosci/news%2C1094385%2Cukraincy-wysadzili-w-powietym-pociag-z-paliwem-dla-rosyjskiej-armii-na>.
- European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), made in Geneva on September 30, 1957, *Journal of Laws of 1975*, No. 35, item 189.
- European Railway Agency, Assessment criteria for railway undertakings and infrastructure managers used by national safety authorities to assess compliance with the safety requirements set out in safety certificates and safety authorizations issued in accordance with Article 10. Para. 2 lit. a) and art. 11 sec. 1 lit. a), date 31/05/2007.
- Government statement of February 15, 2021 on the entry into force of the amendments to the Regulations for the International Carriage of Dangerous Goods by Rail (RID), Annex C to the Convention Concerning International Carriage by Rail (COTIF), drawn up in Bern on May 9, 1980, *Journal of Laws of 2021*, item 992.
- Grabarek, I., Bęczkowska, S. 2010. Analiza czynników warunkujących ergonomiczne warunki pracy i bezpieczeństwo podczas transportu towarów niebezpiecznych. *Logistyka*, No. 4, 1-8.
- Instruction on the procedure for the transport of dangerous goods by rail Ir-16. 2021, on the basis of the Act of March 28, 2003 on rail transport, unified text. *Journal of Laws of 2021*, item 1984.
- Instruction on the transport of extraordinary shipments Ir-10 along the 1435 mm track. 2022. Appendix No. 1 to the Resolution No. 117/2022 of the Management Board of PKP Polskie Linie Kolejowe SA of 02.22.2022, Warsaw.

- Jałowiec, T. 2021. Ładunkoznawstwo dla logistyki. Wybrane problemy. Difin Publishing House. Warsaw, p. 156.
- Jaworska, K., Nowacki, G. 2017. Analiza przewozu towarów transportem kolejowym w Polsce. Buses: technology, operation, transport systems, No. 9, 74-78.
- Jaworska, K., Nowacki, G. 2017. Ratownictwo podczas przewozu towarów niebezpiecznych transportem kolejowym. Autobusy, technika, eksploatacja, systemy, No. 9, 79-84.
- Jaworska, K., Nowacki, G. 2019. Transport kolejowy w systemie logistycznym Polski. TTS Technika Transportu Szynowego, No. 4/2019, 46-52.
- Kiewlicz, R. 2022. Lotos Kolej przewiezie ukraińskie towary. Paliwo i zboże tranzytem przez Polskę, website of the Trojmiasto portal, [https://zdrowie.trojmiasto.pl/Lotos-Kolej-przewiezie-ukraiński-towary-Paliwo-i-zboze-tranzytem-przez-Polske-n167479.html?strona=2 & vop = w](https://zdrowie.trojmiasto.pl/Lotos-Kolej-przewiezie-ukraiński-towary-Paliwo-i-zboze-tranzytem-przez-Polske-n167479.html?strona=2&vop=w).
- Koldys, K. 2022. Towary niebezpieczne. Klasyfikacja i zagrożenia, strona internetowa portalu behapowcy.com, <https://behapowcy.com/towary-niebezpieczne-klasyfikacja-i-zagrozenia/>, dostęp: 11.04.2022 r.
- Kopczewski, R., Nowacki, G. 2019. Wykorzystanie inteligentnych systemów transportowych do monitorowania pojazdów przewożących towary niebezpieczne. Autobusy, technika, eksploatacja, systemy, No. 10-11, 64-73.
- Łabuz, P. 2015. Problematyka przewidywania rozwoju przestępczości – kierunki, obszary, tendencje. In: Lis, W. (ed.). Współczesne zagrożenia bezpieczeństwa państwa. Wydawnictwo KUL. Lublin, 31.
- Motowidlak, U., Motowidlak, T. 2016. Funkcjonowanie łańcuchów dostaw ropy naftowej i gazu ziemnego do Polski. Uwarunkowania infrastrukturalne i geopolityczne. Publishing House of the University of Łódź, Łódź, 7-17.
- Neider, J. 2019. Transport międzynarodowy. Wydawnictwo PWE. Warszawa.
- Pawlik, M. 2016. Bezpieczeństwo kolei w kontekście powiązań pomiędzy dyrektwami o bezpieczeństwie kolei i interoperacyjności kolei, analiza z punktu widzenia zarządzania bezpieczeństwem. Przegląd komunikacyjny, No. 9, 11-20.
- Pilaszkiewicz, A. 2003. Przewozy kolejowe pakowanych towarów niebezpiecznych. Packaging, No. 10, 10-13.
- Polska dostarczy Ukrainie paliwo z krajowych rezerw. 2022. website of the e-petrol.pl portal, <https://www.e-petrol.pl/wiadomosci-polska/109387/polska-dostarczy-ukrainie-paliwo-z-krajowych-rezerw>.
- Potocki, M. 2022. Ukraina zmaga się z potężnym kryzysem paliwowym. website of Dziennik Gazeta Prawna, <https://www.gazetaprawna.pl/wiadomosci/swiat/artykuly/8416755,ukraina-zmaga-sie-z-potężnym-kryzysem-paliwowym>. Html.
- Publicystyka ngo.pl 2022. Poland reached an agreement with Ukraine on the resumption of transit, the website of the ngo.pl portal, <https://publicystyka.ngo.pl/polska-dogadala-sie-z-ukraina-w-sprawie-wznowiska-tranzytu>.
- Railway traffic safety report 2021. 2022. Railway Transport Office, Warsaw, 54.
- Report on the functioning of the rail transport market 2021. 2022. Office of Rail Transport, Warsaw, 113.
- Rogalski, G., Pyza, D. 2018. Organizacja przewozów towarów niebezpiecznych. Prace Naukowe Politechniki Warszawskiej. Transport, nr 120, 341-350.
- Semenov, I.N., Filina, L., Kotowska, I., Pluciński, M., Wiktorowska-Jasik, A. 2008. Zintegrowane łańcuchy transportowe. Difin Publishing House. Warsaw, 81.

- Tkaczyk, S., Banasiak, J. 2004. Opakowania towarów niebezpiecznych stosowane w transporcie kolejowym. *Scientific Papers of the Silesian University of Technology*, No. 54, 129-139.
- Torretta, V., Rada, E.C., Schiavon, M., Viotti, P. 2017. Decision support systems for assessing risks involved in transporting hazardous materials: A review. *Safety Science*, No. 92, 1-9.
- UTK 2022a. Przewóz towarów niebezpiecznych (Carriage of dangerous goods). website [utk.gov.pl](https://www.utk.gov.pl/pl/bezpieczenstwo-systemy/przewoz-towarow-niebez/11849,Przewoz-koleja-towarow-niebezpiecznych.html), <https://www.utk.gov.pl/pl/bezpieczenstwo-systemy/przewoz-towarow-niebez/11849,Przewoz-koleja-towarow-niebezpiecznych.html>.
- UTK 2022b. Bezpieczny przewóz towarów niebezpiecznych (Safety transport of dangerous goods), website [utk.gov.pl](https://utk.gov.pl/pl/aktualnosci/15344,Bezpieczny-przewoz-Towarow-dangerous.html), <https://utk.gov.pl/pl/aktualnosci/15344,Bezpieczny-przewoz-Towarow-dangerous.html>.
- Zarei, E., Gholamizadeh, K., Khan, F., Khakzad, N. 2022. A dynamic domino effect risk analysis model for rail transport of hazardous material . *Journal of Loss Prevention in the Process Industries*, No. 74, 1-21.