
Adrian Budny[✉], **Tomasz Rokicki**^{1✉}

¹Warsaw University of Life Sciences – SGGW

Road transport of dangerous goods in Poland

Transport samochodowy towarów niebezpiecznych w Polsce

Abstract. Road transport of dangerous goods, due to their specific properties that may endanger people and the environment, is burdened with many procedures and numerous documentation related to the carriage and transport. Every year, the number of carriage of dangerous goods increases, which forces road users, especially people transporting these goods, to have a special entitlement that will allow for the safe transport of dangerous goods. The aim of the written assignment was to present the functioning of the transport of dangerous goods and the standards and rules to be followed in order not to pose a threat at any stage of the movement of this type of cargo. It was found that the number of accidents and incidents resulting from road transport of hazardous materials in Poland grows slower than the volume of this transport. The reason is the better and better adherence to the safety procedure. To reduce the risk of a hazard in the road transport of dangerous goods, it is extremely important to comply with the ADR agreement, be familiar with the law and regulations.

Key words: dangerous goods, hazardous substances, the ADR, road transport

Synopsis. Transport samochodowy towarów niebezpiecznych ze względu na ich specyficzne właściwości, które mogą zagrażać człowiekowi oraz otoczeniu jest obarczony wieloma procedurami i liczną dokumentacją związaną z przewozem i transportem. Każdego roku wzrasta liczba przewozów towarów niebezpiecznych, co wymusza na uczestnikach ruchu, a zwłaszcza osobach transportujących owe towary posiadanie szczególnych uprawnień, które pozwalają będą na bezpieczny przewóz niebezpiecznych ładunków. Celem pracy było przedstawienie funkcjonowania przewozów towarów niebezpiecznych oraz norm i zasad, jakich należy przestrzegać, aby nie stwarzać zagrożenia na żadnym z etapów przemieszczania się tego rodzaju ładunków. Stwierdzono, że liczba wypadków i incydentów wynikających z transportu drogowego materiałów niebezpiecznych w Polsce rośnie wolniej niż wielkość tego transportu. Przyczyną jest coraz lepsze przestrzeganie procedury bezpieczeństwa. Chcąc zmniejszyć ryzyko powstania zagrożenia w transporcie drogowym towarów niebezpiecznych, niezwykle ważne jest przestrzeganie umowy ADR, znajomość prawa i przepisów.

Słowa kluczowe: towary niebezpieczne, substancje niebezpieczne, umowa ADR, transport drogowy

Jel codes: R40, R42

✉ Adrian Budny – e-mail: adrian.budny.94@gmail.com

✉ Tomasz Rokicki – Warsaw University of Life Sciences – SGGW; Department of Logistics;
e-mail: Tomasz_rokicki@sggw.edu.pl; <https://orcid.org/0000-0003-3356-2643>

Introduction

Recent years have seen an increase in the volume of hazardous materials being transported by road. This poses a risk. In the event of a collision, there is a very high risk that the substances transported will escape, causing environmental contamination that poses a potential danger to humans and the environment. Strict compliance with the rules is therefore necessary. The carriage of dangerous goods is regulated in the Act on the Carriage of Dangerous Goods by Road and the European Agreement ADR, which is supervised by the Ministry of Health, specifically the Inspector for Chemical Substances and Preparations and the Environment, functioning according to the Act on Chemical Substances and Preparations [Kociński 2009].

The ADR agreement has common origins with the agreements on international transport: by sea (IMDG), by rail (RID), and by air (ICAO). The purpose of the ADR provisions is primarily to eliminate or reduce risks associated with the transport of dangerous goods by reducing the likelihood of an accident occurring and the extent of any damage. Such actions should not result in transport bans, but the transport itself must meet many legal requirements and restrictions. The detailed regulations mainly concern [Zielińska and Zelent 2008]: the rules for the classification of hazardous materials, conditions and manner of road transport of hazardous materials, the marking of packages, additional requirements concerning the vehicle transporting certain hazardous materials, its marking, equipment and the vehicle crew, documents required during transport, their templates and the manner of their issuance.

According to the guidelines of the ADR agreement, the transport of dangerous goods is subject to specific orders and bans, including those concerning the approval of the material for transport, its packaging, classification and marking, requirements concerning the means of transport of the vehicle, and the execution of the transport. Thanks to this classification, dangerous goods are assigned methods for choosing the right way of transportation, appropriate packaging, and procedures to be followed during transport or the occurrence of negative events, ensuring safety. All hazardous materials produced in the world are divided into 13 hazard classes, which means that after classifying the goods to the appropriate group and assigning it a number, it is necessary to select the appropriate means of transport and appropriate packaging of the goods, as well as persons managing the transport who have the relevant authorizations and training [Kisperska-Moroń and Krzyżaniak 2009]. The ADR agreement is amended every two years in the odd-numbered year. Such an agreement consists of a proper agreement and annexes A, B, which are its integral part. The pertinent agreement determines legal relations between the participating states, whereas annexes contain provisions regulating to a large extent the conditions of transport of particular hazardous materials in international road transport. Polish regulations have been based on international requirements, which has made it possible to significantly increase the level of transport safety through the application of international technical standards, constant improvement of regulations, and application of the same requirements in domestic and international transport. Protection of dangerous goods is based primarily on the human factor, i.e. the people who handle, organize and supervise the transport. Transport includes both transport and the loading, unloading, handling, and storage of toxic and explosive substances. The vast majority of hazards involving these special materials are due to negligence and disregard for fundamental safety rules by employees who fill tanks and containers without checking their tightness and

by vehicle drivers who do not follow the basic rules that are required during transport. To maintain appropriate conditions to ensure the correct course of transport, the rules contained in instructions, codes, laws, and other legal regulations concerning the transport of dangerous goods must be strictly observed. Provisions on the protection of dangerous goods are mainly contained in section 1.10 of the ADR agreement, where precautions are set out to reduce the risk of theft or dangerous goods being misused or leading to danger to people, the environment, or property. They were introduced into the ADR Agreement due to the possible use of dangerous goods for terrorist purposes [Urban and Szylar 2014].

The purpose of the study was to present the functioning of the transport of dangerous goods, the standards, and the rules that must be observed in order not to pose a threat at any stage of the movement of this type of cargo. The specific objectives of the study were as follows: to present the legal regulations on the transport of dangerous goods, to define the risks arising from the transport of this type of cargo, as well as the number of dangerous incidents during the transport of dangerous goods by road.

The paper has one research hypothesis – the number of accidents and incidents resulting from the transport of hazardous materials by road in Poland is increasing at a slower rate than the volume of such transport.

Materials and Methods

Using the method of purposeful selection, the area related to the transport of dangerous goods by road was selected for the study. Sources of materials were: literature on the subject, legal regulations on the transport of dangerous goods, reports and analyses on the transport of dangerous goods, websites. The following methods were used for data analysis and presentation: descriptive, tabular, graphic.

Results and discussion

Safety issues in the transport of hazardous materials by road

The transport of hazardous materials is a real danger to people and the environment. It is also an area of frequent negligence and conflicts with the law, because every day forwarding companies, i.e. carriers, shippers, and drivers, have to deal with many factors that affect the safe transport of dangerous goods. Issues related to the safety of road transport of dangerous goods are based primarily on the procedures available to those who order the transport and loading of dangerous goods, as well as on all actions aimed at ensuring safety in the transport of these materials [Wołczański and Rut 2014].

To ensure an appropriate level of road safety, it is necessary to improve the functioning of the existing legal regulations that apply to transport companies, as well as to enforce them thoroughly and strictly. General recommendations, which are commonly used in road transport of dangerous goods, are published in The European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR). Each means of transport adapted to the transport of dangerous goods meets specific construction requirements, which are checked and respected by all participants in the transport chain. The transport of dangerous goods is a complicated process due to the risks it may cause. At each stage of the transport,

from the preparation of the goods for transport, through loading, transport, unloading, and handing over to the final recipient, the highest precautions should be observed, and all the actions taken should take into account the potential risk of a situation endangering the life or health of people and animals, as well as the environment. The transport of dangerous goods is not a simple process and the number of steps and procedures to be followed to comply with the regulations means that the risk of danger is reduced to a minimum. Maintaining all safety measures during loading, handling, and transport [Kociołek 2010].

The main routes for transporting dangerous goods are mainly urbanized areas. The army together with the State Fire Service has developed a detailed map of roads that are used for transporting dangerous goods. It shows the routes on which vehicles may legally travel, as well as specially designated stopping places and detours in large urban areas, all to maintain maximum safety measures. The map also includes details of all the dangerous goods advisers, who are responsible for many processes relating to the transport of dangerous goods. Their main task is to plan loading and handling in such a way that it complies with the law by properly classifying and labeling the goods and cargo in question. Dangerous goods are classified with due care and precision to ensure their safe transport. The basic safety measures in the context of dangerous goods transport are [Bursztyński et al. 2010]:

- entrusting goods to experienced and trained drivers,
- the use of means of transport specifically designed for this purpose,
- appropriate vehicle equipment,
- to comply with the standards and rules designed to maintain safety.

The required additional equipment of the vehicle results from the issued written instruction intended for the vehicle crew. The basic equipment of the vehicle includes [Janczak 2011]:

- a fire extinguisher (2 kg + resulting from the carrying capacity of the vehicle),
- a minimum of one wheel chock (corresponding to the diameter of the wheels and the weight of the means of transport),
- two warning signs such as a triangle and reflective bollards,
- flashing lights emitting orange light,
- a number of reflective waistcoats or warning clothes corresponding to the number of crew members in the vehicle,
- a torch for all crew members,
- protective gloves,
- special eyewash,
- breathing masks,
- safety goggles,
- protection for manholes.

Regardless of the type of dangerous goods being transported, special transport must comply with all standards and regulations imposed by law. Any deviation or negligence in this respect may endanger the life and health not only of the operators of the vehicle transporting the hazardous materials but also of other road users. Negligence threatening leakage of toxic substances is also a very serious threat to the environment [Wołczański and Rut 2014].

The volume of road transport of hazardous materials in Poland

The transport of dangerous goods is an important branch of road transport. It is also very important in the context of threats it poses to road traffic. According to available data, 88–

90% of dangerous goods in Poland are transported by road, and only 8–10% by rail [Grzegorzczuk and Buchcar 2009, Kopczewski and Nowacki 2018].

Over 150 million t of dangerous goods are transported annually by road in Poland, which is over 430,000 t per day. To transport this cargo on standard 18-t semi-trailers, 24,000 trucks are needed daily. Accordingly, Poland needs a well-developed transport network to support trade and economic growth, create jobs and favorable economic conditions. Based on statistical data, it may be noted that in the case of transport of hazardous materials by road, the number of accidents is gradually decreasing from year to year. This is probably due to greater attention being paid by the services inspecting vehicles transporting hazardous materials. Their technical condition is improving. In January 2012, the Act on the Transport of Dangerous Goods transferred the supervision over this transport from voivodes to the minister responsible for transport.

Annually, 150 million t of dangerous goods (TN) are transported on Polish roads. According to available data, the number of dangerous goods transport has more than doubled between 2016 and 2019. The total volume of goods including dangerous goods that are transported in Poland by domestic road transport as well as international road transport has been increasing [Eurostat]. Figure 1 presents data on the transport of dangerous goods by road in Poland in particular years.

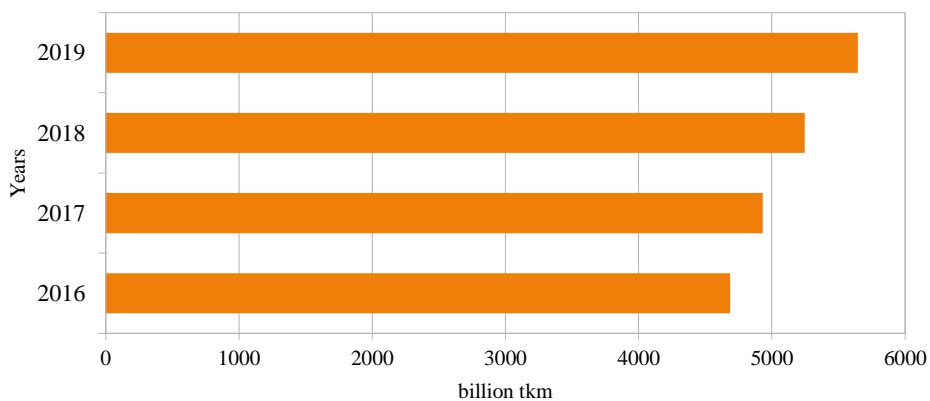


Figure 1. Freight performance in the transport of dangerous goods in billion tkm in 2016–2019

Rysunek 1. Praca przewozowa przy transporcie towarów niebezpiecznych w mld tkm w latach 2016–2019

Source: [Eurostat, Transport database].

The transport of dangerous goods in Poland has been systematically increasing. Road transport is one of the most frequently selected modes of transport of dangerous goods. About 80% of all dangerous goods in Europe were transported by road. In Poland this indicator is similar. Deciding on this type of transport of dangerous goods is primarily related to the costs incurred by the organizer of the transport. Nowadays road transport is considered to be one of the cheapest modes of transport for dangerous goods.

Most dangerous goods are transported in the vicinity of Tricity, Bydgoszcz, Tarnów, and Kielce. Dangerous goods are delivered mainly to industrial and production plants, of

which there are over 300 in Poland, 60 of which are considered to be particularly dangerous and hazardous to humans and the environment. These are plants and processing plants where hazardous substances are produced or used. Figure 2 presents the transport work carried out by different modes of transport between 1990 and 2020, concerning dangerous goods.

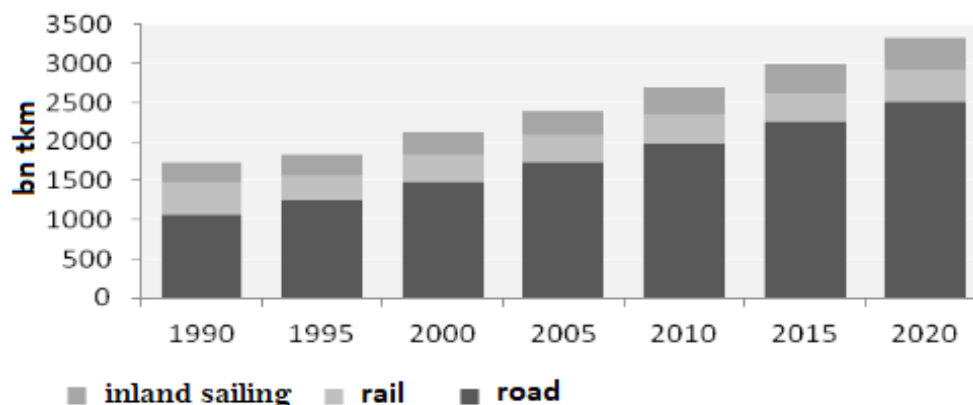


Figure 2. Dangerous goods transport by various modes of transport in 1990–2020 in the European Union
Rysunek 2. Przewozy towarów niebezpiecznych różnymi gałęziami transportu w latach 1990–2020 w Unii Europejskiej

Source: [ADR – Gazy].

Road transport was responsible for most of the transport work for dangerous goods. Among EU countries, Poland was in second place behind Germany, and ahead of Spain and France, in terms of dangerous goods transport. In 2019, hazardous goods transport in the EU accounted for 87.10 million tkm, of which transport in Poland was about 11 million tkm [Pułkowski and Domański 2010]. A comparison with other EU countries is shown in Table 1. It is clear that Poland, just after Spain and Germany, transported the most dangerous goods compared to the other EU countries.

The largest group of products transported in Poland were flammable liquids (more than half of the dangerous goods transported). Two other groups, gases (compressed, liquefied or dissolved under pressure) and corrosive substances, represented 14 and 10% respectively. These statistics are similar compared to previous years. In Poland, according to 2016 statistics, 88% of dangerous goods were transported by road and only 12% by rail. Another important statistic is the percentage use of the means of transport of dangerous goods. It was as follows [Grzegorzczak 2011, Kopczeński and Nowacki 2018]: tanks up to 79%, containers 20%, canned goods 1%. Chemical accidents and disasters may also cause the greatest potential risks. The predominant threats here are those arising from the way hazardous chemicals are stored and transported. As a result of failures, often combined with the negative impact of natural forces, hazardous substances leak into the environment in an uncontrolled manner and cause a potential hazard [Nowacki and Chmieliński 2017].

Table 1. Transport of dangerous goods in Poland compared to other EU countries

Tabela 1. Przewóz towarów niebezpiecznych w Polsce na tle innych krajów UE

Specification	Yearly transport of dangerous goods (million tkm)			
	2016	2017	2018	2019
EU	64 209	73 987	84 217	68 269
Germany	18 831	23 770	25 013	23 284
Spain	324	1 570	14 451	1 514
Poland	7 806	8 112	8 923	9 311
France	5 545	6 239	5 770	5 402
Latvia	6 865	6 555	4 677	4 872

Source: [Eurostat, Transport of dangerous goods].

The volume of dangerous goods transported by road is steadily increasing. Currently, the share of dangerous goods transport in the total number of road transports is estimated at 8–12%, of which liquid fuels such as petrol and diesel oil have the largest share (about 70%) [Nowacki and Chmieliński 2017]. This is related to the increasing demand for motor fuels. Detailed data on the volume of dangerous goods transport in Poland in 2015–2019 and the number of dangerous situations and accidents involving them are presented in Table 2.

Table 2. Transport of dangerous goods by road in 2015–2019 and the number of accidents in a given year

Tabela 2. Przewóz towarów niebezpiecznych transportem drogowym w latach 2015–2019 oraz liczba wypadków w danym roku

Specification	Transport of dangerous goods in the years				
	2015	2016	2017	2018	2019
Number of dangerous goods transported by road	22 965	23 618	25 866	27 676	29 145
Number of hazardous incidents	26	44	43	37	34
Share of hazardous events in road transport	0.1132 %	0.1862 %	0.1662 %	0.1337 %	0.1132 %

Source: [UTK 2019].

One can see an increase in the number of transports of dangerous goods by road, while the number of dangerous incidents has been steadily decreasing since 2015. The highest number of dangerous incidents was recorded in 2016 and the lowest in 2015, of which it should be remembered that in 2016 the total number of transports was almost 7 thousand lower than in 2019. Overall, the percentage of dangerous incidents in this type of transport was very low, as it was less than 0.2% [Kopczewski and Nowacki 2018].

Threats connected with the transport of hazardous materials may result, among other things, from technical defects of vehicles in which these substances are transported, improper operation of means of transport, poor condition of roads, and failure to observe road traffic safety [Bojar 2011]. In over 80% of cases, these incidents concern transport of liquid fuels,

the transport of which is particularly dangerous to the environment because of the risk of explosion and fire.

In order to reduce the risks involved in the transport of dangerous goods, it is essential to comply with the regulations in force for each of the participants in the process of transporting dangerous goods. Only informed action in compliance with the regulations will make it possible to minimize the risks involved in the transport of dangerous goods, both in Poland and around the world.

Conclusions

Year on year, the number of dangerous goods being transported by road is increasing. As a result, the hazards resulting from the movement of these goods are also increasing. During a road incident, there is a great risk that a substance will escape and cause contamination and degradation of the environment, but also a threat to human life and health. The transport of dangerous goods not only requires specialist knowledge of composition, chemical, and physical properties but also specialist packaging and means of transport. Very restrictive standards and rules of conduct apply to the transport of this type of goods. The provisions of the ADR agreement are commonly applied.

The article presents a hypothesis that the number of accidents and incidents resulting from the transport of hazardous materials by road in Poland is growing slower than the volume of such transport. The hypothesis was verified positively. Although the share of road transport in the transport of hazardous substances is growing year by year, all safety procedures are maintained to minimize accidents.

To reduce the risk of causing a hazard in road transport of dangerous goods, it is extremely important to observe the ADR agreement, to know the law and the regulations which aim to ensure that dangerous goods are properly marked and transported. All these actions undoubtedly improve road safety and minimize the occurrence of danger in road transport.

References

- ADR – Gazy, [źródło elektroniczne] <http://gazy-adr.prv.pl/index.php?page=prognozy> [access: 22.04.2020].
- Bojar P., 2011: Ocena ryzyka zajścia zdarzeń niepożądanych wynikającego z naruszeń przepisów, *Logistyka* 6, 13, 273–282.
- Bursztyński A., Drewek W., Zieliński M., 2010: Uwarunkowania i możliwości strategicznego transportu wojsk i techniki wojskowej, Sowa, Gdynia.
- Eurostat, Transport database, [electronic source] <http://ec.europa.eu/eurostat/web/transport/data/database> [access: 20.04.2020].
- Eurostat, Transport of dangerous goods, [electronic source] https://ec.europa.eu/eurostat/data-browser/view/rail_go_dnggood/default/table?lang=en [access: 22.04.2020].
- Grzegorzczak K., 2011: Przewóz towarów niebezpiecznych, *Kwartalnik Towary Niebezpieczne* 3, 21.
- Grzegorzczak K., Buchcar R., 2009: Towary niebezpieczne, *Transport w praktyce, AdeR*, Kraków.
- Janczak A., 2011: ADR w spedycji i magazynie, *Zacharek – Dom Wydawniczy*, Warszawa.
- Kisperska-Moroń D., Krzyżaniak S., 2009: *Logistyka, Biblioteka Logistyka*, Poznań.
- Kociołek K., 2010: *Drogowy przewóz towarów niebezpiecznych*, Wydawnictwo Tarbonus, Warszawa.
- Kokociński M., 2009: *Praktyczne aspekty stosowania ADR w przewozie towarów niebezpiecznych*, Credo, Piła.
- Kopczewski R., Nowacki G., 2018: Ewaluacja stanu bezpieczeństwa przewozu drogowego towarów niebezpiecznych w Polsce, *Autobusy: technika, eksploatacja, systemy transportowe* 19, 270–278.

- Nowacki G., Chmieliński M., 2017: Analiza transportu towarów niebezpiecznych w państwach członkowskich Unii Europejskiej, *Autobusy: technika, eksploatacja, systemy transportowe* 9, 11, 104–111.
- Pułkowski M., Domański W., 2010: Bezpieczeństwo transportu drogowego paliw płynnych w cysternach – podstawowe obowiązki uczestników przewozu, *Bezpieczeństwo pracy* 9, 12, 9–13.
- Urban J., Szylar K., 2014: Bezpieczeństwo przy transporcie towarów niebezpiecznych, [w:] *TransLogistics 2014*, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 53–66.
- UTK, 2019: Bezpieczny przewóz towarów niebezpiecznych, [electronic source] <https://utk.gov.pl/pl/aktualnosci/15344,Bezpieczny-przewoz-towarowniebezpiecznych.html> [access: 20.04.2021].
- Wółczański T., Rut T., 2014: Bezpieczeństwo w transporcie drogowym materiałów niebezpiecznych, *Logistyka* 4, 12–16.
- Zielińska T., Zelent S., 2008: *Transport samochodowy towarów niebezpiecznych*, Ośrodek Doradztwa i Doskonalenia Kadr, Gdańsk.