

# Safety restrictions in the logistics of dangerous and toxic substances

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**Abstract:** In this work the difficulties of a safety restriction in the transport of chemical substances is explored. The ranking of dangerous substances and materials is presented to indicate that substances used in various industries have been called hazardous. Transport of substances classified in hazardous group or even toxic is regulated by international rules, which apply in all countries of Europe - The European Agreement Concerning the International Carriage of Dangerous Goods by Road. This legislation aimed to eliminate or reduce the risks associated with transport of dangerous substances. The main aim of this article is to present the most important aspects which entrepreneurs planning the logistics of hazardous substances should consider.

**Key words** – logistic, safety regulation, hazardous substance

## 1. Classification of dangerous substances

The materials (goods) and objects which carriage (transport) is prohibited under the laws and their transport is allowed only under the conditions specified in the ADR regulations are called dangerous (BUBBICO R., DI CAVE, S., MAZZAROTTA, B. 2004, ELSHAFFEY M.M. et al. 2009, FÖRSTER H., GÜNTHER W. 2009, GERBEC M. 2008, KUNCYTYÉ R. ET AL. 2003, LEE. C.C. 1986, OPPELT E.T. 1987).

Transport of dangerous materials is defined by the ADR European contract established in Geneva on 30 September 1957 under the auspices of the United Nations Economic Commission, developed and published by The European Agreement concerning the International Carriage of Dangerous Goods by Road, ratified by Poland in 1975. ADR regulations for the carriage of dangerous substances are updated every two years (the beginning of odd).

### 1.1. The ranking of dangerous substances

All materials or substances having dangerous characteristics must be identified, classified and named standard unique names used in the ADR regulations on the carriage of dangerous goods. Dangerous materials are classified in one of 13 classes. Each material has its own position marked four- number (UN) and is assigned to one of three packaging groups (PG). These four pieces of information (UN, name by ADR, class, and PG) are enough to identify any dangerous material. Dangerous materials are classified according to the following priority ranking of risks (Table 1).

## 1.2. Material safety data sheets (MSDS) in RECH system

The fundamental tool used in REACH to ensure the flow of information in the supply chain to initiate measures to guarantee the safety and protection of human health and the environment are the chemical safety data sheets. The Safety Data Sheets must include information about the dangers of substance or preparation, as well as information on the recommended risk management measures necessary to adequately control dangers to health and the environment. In accordance with Article. 31 of the REACH Regulation the supplier of a substance or preparation to the recipient also provides the MSDS in the official language of the country in which the substance or preparation is placed on the market (based on Regulation (EC) No 1907/2006 of the European Parliament and of the Council, Official Journal of the European Union, L 136/3 and UK REACH Competent Authority Information Leaflet Number 8 – Exemptions - January 2009).

On the other hand the priority list of "most toxic" substances, based on a prioritization of substances

based on a combination of their frequency, toxicity, and potential for human exposure (Table 2).

Table 1. The risk ranking of dangerous substances (materials)

No.	Class	Characteristic
1.	1	Explosive and pyrotechnic materials
2.	2	Gases
3.	3	Flammable liquids
4.	4.1	Flammable solids materials, self-reactive substances and solid desensitized explosives
5.	4.2	Flammable materials
6.	4.3	Substances which in contact with water emit flammable gases
7.	5.1	Oxidizing substances
8.	5.2	Organic peroxides P1 - Organic peroxides, without temperature control, P2 - Organic peroxides, temperature controlled
9.	6.1	Toxic substances
10.	6.2	Infectious substances
11.	7	Radioactive materials
12.	8	Caustic materials
13.	9	Various dangerous substances and articles M1 - Materials that if inhaled in the form of fine dust, may constitute a danger for health M2 - Materials and instruments, which in case of fire may form dioxins M3 - The materials give off flammable vapors M4 - Lithium accumulators M5 - Emergency items M6-M8 - Environmentally hazardous materials M9-M10 - Materials with high temperature M11 - Other hazardous materials, do not corresponded to the definitions of other classes

Table 2. Top ten of the priority list of hazardous substances

2013 rank	Substance name	CAS	Total Pts	NPL Freq	Freq Pts	Tox	Tox Pts	GMMC Water	GMMC Soil	GMMC Air	TDD	SC	SC Pts	Exp to C	Exp to M	PExp to M	Exp Used	Exp Pts
1	arsenic	007440-38-2	1670	1140	538	1	600	6E-02	5E+01	8E-05	7E-02	7E-02	242	532	719	1794	1	290
2	lead	007439-92-1	1529	1272	600	10	400	1E-01	9E+02	3E-03	3E-01	3E-02	229	588	843	2400	1	300
3	mercury	007439-97-6	1459	832	392	1	600	3E-03	3E+00	3E-03	5E-02	5E-02	237	173	302	640	1	229
4	vinyl chloride	000075-01-4	1360	593	280	1	600	6E-02	1E+00	9E-03	2E-01	2E-01	259	125	139	410	1	221
5	polychlorinated biphenyls	001336-36-3	1344	547	258	1	600	1E-02	9E+01	1E-03	5E-02	5E-02	237	283	368	884	1	248
6	benzene	000071-43-2	1328	972	458	10	400	6E-02	1E+00	3E-02	5E-01	5E-02	236	201	302	936	1	234
7	cadmium	007440-43-9	1319	1003	473	10	400	4E-02	2E+01	1E-04	4E-02	4E-03	196	293	469	1113	1	250
8	benzo(a)pyrene	000050-32-8	1305	545	257	1	600	3E-02	7E+00	3E-04	4E-02	4E-02	231	99	239	534	1	217
9	polycyclic aromatic hydrocarbons	130498-29-2	1280	401	189	1	600	2E-01	2E+02	1E-03	3E-01	3E-01	266	147	184	630	1	225
10	benzo(b)fluoranthene	000205-99-2	1251	450	212	1	600	3E-02	1E+01	7E-06	4E-02	4E-02	230	52	181	345	1	209

CAS - Chemical Abstracts Service Registry Number;

Total Pts - Total Points;

NPL Freq - National Priorities List frequency;

Freq Pts - Frequency points;

Tox - Reportable Quantity or Toxicity/Environmental Score;

Tox Pts - Toxicity Points;

GMMC - Geometric Mean Maximum Concentration for water(mg/l), soil(mg/kg), air(mg/m<sup>3</sup>);

TDD - Theoretical Daily Dose;

SC - Source Contribution;

SC Pts - Source Contribution Points;

Exp to C (category 1) - Exposure to Contaminant;

Exp to M (cat. 2) - Exposure to Media;

PExp to M (cat.3) - Potential Exposure to Media;

Exp Used - Exposure Category used to determine Exposure Points; Exp Pts - Exposure Points.

Source: [http://www.atsdr.cdc.gov/spl/resources/ATSDR\\_2013\\_SPL\\_Detailed\\_Data\\_Table.pdf](http://www.atsdr.cdc.gov/spl/resources/ATSDR_2013_SPL_Detailed_Data_Table.pdf)

## 2. REACH Regulation

REACH (ang. Registration, Evaluation and Authorisation of Chemicals) is a regulation of the European Parliament and Council Regulation (EC) No 1907/2006 concerning the safe use of chemicals through their registration and evaluation, and in some cases, licensing and trade restrictions and the use of certain chemicals. The REACH regulation, applied directly, without the need to be introduced into Polish law. The law entered into force on 1 June 2007 and replaces or amends several of existing Community legislation, both the regulations and directives introduced into Polish law by Law on 11 January 2001 on chemical substances and preparations. REACH applies throughout the European Union, Norway, Iceland and Liechtenstein. Supervision over the implementation of the Regulation deals with the European Chemicals Agency (ECHA) in Helsinki. The main purpose of the REACH regulation is to ensure a high level of health and the environment, implementation of alternative methods for assessing hazards of substances and the free circulation of substances on the internal market. The rules of REACH apply at every stage - from production through to marketing, distribution up to the application on its own form or in a mixture or in the article (based on Regulation (EC) No 1907/2006 of the European Parliament and of the Council, Official Journal of the European Union, L 136/3 and UK REACH Competent Authority Information Leaflet Number 8 – Exemptions - January 2009).

The fundamental aim of the REACH Regulation is to provide a high level of protection of human health and the environment from risks posed by chemicals produced, imported and used or marketed in the European Community. The effective management of risks associated with the use of chemical substances in the workplace gives this possibility.

The regulations encourage the substitution of highly dangerous substances with less hazardous and dangerous technology; less dangerous, if suitable alternatives are available and applicable to an economical and technical point of view.

The purpose of the REACH Regulation is to ensure the free movement of chemical products in an internal market, by introducing a level of chemical

requirements for all EU members and to improve the competitiveness and innovation (based on Regulation (EC) No 1907/2006 of the European Parliament and of the Council, Official Journal of the European Union, L 136/3 and UK REACH Competent Authority Information Leaflet Number 8 – Exemptions - January 2009).

## 3. Transport of dangerous materials

For the transport of hazardous materials motor vehicles or vehicle combinations can be used, except a motorcycle or combination of vehicles consisting of a motorcycle and trailer. A combination of vehicles may have only one semi-trailer or trailer. According to ADR, all motor vehicles with a maximum mass over 12 tonnes and first registered as of 1/1/1998 should have a speed limiter set, that it cannot exceed a speed of 90 km/h (BUBBICO R., DI CAVE, S., MAZZAROTTA, B. 2004, ELSHAFFEY M.M. et al. 2009, FÖRSTER H., GÜNTHER W. 2009, GERBEC M. 2008, KUNCYTYÉ R. et al. 2003).

In Poland, according to the highway code, each truck with a maximum mass exceeding 3.5 tonnes and a vehicle, for which the specified minimum total weight of the vehicle over 3.5 tonnes, must be fitted with approved speed limiter installed by the producer or authorized entity. The speed controller limits the maximum speed of the truck to 90 km/h. Motor vehicles and trailers intended for use as transport units for transporting dangerous goods must have braking systems with a construction and performance that satisfies the relevant requirements of ECE Regulation No. 13.

Any vehicle for transporting materials and dangerous goods should be provided (according to ADR) in the appropriate safety equipment and fire extinguishers. Some of this equipment is fixed and unchanging regardless of the cargo - a basic piece of equipment, and part is dependent on the physicochemical properties of carriage materials.

Each vehicle carrying dangerous materials and goods should have at least one chock to be placed under the wheels, two standing warning signs, marking the point of failure (e.g., reflective pins, reflective triangles, or flash with an orange light, powered independently from the vehicle's electrical system), warn-

ing vest or warning clothing for each crew member, a flashlight (which contains no metal surfaces against the sparking) for each crew member.

#### 4. Summary and conclusions

As an additional safety equipment, depending on the nature of the cargo includes equipment for respiratory protection (such as an emergency escape mask or respirator with absorber). If the ADR contract is listed special rule S7, a vehicle must also be equipped with personal protective equipment (e.g. apparatus with water for rinsing eyes, glasses, gloves and footwear) and equipment which is necessary to take the additional or special set written in instructions (usually equipment designed for use in the case of small leakages, these are the containers for the collection of bulk materials, a device for inlets sealing, sewers and manholes, sealing putty).

The vehicle has to contain the following documents during transportation of hazardous materials: transport documents, written instructions for the driver, driver's training certificate (if required), certificate of qualification of driver, vehicle-approval certificate for the carriage of certain dangerous goods (for EX/II, EX/III, FL, OX, AT), permission for carriage of certain goods.

The accident instructions for the driver are prepared for every considered material. These instructions include the physicochemical properties of the material and the treatment in the event of an accident. These instructions should include: name of material or product groups, class and UN number, description of cargo, description of cargo. The description should be short, limited to the physical state of the material, e.g., color and smell - to help identify the release of the material, type of threat to the materials (the dominant threat, the threat of additional behavior of the material under the effect of flame or heat, information, whether the transported materials react dangerously with water). A brief description of the remedies that should apply to the driver, personal protective equipment that the driver should have.

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