DaGoB publication
series 5:2007

Transport of Dangerous Goods in the Baltic Sea Region

Project part-financed by the European Union
(European Regional Development Fund) within
the BSR INTERREG III B Neighbourhood Programme

DAGOB

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Baltic Sea Region INTERREG III B

DaGoB publication series
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This publication has been produced with the financial assistance of the European Union. The contents of this publication is the sole responsibility of the publisher and can under no circumstances be regarded as reflecting the position of the European Union.

ISBN 978-951-564-533-3

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Acronyms

ADR	The European Agreement concerning the International Carriage of Dangerous Goods by Road
BAG	Federal Authority of Goods Traffic
BAM	Federal Institute for Material Research and Testing
BC Code	Code of Safe Practice for Solid Bulk Cargoes
BSR	Baltic Sea Region
CSO	The Central Statistical Office of Finland
DaGoB	Safe and Reliable Transport Chains of Dangerous Good in the Baltic Sea Region
DG	Dangerous Goods
EBA	Federal Railway Authority
EU	European Union
GGVBinSch	Dangerous Goods Regulation Inland Navigation
GGVSE	Dangerous Goods Regulation for Road and Rail
GGVSee	Dangerous Goods Regulation Sea
IBC Code	International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
IGC Code	International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
IMDG Code	International Maritime Dangerous Goods code
INF Code	Code fort he Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships
MARPOL	International Convention for the Prevention of Pollution from Ships
MoU	Memorandum of Understanding
PTB	Federal Physical and Technological Institute
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail
SOLAS	International Convention for the Safety of Life at Sea
UN	United Nations

1 INTRODUCTION

This report has collected the data of Dangerous Goods (DG) transported in the Baltic Sea Region (BSR). The countries included are: Estonia, Finland, Germany, Latvia, Lithuania and Sweden. Each of these countries have partners in the DaGoB project and that is the reason for including only these countries. The statistics are from the years 1997-2006, concentrating on the latest possible data. Report includes information on dangerous goods road, rail and maritime transport modes.

The data from each country has been collected by the DaGoB partners and compiled into this Baltic Sea Region report by the WP 1 Leader, Turku School of Economics.

This report is part of the Safe and Reliable Transport Chains of Dangerous Goods in the Baltic Sea Region –project. DaGoB project aims at improving the co-operations between public and private stakeholders related to DG transport in the BSR by connecting the stakeholders on different levels, providing up-to-date information on cargo flows, supply chain efficiency and risks related to DG transport.

Along this survey of dangerous goods flows in the BSR, DaGoB project has also provided an overview of related incidents and accidents in the region. Also selected dangerous goods supply chains will be modelled including detailed process descriptions. Finally, DaGoB analyses and discusses key problems on selected cases and offers recommendations for remedial actions.

1.1 Legislation

Regulations concerning dangerous goods transport are much based on international agreements and EU legislation. Dangerous goods transport regulations are constantly being amended to improve safety and to keep up with science and technical development.

The most essential regulations of the dangerous goods transport are included in the National Acts on Transport of Dangerous Goods. In most cases these acts are skeleton laws, which have all the essential regulations of the different transport modes included. Detailed regulations are given in the separate amendments of each different transport mode.

These legislation and administrative issues are more detailed explained in other DaGoB publications, namely in publication 3:2006 Carriage of

Dangerous Goods and Law, and in publication 3:2007 Dangerous Goods Transport in the Baltic Sea Region: Authorities, Agencies and Regulations.

1.1.1 Road and Railroad Transport of Dangerous Goods

Regulations given according to the transport of dangerous goods in road and railroad are based on the international ADR agreement and RID regulations as well as on corresponding EU Directives.

Besides, there are also some National Acts on Transport of Dangerous Goods, which are applied in the road and rail transport. These regulations have clauses about dangerous goods classes, packagings, containers, tanks, shipping documents, transport, loading, vehicles, route restrictions of road transport, safe handling of coaches in the railway yards, detailed responsibilities of different parties taking part in road or rail transport, authorities supervising the transportation and about incident reporting.

1.1.2 Maritime Transport of Dangerous Goods

In maritime transport of dangerous goods the regulations given from transport of bulk and parcelled goods are conformed. MARPOL convention, binding BSR countries, includes regulations about transportation of petroleum and oil products to prevent the water pollution, transportation of liquid chemicals as well as transportation of marine pollutants.

International agreement on Safety of Life at Sea (SOLAS) from the year 1974 includes chemical tanker code (IBC-Code) and gas tanker code (IGC-Code), which regulate the structure and equipment of these tankers. In bulk cargoes the BC-Code, which includes instructions about the safe transportation of bulk cargo, is applied.

IMDG-Code, which is part of SOLAS agreement, includes regulations about the classification of goods, transport packages and tanks, and their markings as well as shipping documents and notifications. INF-Code includes regulations about general cargo transportation of irradiated nuclear fuel, plutonium and some radioactive waste.

In addition, National Maritime Administrations give more accurate regulations and instructions about applying these rules in the maritime transport. If transporting packaged dangerous goods in ro-ro ships in the Baltic Sea, Gulf of Bothnia, Gulf of Finland and in mouth of the Baltic Sea it

has to be done by the rules and conditions of Memorandum of Understanding (MoU) for the Transport of Packaged Dangerous Goods on Ro – Ro Ships in the Baltic Sea. MoU has been enforced by the decision of the National Maritime Administrations.

1.1.3 Other Regulations

In addition to those previous regulations, there are also regulations about dangerous goods safety advisors, driving authorisation of hauliers and road transport controlling, pressure equipment, tanks and packagings for dangerous goods transport as well as compulsory notifications of dangerous goods or marine pollutant in maritime transport.

1.2 Dangerous Goods Covered by the Report

“Dangerous Good” means a good which, because of its danger of explosion, fire or radiation, toxicity, corrosiveness or other similar characteristic may cause harm to humans, to the environment or to property.

1.2.1 Road and Rail

Dangerous goods are classified as follows:

Class 1	Explosives
Class 2	Gases
Class 3	Flammable liquids
Class 4.1	Flammable solids, self-reactive substances and solid desensitised explosives
Class 4.2	Substances liable to spontaneous combustion
Class 4.3	Substances which in contact with water emit flammable gases
Class 5.1	Oxidising substances
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

Within the various different classes, each transported substance has its own title and four-digit UN number. For example the title of caustic soda is “UN 1824 Sodium hydroxide solution”. For more details on classifications see Appendix I “Dangerous goods classes” of this report.

1.2.2 Sea

Chemicals which are dangerous in terms of their marine pollutant characteristics are broken down in accordance with Annex II of the MARPOL Convention (“noxious liquid substances carried in bulk”) into classes A, B, C and D. Class A is the most polluting of the marine environment, while class D comprises substances which have only limited danger characteristics. Chemicals which are regarded as being harmless to the marine environment when released in small quantities are listed in appendix III to Annex II of the MARPOL Convention. These substances may pollute the sea in large quantities, but no release regulations have been set for them.

Transportations of oil are broken down into transportations of crude oil and those of oil products.

In general cargo transportations, substances are broken down in accordance with the IMDG code into transportation classes equivalent to those in land transportations (classes 1 – 9). Packaged dangerous goods which pollute the marine environment are labelled in accordance with the IMDG code as “marine pollutants” or “severe marine pollutants”.

2 ESTONIA

2.1 Introduction

This part of the report collects the data of dangerous goods transported in Estonia in the years 2005 and 2006. This Estonian part of the report was provided to us by DaGoB partners: Estonian Railway Inspectorate and Estonian Maritime Administration.

2.2 Transport of Dangerous Goods by Road

There are no exact statistics available from the Estonian dangerous goods road transport, but from the following table, which was collected from the Statistics Estonia's databank, we can calculate an estimate figure.

Table 1 Goods carried by road in Estonia in 2005 (in thousand tonnes) (Source: Statistics Estonia)

Group of goods total	29,868
Solid mineral fuels	1,187
Crude petroleum	81
Petroleum products	1,401
Natural and chemical fertilizers	133
Coal chemicals, tar	7
Chemicals other than coal chemicals and tar	190

From the Table 1 we can make an estimate that approximately 2 million tonnes of dangerous goods was transported by road in Estonia in 2005. Most parts of the crude petroleum, petroleum products and chemicals other than coal chemicals are dangerous goods. Also some parts of the solid mineral fuels and fertilizers are considered to be dangerous goods. This adds up to about 2 million tonnes of dangerous goods road transport in Estonia.

2.3 Transport of Dangerous Goods by Rail

In 2005 the total volume of dangerous goods transported in Estonia by rail was as high as 31.3 million tonnes. This is however approximate figure, because it is calculated from the total freight amounts. As of 2005, the transport of dangerous freight amounts approximately to 71% of the total freight volume (31.3 million tonnes and 44,2 million tonnes respectively) carried on Estonian Railways ltd. Infrastructure.

In 2005 the majority of transportations consisted of class 9 (other dangerous substances). The next largest class transported was class 3 (flammable liquids). The total share of other dangerous goods was below 10%. The distribution of all classes of goods is shown in Table 2.

Table 2 Distribution of dangerous goods transport units by rail in Estonia in 2005 (Source: Estonian Railway Inspectorate)

Category	Wagons	
	units	%
9 - Other dangerous substances	287,079	53.5
3 - Flammable liquids	217,800	40.6
5.1 - Oxidizing substances	23,944	4.5
2 - Gases	5,051	0.9
8 - Corrosive substances	1,093	0.2
4.2 - Substances liable to spontaneous combustion	942	0.2
6.1 - Poisonous substances	217	0.0
4.3 - Substances that extract flammable gases when exposed to water	29	0.0
1 - Explosives	1	0.0
Total	536,156	100.0

Table 3 shows the volumes of the most transported dangerous goods and their transport routes during the years 2002–2005.

Table 3 Examples of Dangerous Goods carried in Estonian Railways in 2002-2005 (in tonnes)(Source: Estonian Railway Inspectorate)

	class	2002	2003	2004	2005
Acetic acid	8	2,672	3,196	3,260	3,959
Soapstone		2,386	2,787	2,494	2,773
Methanol	3	312	729	668	1,780
Hydrochloric acid	8	348	787	690	1,123
Sulphuric acid	8	594	792	330	791
Ironsulphate	9.1	0	0	263	593
Anhydrous ammonia	2.2	517	551	398	345
Nitric acid	8	278	213	350	265
Isopropanol	3.2	0	0	0	168
Hydrogen	5.1	0	124	751	118
Diethylene glycol	6.1	0	119	335	109
Aluminium sulfate	8.3	261	253	494	99
Butyl acetate	3.2	0	0	39	98
Ethylene glycol	3.3	0	52	40	57
Lard acid	9.1	60	0	0	50
Fish powder	4.2	3,916	2,469	2,062	3,665
Animal foodstuff	4.2	4,791	14,429	20,451	21,212
Fertilizer		24,290	33,051	27,485	28,117
Gasoline	3.1	12,786	2,300	0	0
Diesel	3	13,849	7,539	0	0

Approximately 53% of the total volume of dangerous freight came from Pechory-Tartu and Valga-Tartu direction and 47% from Narva direction.

Approximately 80% of the total volume of dangerous freight destinated/cumulated to Maardu-Muuga area. The remaining 20 % was divided so that 15% of the total volume was divided between Tallinn and Paldiski and 5% was left to the rest of the destinations in Estonia.

The most common dangerous substances that are transported on railways belong to the UN category 9. These are mainly characterized as having a potential polluting effect to the environment (compared to flammability or explosiveness). The second popular UN category of substances transported was 3, mostly made up by less dangeorus diesel fuel or its fractions. The volumes and share of substances from other UN categories were significantly smaller.

2.4 Transport of Dangerous Goods by Sea

For this part of the report dangerous goods (hazardous cargoes) are dangerous and polluting good as defined in Article 3 of the Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 establishing a Community vessel traffic monitoring and information system. It means that these are all cargoes listed in IMDG, BC (Appendix B), IBC and IGC Codes, and oils, noxious substances and harmful substances as defined, respectively, in Annexes I, II and III to the MARPOL Convention.

The information concerning the dangerous goods on board of ships arriving or leaving the Estonian ports have been required in accordance with the Article 13 of the Directive 2002/59/EC.

In 2006 the total volume of maritime transportations of dangerous goods was 33.2 million tonnes. Table 4 shows the total volume of maritime transportations in 2006 and their spread between import and export.

Table 4 Sea transport of hazardous cargo by different type of ships via Estonian ports in 2006 (in thousand tonnes) (Source: Estonian Maritime Administration)

Cargoes	Import	Export	Import+export	Number of ships involved	Share (%)
Dangerous goods in packaged form	114.2	562.0	676.2	1,810	2.0
Solid bulk cargoes	592.1	7,490.8	8,082.9	725	24.4
Chemicals in bulk	241.0	301.3	542.4	125	1.6
Oil in bulk	2,941.9	20,939.3	23,881.2	958	72.0
Total	3,889.3	29,293.4	33,182.7	3,618	100

The distribution of all dangerous goods classes is shown in the following table. Class 3 is by far the most transported substance with almost 74% share of the total amount.

Table 5 Classified dangerous goods flows via Estonian ports in the period 01.01.2006 - 31.12. 2006 (*Flammable liquids in bulk are included) (in thousands tonnes) (Source: Estonian Maritime Administration)

Hazard class	Import	Export	Import+export	Share (%)
Class 1	0.5	0.3	0.8	0.0
Class 2	17.9	19.0	36.9	0.1
Class 3*	3,046.4	21,395.3	24,441.7	73.7
Class 4.1	17.7	0.4	18.1	0.1
Class 4.2	0.1	1.2	1.3	0.0
Class 4.3	0.1	0.3	0.4	0.0
Class 4	17.9	1.8	19.7	0.1
Class 5.1	29.5	227.9	257.4	0.8
Class 5.2	>0.1	-	>0.1	0.0
Class 6.1	11.4	42.8	54.2	0.2
Class 6.2	0	-	0	0.0
Class 7	0	0	0	0.0
Class 8	25.8	6.9	32.7	0.1
Class 9	157.5	138.2	295.7	0.9
Total	3,889.3	29,293.5	33,182.8	100.0

In 2006, there were 3 cargoes with annual capacity over 1 million tonnes, 13 cargoes over 100,000 tonnes, 24 cargoes over 10,000 tonnes and 110 cargoes over 1,000 tonnes. Total number of notified individual dangerous goods (hazardous cargoes) was 337.

3 FINLAND

3.1 Introduction

This Finnish part of the report has collected the data of Dangerous Goods transported in Finland in the year 2002. It includes information on dangerous goods road, rail and maritime transport. This data has been collected from a five-year report of dangerous goods transport prepared by the Finnish Ministry of Transport and Communications. Ministry has published similar reports also in 1987, 1992 and 1997. The full report: “Transport of Dangerous Goods in Finland in 2002” (DaGoB publication series 2:2006) has been published earlier by the DaGoB project and in here we will present just some parts of that report.

3.2 Transport of Dangerous Goods by Road

In the case of transportations by road, this Finnish part of the report covers dangerous goods of classes 1 – 6.2, 8 and 9, where the volume of material transported at one time exceeds the “exemption limit”. The report excluded transportations in the Åland Islands and transportations which took place under supervision of the defence forces. Radioactive materials (class 7) remained outside the scope of the questionnaire, since the most important transportations of these are always known to the authorities and it is not appropriate to state the volume of these transportations in mass units.

In 2002, the total volume of dangerous goods transported by road in Finland was 12.3 million tonnes. According to the report, the growth in comparison to 1997 was about 2.7 million tonnes. Only some of this amount can be regarded as representing genuine growth in the volume transported. Over the course of the questionnaire which formed the basis of this road transportation report, it became apparent that the companies answering the questionnaire had studied the questionnaire more thoroughly than in the past, and that the answers were more exact. Presumably one reason for this is the development of electronic recording systems in companies in the area of logistic functions. The introduction of the safety adviser system in 2000 has in turn increased Dangerous Goods Transport expertise in companies,

and consequently the questionnaire reached the desk of the right person more quickly.

According to the Central Statistical Office of Finland, the volume of dangerous goods transported in 2002 was 15.7 million tonnes, and the share of the total volume of goods in road transport represented by dangerous goods was 4% (Road Traffic haulage statistics 2002). The CSO's results are based on a sampling study carried out by statistical methods. Data on lorry use during two consecutive study days was collected by a quarterly postal questionnaire, using a questionnaire form similar to the driver's log. In part, the discrepancy with this Ministry of Transport and Communications report can be explained by the different ways of collecting data. The CSO's statistics are based on data obtained from haulage companies, where a given volume of freight can be repeated a number of times when the same consignment is transported by a number of haulage companies.

3.2.1 Transport Volume of Dangerous Goods by Road

In 2002 the total volume of road transportations of dangerous goods was 12.3 million tonnes. Figure 1 shows the total volumes of road transportations in 1987, 1992, 1997 and 2002.

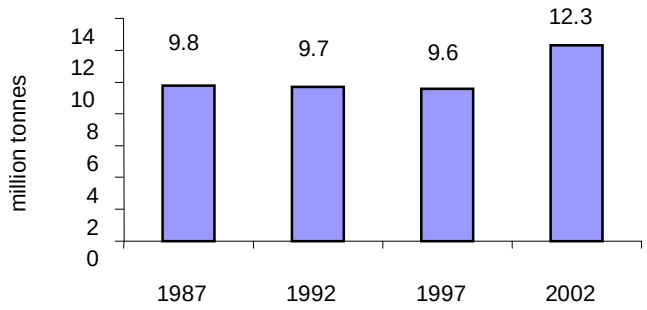


Figure 1 Total volume of dangerous goods transported by road in Finland in 1987, 1992, 1997 and 2002 (in million tonnes) (Source: Ministry of Transport and Communications Finland)

In 2002 the largest proportion of transportations were those of class 3 (flammable liquids), at about 67%. Next largest was class 8 (corrosive substances), with a share of about 15%. Class 2 (gases), class 5.1 (oxidising substances) and class 6.1 (toxic substances) each had a share of about 5%.

The share of dangerous goods belonging to class 9 was just under 2%. The total share of all other dangerous goods was below 1%. The distribution of all classes of goods is shown in Figure 2.

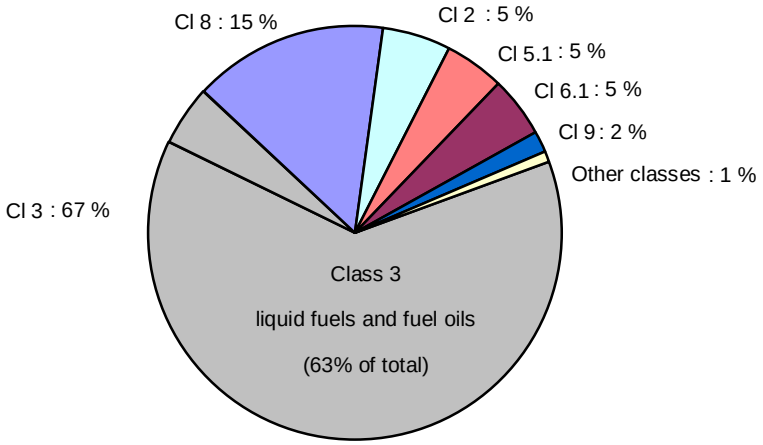


Figure 2 Distribution (%) of road transportations of dangerous goods in Finland in 2002 (Source: Ministry of Transport and Communications Finland)

Figure 3 shows the distributions of the classes of goods during 1987, 1992, 1997 and 2002.

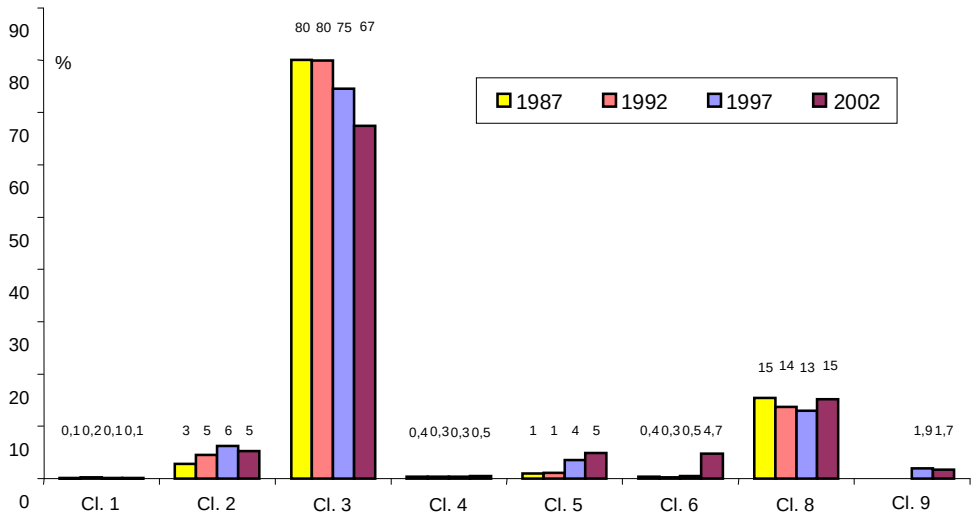


Figure 3 Distribution (%) of road transportations of dangerous goods by transportation class in Finland in 1987, 1992, 1997 and 2002 (Source: Ministry of Transport and Communications Finland)

3.2.2 Transport of Dangerous Goods by Road: Tonne-kilometres and Average Transportation Journeys

The total accumulated figure for road transportations of dangerous goods was about 1.7 billion tonne-kilometres. Table 6 shows tonne-kilometres by class; their shares of the total performance; and average transportation journeys.

Table 6 Road transport performance of dangerous goods in Finland in 2002 (Source: Ministry of Transport and Communications Finland)

Transportation class	Transportation performance (million tonne-km)	Share of total performance (%)	Average transportation journey (km) (Road traffic haulage statistics 2002)
1	5.0	0.3	69
2	158.0	9.2	193
3	973.3	56.8	133
4.1	17.3	1.0	
4.2	10.5	0.6	
4.3	5.5	0.3	300
5.1	98.0	5.7	
5.2	15.4	0.9	173
6.1	99.4	5.8	
6.2	0.0	0.0	189
7	-		-
8	272.5	15.9	147
9	58.6	3.4	127
Total	1,713.5	100	137

In terms of tonne-kilometres, the share of the total performance represented by flammable liquids (class 3) was 56.8%; that of corrosive substances (class 8), 15.9%; and that of gases (class 2) 9.2%. The shares of class 5.1 and of class 6.1 were in both cases just under 6%. The share of class 9 was 3.4%, and that of class 4.1 about 1%. The share of other classes was insignificant.

According to the CSO, the share of the entire transportation performance represented by dangerous goods was 8% (tonne-kilometres) (Road traffic haulage statistics 2002).

In transportations by road, the transportation journeys for dangerous goods are longer than average. According to the CSO, in 2002 the average transportation journey for dangerous goods was 137 kilometres, while in the case of all goods it was 48 kilometres (Road traffic haulage statistics 2002).

Explosives (class 1) had the shortest average transportation journey, about 70 km. The longest average transportation journey, 300 km, was in classes 4.1, 4.2 and 4.3. The average transportation journeys of all other classes were 100–200 km.

3.3 Transport of Dangerous Goods by Rail

The data on rail transportations was obtained from the Rail Administration. This is based on VR Cargo's freight data. The report includes the total volume of dangerous goods transported by rail, volumes by transportation class, and also tonne-kilometres and transportation routes.

In 2002 the total volume of dangerous goods transported by rail was 6.1 million tonnes. According to the report, the fall in comparison to 1997 was about 2.3 million tonnes. Following 1997 there was a reduction in transportations, with the total volume transported varying between 5.8 and 6.9 million tonnes during the years 1998–2002. Figure 4 shows the total volumes in 1997–2002.

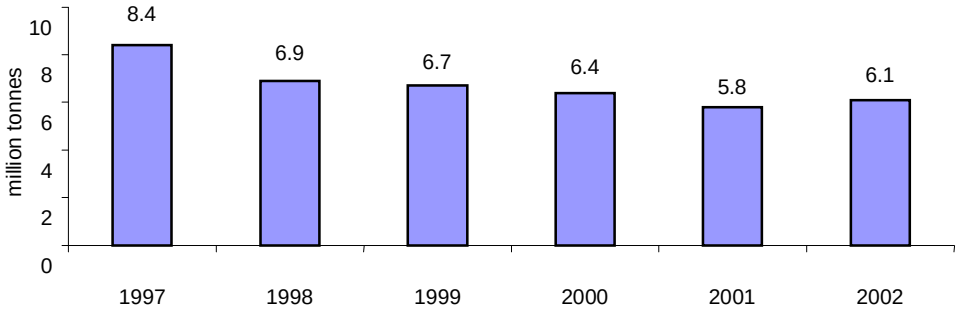


Figure 4 Total volume of dangerous goods transported by rail in Finland during 1997–2002 (in million tonnes) (Source: Ministry of Transport and Communications Finland)

3.3.1 Transport Volume of Dangerous Goods by Rail

In 2002 the total volume of dangerous goods transported by rail was 6.1 million tonnes.

In 2002 the majority of transportations consisted of class 3 (flammable liquids), at about 69%. The next largest classes transported were class 8 (corrosive substances) at 15% and class 2 (gases) at 11%. The share of class 5.1 (oxidising substances) was 2%. Class 4.1 and class 6.1 (toxic substances) both had a share of about 1%. The total share of other dangerous goods was below 1% (classes 1, 4.3 and 9). The distribution of all classes of goods is shown in Figure 5.

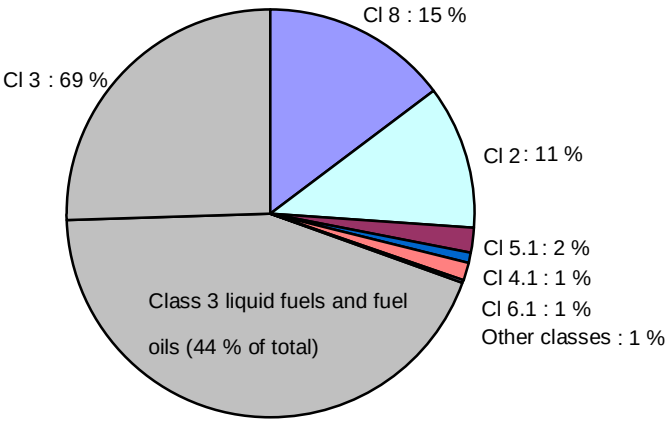


Figure 5 Distribution (%) of rail transportations of dangerous goods in Finland in 2002 (Source: Ministry of Transport and Communications Finland)

Figure 6 shows the distributions of the classes of goods during the years 1998–2002.

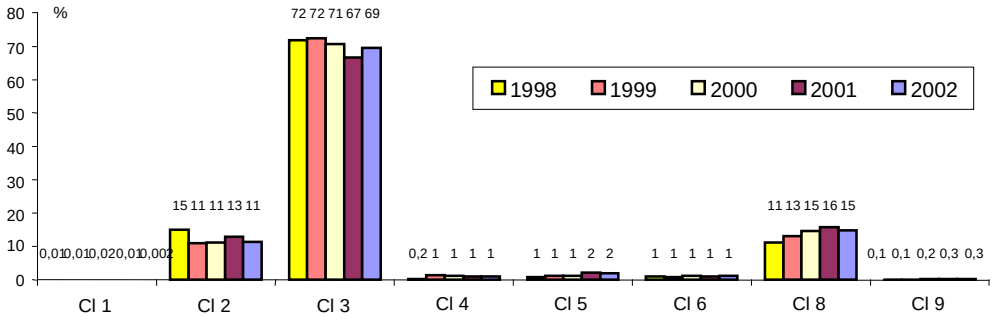
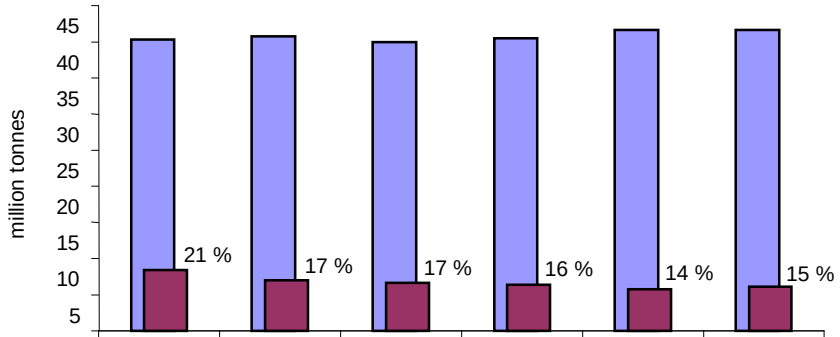


Figure 6 Distribution (%) of rail transportations of dangerous goods by transportation class in Finland in 1998–2002 (Source: Ministry of Transport and Communications Finland)

According to the Rail Administration, in 2002 about 41.7 million tonnes of freight were transported by rail in Finland in 2002 (Finnish Railway Statistics 2003). Thus the share of this total volume represented by dangerous goods was about 15%. Figure 7 shows the equivalent data for the years 1997–2002.



	1997	1998	1999	2000	2001	2002
All goods	40.3	40.7	40.0	40.5	41.7	41.7
DG	8.5	6.9	6.7	6.4	5.8	6.1

Figure 7 Railway freight transport volumes in Finland during 1997–2002 (in million tonnes) (Source: Ministry of Transport and Communications Finland)

3.3.2 Transport of Dangerous Goods by Rail: Tonne-kilometres and Average Transportation Journeys

In railway transportations of dangerous goods, the total accumulated volume was about 1.6 billion tonne-kilometres. Table 7 shows tonne-kilometres by class; their share of the total performance; and average transportation journeys.

Table 7 Rail transport performance of dangerous goods in Finland in 2002 (Source: Ministry of Transport and Communications Finland)

Transportation class	Transportation performance (million tonne-km)	Share of total performance (%)	Average transportation journey (km)
1	0.1	0.0	635
2	247.7	15.6	331
3	930.2	58.6	268
4.1	1.5	0.1	226
4.2	-	-	-
4.3	0.1	0.0	252
5.1	21.7	1.4	225
5.2	-	-	-
6.1	20.5	1.3	320
6.2	-	-	-
7	-	-	-
8	357.9	22.6	366
9	7.9	0.5	466
Total	1,587.6	100	307

In tonne-kilometres, the share of the total performance represented by flammable liquids (class 3) was 58.6%; that of corrosive substances (class 8), 22.6%; and of gases (class 2) 15.6%. The share of class 5.1 and of class 6.1 was slightly over 1% in both cases. The share of other classes was insignificant.

The average transportation journey of all classes was 307 km. The lengths of transportation journeys varied depending on the class involved. Explosives (class 1) had the longest average transportation journey, over 600 km. The next longest average transportation journey, 466 km, was in class 9. The average transportation journeys of classes 2, 6.1 and 8 were 300–400 km. The average transportation journeys of classes 3, 4.1, 4.3 and 5.1 were 200–300 km.

3.3.3 Transport of Dangerous Goods by Rail between Russia and Finland

In 2002 a total of 4.6 million tonnes of dangerous goods were transported by rail in traffic between Finland and Russia, representing 76% of all rail transportations of dangerous goods. Table 8 shows the volumes of

dangerous goods transported via Niirala and Vainikkala, by transportation class.

Table 8 Dangerous Goods rail transportations between Russia and Finland in 2002 (in thousand tonnes) (Source: Ministry of Transport and Communications Finland)

Transportation class	From Russia to Finland	From Finland to Russia	Total traffic between Finland and Russia	Share of total volume in class (%)
1	0.0	0.0	0.0	5
2	606.4	0.7	607.1	88
3	3,900.6	6.9	3,907.5	93
4.1	8.7	3.9	12.6	23
4.2	-	-	-	-
4.3	-	-	-	-
5.1	0.4	4.9	5.4	4
5.2	-	-	-	-
6.1	59.3	-	59.3	83
6.2	-	-	-	-
7	-	-	-	-
8	32.3	8.8	41.1	5
9	1.7	2.1	3.8	21
Total	4,609.4	27.4	4,636.7	

3.4 Transport of Dangerous Goods by Sea

The data on transportations by ship was obtained from the Maritime Administration. This is based on the data notified by ports, and on the Maritime Administration's statistics. The report includes total volumes of bulk and general cargo transported, and the distribution of this between different ports.

3.4.1 Transport Volume of Dangerous Goods by Sea

In 2002 the total volume of transportations of dangerous goods by ship was 39.2 million tonnes. Imports represented 64% of this and exports 36%. According to the report, the growth in transportations by ship in comparison to 1997 was about 5 million tonnes (15%). Table 9 shows total transportation

volumes by ship, and the change in comparison to the volumes transported during 1997. Figure 8 shows the distribution of transportations by ship.

Table 9 Dangerous goods transportations by sea in Finland in 2002 compared to transportations in 1997 (in thousand tonnes) (Source: Ministry of Transport and Communications Finland)

Transportation class	Transportation volume	Change in comparison to 1997	
			(%)
Bulk:			
Gases	377.7	+37.8	+ 11
Chemicals	4,905.9	+1,794.8	+ 56
Crude oil and oil products	25,757.8	+2,998.5	+ 13
Solid bulk	7,413.1	-138.8	- 2
General cargo (IMDG)	726.7	+274.0	+ 61
Total	39,181.1	+4,966.4	+ 15

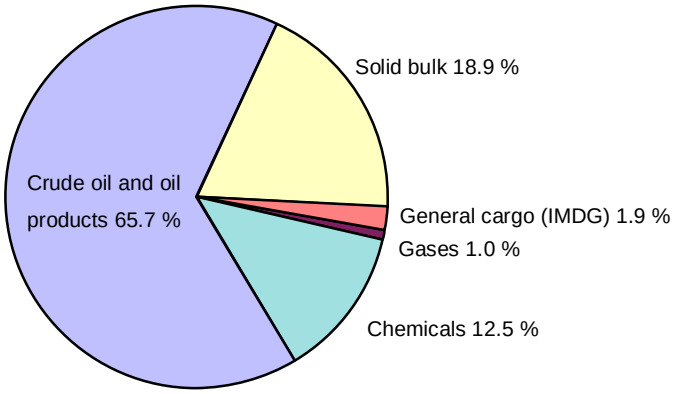


Figure 8 Distribution (%) of transportation of dangerous goods by sea in Finland in 2002 (Source: Ministry of Transport and Communications Finland)

3.4.2 Transport Volume of Dangerous Goods by Sea: Bulk Cargo

The total volume of bulk transportations was 38.5 million tonnes, representing 98.1% of all transportations of dangerous goods by ship. Import accounted for 65% of bulk transportations. Table 10 shows the import and export figures for bulk transportations broken down into gases, chemicals, crude oil and oil products plus solid bulk.

Table 10 Volume and distribution (%) of dangerous goods bulk transportations in Finland in 2002 (in thousand tonnes) (Source: Ministry of Transport and Communications Finland)

Bulk	Import	Export	Total volume (import + export)	Share of bulk transportations (%)
Gases	293.3	84.4	377.7	1
Chemicals	1,014.5	3,891.3	4,905.9	13
Crude oil and oil products	16,598.8	9,158.9	25,757.8	67
Solid bulk	6,897.4	515.7	7,413.1	19
Total	24,804.1	13,650.3	38,454.4	100

3.4.3 Transport Volume of Dangerous Goods by Sea: General Cargo

The share of all transportations by ship represented by general cargo (IMDG transportations) was only about 2%, in total 726.7 thousand tonnes, which was split almost equally between import and export. The volume imported was 383.1 thousand tonnes (53%) and that exported 343.7 thousand tonnes (47%).

Table 11 shows volumes of general cargo transported by ship, by transportation class.

Table 11 IMDG transportations in 2002, and comparison with transportations in 1997 (in thousand tonnes) (Source: Ministry of Transport and Communications Finland)

Transportation class (IMDG)	Import	Export	Total volume (import + export)	Share of IMDG transportations (%)	Change in comparison to 1997 (%)
1	8.9	0.7	9.6	1.3	+ 80
2	38.5	21.3	59.8	8.2	+ 73
3	132.6	115.9	248.5	34.2	+ 104
4.1, 4.2, 4.3	10.9	6.9	17.8	2.4	- 17
5.1, 5.2	44.4	55.7	100.1	13.8	+ 28
6.1, 6.2	31.3	17.3	48.6	6.7	+ 13
7	0.0	0.0	0.1	0.0	- 74
8	77.4	54.5	131.9	18.2	+ 46
9	39.1	71.3	110.4	15.2	+ 92
Total	383.1	343.7	726.7	100	+ 61

The largest category of general cargo transported in 2002 was class 3 (flammable liquids) at about 34%. The next largest was class 8 (corrosive substances) with a share of about 18%. The share of class 9 was 15%. The combined share of class 5.1 (oxidising substances) and class 5.2 (organic peroxides) was just under 14%. Class 2 (gases) represented a share of about 8%. The combined share of class 6.1 (toxic substances) and class 6.2 (infectious substances) totalled just under 7%. The combined share of classes 4.1, 4.2 and 4.3 came to about 2.5%, and that of class 1 (explosives) to just over 1%. The share of class 7 (radioactive substances) was insignificant (0.01%).

3.4.4 Transport Volume of Dangerous Goods by Inland Waterways

According to the report, inland waterway transportations were carried out via three inland water ports only. At Varkaus, Savonlinna and Lappeenranta a total of 111,131 tonnes were transported. These transportations consisted entirely of solid bulk.

3.5 Distribution of Dangerous Goods by Class in the Various Forms of Transportation

Table 12 shows the distribution of dangerous goods by class in road and railway transportations, in general cargo transportations by ship and in air transportations.

Table 12 Distribution of dangerous goods by class in road, rail, sea and air mode in Finland in 2002 (Source: Ministry of Transport and Communications Finland)

Transportation class	Road transportations (%)	Rail transportations (%)	General cargo transportations by ship (IMDG) (%)	Air transportations (%)
1	0.1	0.0	1.3	7.3
2	5.3	11.4	8.2	14.6
3	67.5	69.4	34.2	
4.1	0.5	0.9		28.9
4.2	0.0	0.0		0.0
4.3	0.1	0.1	2.4	0.4
5.1	4.8	2.0		0.5
5.2	0.1	0.0	13.8	0.0
6.1	4.7	1.2		0.8
6.2	0.0	0.0	6.7	0.9
7	(not included in the report)	0.0	0.0	16.1
8	15.3	14.8	18.2	6.3
9	1.7	0.3	15.2	24.9
Total	*100*	*100*	*100*	*100*

In all forms of transportation, the largest share was that of transportations of flammable liquids (class 3). In transportations by road and by rail, the distribution between different classes of goods was similar. In contrast to the situation with land transportations, class 9 substances accounted for a large proportion of IMDG and air transportations. Radioactive material accounted for a considerable share of air transportations, as did classes 5.1 and 5.2 in the case of IMDG transportations.

4 GERMANY

4.1 Introduction

This part of the report collects the data of dangerous goods transported in Germany in the years 2001–2004. The data was received from two dangerous goods transport reports[1], published by the Federal Statistical Office of Germany. It consists information about the transport of dangerous goods on road, rail, inland waterways as well as sea mode in each year. This German part of the report was provided to us by DaGoB work package 2 leader, TuTech Innovation GmbH.

With the German Act of Dangerous Goods Transport (GGBefG) the German parliament has authorised the Federal Ministry of Transport with the responsibility to issue regulations as and when required. Some responsibilities are delegated to some subordinated authorities. Before regulations are adopted and issued there is a circulation process to relevant authorities and organisations, particularly to the federal states administrations. Detailed regulations are given in separate regulations for each different transport mode.

Besides the Federal Ministry of Transport the subordinated Federal Authority of Goods Traffic is responsible for the road transport and the Federal Railway Authority for the rail transport. The main regulation for the transport of dangerous goods on inland waterways is the German Dangerous Goods Regulation Inland Navigation. Besides the Federal Ministry of Transport the Federal Water and Shipping Authority is responsible for that.

The regulations for dangerous goods by sea are combination between the regulation which are issued by the German government and also some regulations which are used internationally. These regulations arrange the transport for the maritime transport. The Dangerous Goods Regulation Sea (GGVSee) regulates the maritime transport inside Germany.

The transport data that is represented in this report is divided into two, one is for the data of overall goods and the other is the transport data for dangerous goods in all modes of transport. Both data are represented so the comparison between the dangerous goods and the overall goods can be

[1] Federal Statistical Office Germany (2004): Dangerous Goods Transports 2001/2002 and Federal Statistical Office Germany (2006): Dangerous Goods Transports 2003/2004.

seen. With the comparison, we can see how many percent of dangerous goods are transferred yearly from 2001-2004.

The data is taken from the Federal Statistic Authority of Germany. The basis of the data will be in the volume of dangerous goods transported, that is tonnes of dangerous goods transported in each year according to the classes and also in millions tonne-km. The class 7 is not included in the report.

4.2 Transport of Dangerous Goods

Dangerous goods are transported by road, rail, inland waterway and sea. In the Table 13 below stands the amount of overall freight goods, which were transported inside Germany in 2001-2004.

Table 13 Overall Freight Transport on Road, Rail, Inland Waterway and Sea mode in Germany in 2001-2004 (in million tonnes and tonne-km)

Year	Overall Transport			Road	
	Rail	Inland Waterway	Sea Traffic	German Vehicles	Foreign Vehicles
	in million tonnes				
2001	291.1	236.1	242.2	2,869.3	162.1
2002	289.2	231.7	242.5	2,704.8	160.4
2003	303.8	220.0	251.3	2,727.9	160.9
2004	310.3	235.9	268.2	2,747.6	223.2
	in million tonne-km				
2001	76,165	64,818	X	282,158	83,966
2002	76,283	64,166	X	277,641	83,960
2003	79,841	58,154	X	283,412	83,290
2004	86,409	63,667	X	295,233	133,018
	Change from previous year (based on tonnes)				
2002	-0.7	-1.8	0.2	-5.7	-1.1
2003	5.0	-5.1	3.6	0.9	0.3
2004	2.1	7.2	6.7	0.7	X
	Change from previous year (based on tonne-km)				
2002	0.2	-1.0	X	-1.6	0.0
2003	4.7	-9.4	X	2.1	-0.8
2004	8.2	9.5	X	4.2	X

Source : Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate

In overall the transport inside Germany uses road transport as the main mode of transports. It reaches nearly 80 percent of the total amount transported. Table 13 states that the amount of goods from year 2001 until 2004 reaches more than 2 million tonnes per year, while the other modes only reaches more than 200.000 tonnes per year, quite a big difference.

For the road as mode of transport itself, the biggest amount comes from the transport by the German vehicles. It holds around 70% of total transport that uses road as the mode of transport.

From the change of the amount of goods transported in each year, in year 2002 the amount of goods transported decreased with the biggest decrease happened in the road as the modes. But in the year 2004, there was an increase in all mode of transport with inland waterway ship as the biggest increase among the other.

Table 14 Dangerous Goods Transport on Road, Rail, Inland Waterway and Sea mode in Germany in 2001-2004 (in million tonnes and tonne-km) (Without dangerous goods class 7)

Year	Dangerous Goods Transport				
	Rail	Inland Waterway	Sea Traffic	Road German Vehicles	Foreign Vehicles
	in million tonnes				
2001	46.9	53.1	69.4	167.0	9.1
2002	48.1	50.8	66.8	144.1	8.3
2003	52.1	47.3	66.4	145.9	7.8
2004	53.9	49.9	74.1	146.7	9.5
	in million tonne-km				
2001	12,697	15,241	X	17,277	3,996
2002	12,868	14,091	X	15,933	3,826
2003	13,863	12,963	X	16,422	3,929
2004	13,837	13,651	X	16,708	5,404
	Change from previous year (based on tonnes)				
2002	2.5	-4.3	-3.8	-13.8	-8.7
2003	8.3	-7.0	-0.5	1.3	-5.5
2004	3.6	5.7	11.5	0.5	X
	Change from previous year (based on million tonne-km)				
2002	1.3	-7.5	X	-7.8	-4.3
2003	7.7	-8.0	X	3.1	2.7
2004	-0.2	5.3	X	1.7	X

Source : Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate

From Table 14 that resembles the transport of dangerous goods, the biggest amount of transport also happen in the same mode of transport as in the transport of all goods.

Road holds the biggest value of transport of dangerous goods in each year, but the value decreased quite deep from year 2001 to year 2002. It decreased nearly to 15%, but after that every year kept on increasing.

Table 15 Dangerous Goods percentage compared to Overall Transport in Germany in 2001-2004

Year	Percentage of Dangerous Goods from Overall Transport				
	Rail	Inland Waterway	Sea Traffic	Road	
				German Vehicles	Foreign Vehicles
2001	16.1%	22.5%	28.7%	5.8%	5.6%
2002	16.6%	21.9%	27.5%	5.3%	5.2%
2003	17.1%	21.5%	26.4%	5.4%	4.9%
2004	17.4%	21.2%	27.6%	5.3%	4.3%

In Table 15, the dangerous goods transport is being compared with the total good transport. For inland waterway and sea traffic, more than 20% of the transport is the transport for dangerous goods. In other case, in road as mode of transport, the percentage of dangerous goods is only around 5% compared to the overall transport of goods. It means that the transport of goods that uses road most of the case are the transport of regular goods.

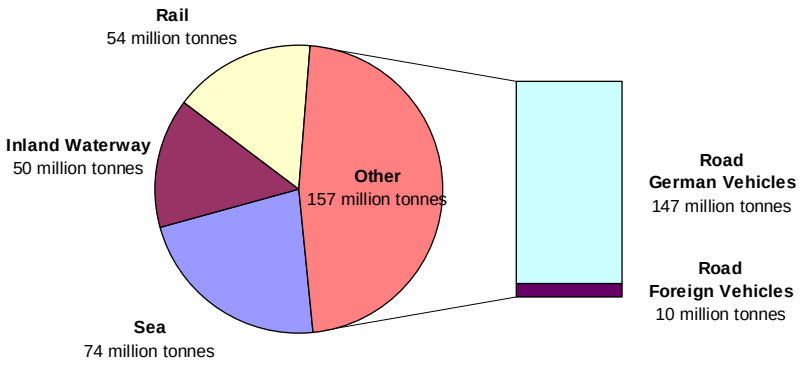


Figure 9 Dangerous Goods Transport in Germany in 2004 (Source: Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate)

From Figure 9 there is detailed information for the amount of dangerous goods transported in year 2004. The same pattern can be seen here that the amount of transport that uses the road as mode of transport is higher than others. With most of them are the German vehicles. The road transport of dangerous goods reaches near to 150 million tonnes of cargo, which is almost 50% of the total dangerous goods transport.

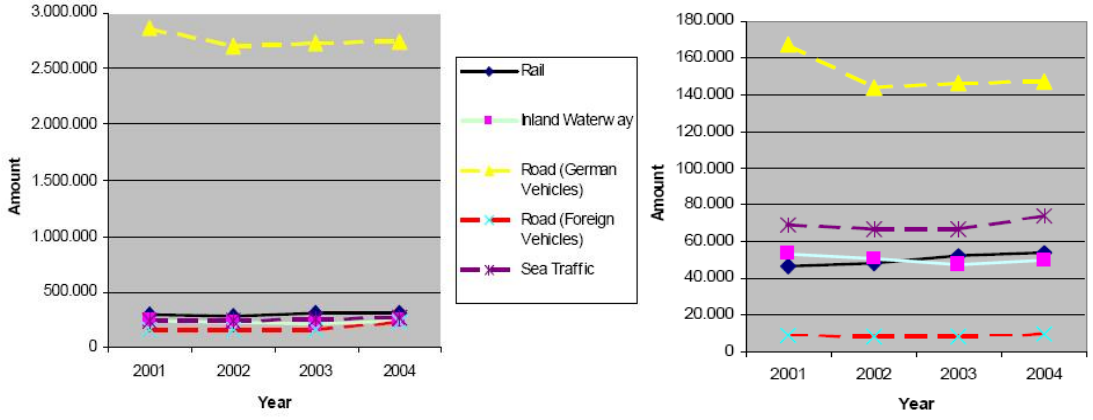


Figure 10 Overall Transport (left) and Dangerous Goods Transport (right) by Road, Rail, Inland Waterway and Sea mode in Germany in 2001-2004 (in thousand tonnes) (Source: Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate)

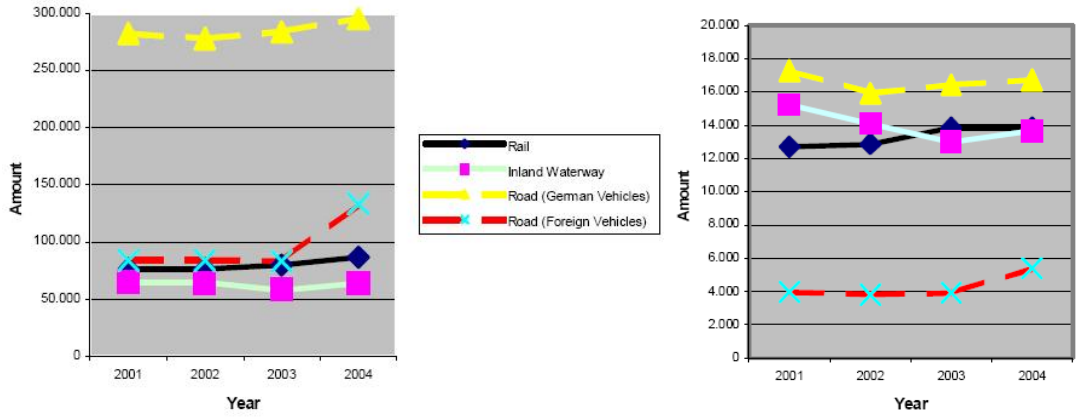


Figure 11 The Overall Transport (left) and Dangerous Goods Transport (right) by Road, Rail, Inland Waterway and Sea mode in Germany in 2001-2004 (in million tonne-km) (Source: Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate)

In the Figures 10 and 11 you can see the big difference in the amount of goods transferred on road and on other modes of transports, either dangerous goods or regular goods. The yearly transport amount of each mode is relatively constant.

4.3 Transport of Dangerous Goods by Road

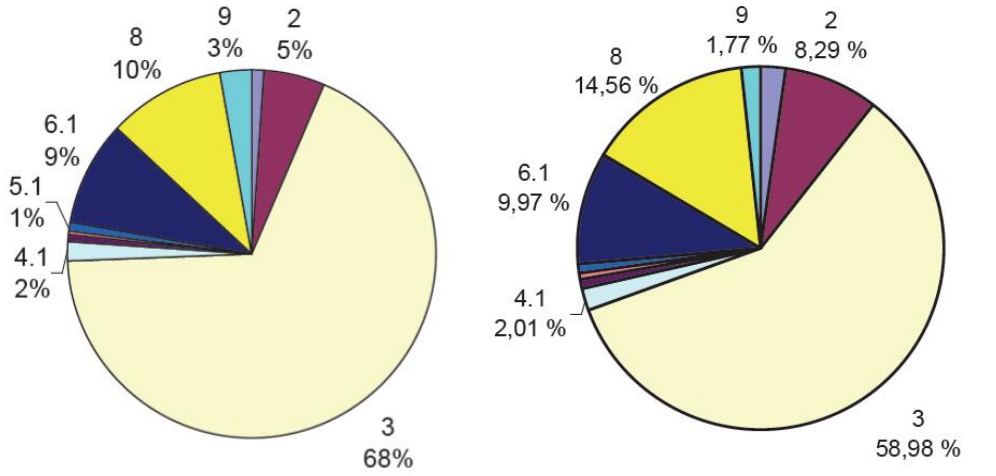
4.3.1 Transport of Dangerous Goods by Road with German Vehicles

The transport of dangerous goods by road will be divided into two parts. One of them is the transport that is done by German vehicles. It will be represented in detail according to each class from year 2001 to 2004. The amount and the distribution of the classes can be seen from Figure 12.

The transport of dangerous goods is most of the case from class 3, which is the class for flammable liquid. The amount reaches over 90 million tonnes per year, which is more than 60% from the total transport. The highest number was recorded in 2001, with 104.9 million tonnes of dangerous goods transported. But the highest percentage compared to the general goods was

in the year 2004, when the dangerous goods contributed 68% of all goods transport.

The transport of dangerous goods class 6.2 decreased dramatically in 2003, from 321 thousand tonnes to only 1,000 tonnes. Same thing occurred with the class 4.2, which decreased from 2.2 million tonnes to only 787 thousand tonnes.



Total: 147 million tonnes

Total: 298,000 million tonne-kilometres

Figure 12 Dangerous Goods Transport by Road with German Vehicles in Germany in 2004. On left the classification is based on tonnes transported and on right, on tonne-kilometres. (Source: Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate)

The Figure 12 shows the percentages of dangerous goods transported with German vehicles in 2004. Class 3 (flammable liquids) has the largest percentage. The share of class 3 is 68%. All other classes have only under 10% shares.

4.3.2 Transport of Dangerous Goods by Road with Foreign Vehicles

As mentioned before the transport of dangerous goods by road is divided into two parts. The first part, German vehicles, can be seen in the previous subchapter, and now in this subchapter there are the figures for foreign vehicles.

The amount of dangerous goods transport with foreign vehicles is not as large as with German vehicles. Foreign vehicles share is only around 5% of the total transport of dangerous goods by road. The most transported class is once again class 3, flammable liquids. The amount reaches over 3 million tonnes per year, which is more than 40% of the total DG transport.

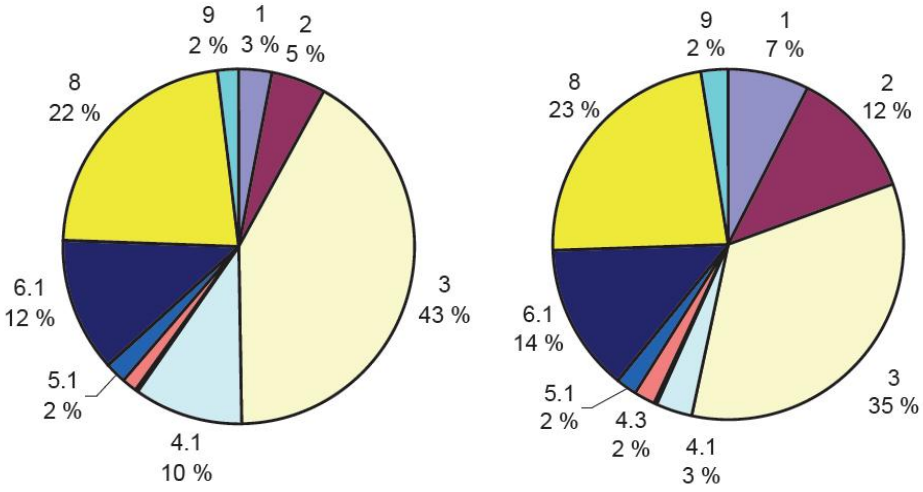


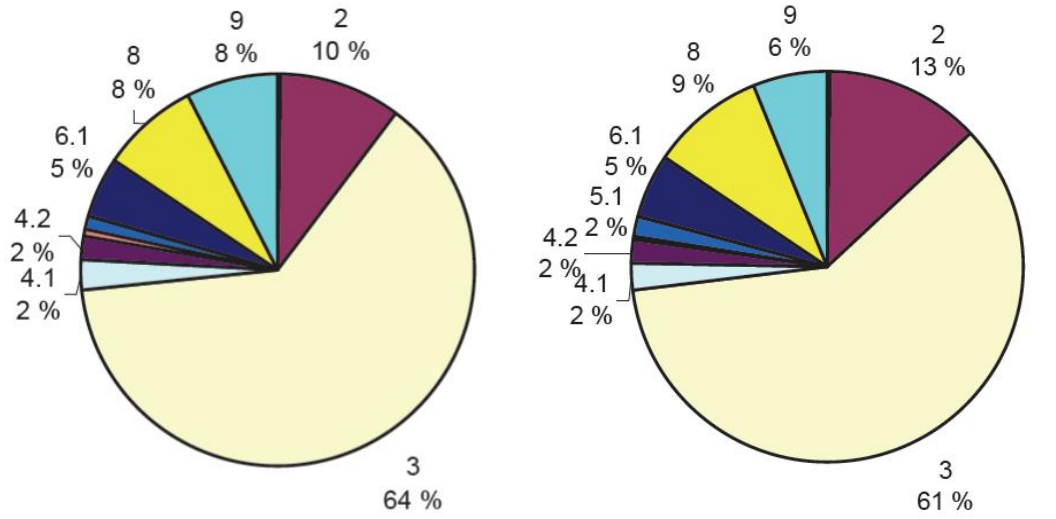
Figure 13 Dangerous Goods Transport by Road with Foreign Vehicles in Germany in 2004. On left the classification is based on tonnes transported and on right on tonne-kilometres. (Source: Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate)

Figure 13 shows the dangerous goods transport amounts with foreign vehicles in percentages, according to the DG classification. The figures are based on 2004 statistics. The largest percentage belongs once again to class 3. The share of this class is 43%. The next share comes from class 8 with 22% of the total dangerous goods transport.

4.4 Transport of Dangerous Goods by Rail

The amount of dangerous goods transported by rail is not as large as the amount of goods transported by road. The amount of dangerous goods transported is around 40-50 million tonnes per year and it has increased during the years 2001-2004. The detailed distribution of each class is shown in Figure 14.

From the Table 34 (in the Appendix II) you can see that class 3 covers once again the largest part of the transport. The amount reaches over 28 million tonnes per year, which is more than 60% of the total transport. The highest amount of transport from this class is reported in 2004, with 33,899 thousand tonnes of dangerous goods.



Total: 54 million tonnes Total: 13,800 million tonne-kilometres

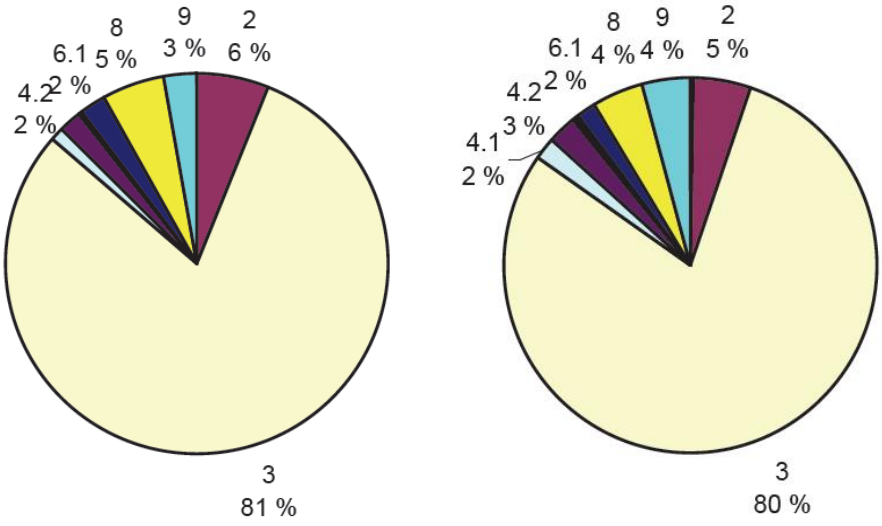
Figure 14 Dangerous Goods Transport by Rail in Germany in 2004. On left the classification is based on tonnes transported and on right, on tonne-kilometres. (Source: Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate)

Figure 14 shows the percentages of dangerous goods rail transport according to the DG classification in year 2004. Class 3 is again the largest. The share of this class is 64%. Class 2, with 10% share is the second largest, followed by class 8 and 9.

4.5 Transport of Dangerous Goods by Inland Waterway

The amount of dangerous goods transported by Inland Waterway is not as large as the amount of goods transported by road but it is quite similar in size with the rail transport. The amount of dangerous goods transported by Inland Waterway is around 45-55 million tonnes per year. The detailed amount and distribution of each class you can find in the Table 35, which is in the Appendix II, and also in the Figure 15 below.

The flammable liquids are once again the largest class, with over 40 million tonnes transported per year. This is more than 80% of the total transport. The highest amount of transport from this class was reported in 2001, with 43,469 thousand tonnes of dangerous goods.



Total: 50 million tonnes Total: 13,700 million tonne-kilometres

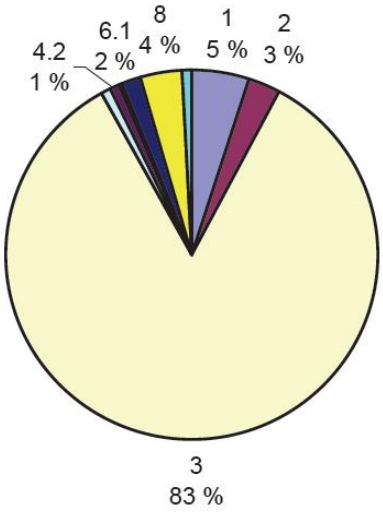
Figure 15 Dangerous Goods Transport by Inland Waterway in Germany in 2004. On left the classification is based on tonnes transported and on right on tonne-kilometres. (Source: Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate)

Figure 15 is the pie chart of the percentages of dangerous goods classes transported by inland waterway in 2004.

4.6 Transport of Dangerous Goods by Sea

The amount of dangerous goods transported by sea is not as large as the transport by road, but it still has higher amount of transport than any other mode. The amount of dangerous goods transported is around 65-75 million tonnes per year. The detailed amount and distribution of each class is in Table 36 (in Appendix II) and
Figure 16.

In Table 36 it is stated that the transport of dangerous goods by sea is mostly class 3 transportations. The amount reaches over 56 million tonnes per year, which is more than 85% of the total transport.



Total: 74 million tonnes

Figure 16 Transport of Dangerous Goods by Sea in Germany in 2004. The classification is based on tonnes transported. (Source: Preparation for the statement of Dangerous Goods Transport for Year 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate)

Figure 16 shows the percentages of dangerous goods classes transported by sea in 2004. The largest percentage is class 3, which is the class for flammable liquid. The share of this class is 83%. All the other classes share the pie quite evenly.

5 LATVIA

5.1 Introduction

The data of Dangerous Goods transported in Latvia is presented for years 2001-2005. It includes information on dangerous goods transport by road and rail. The data is from the Central Statistical Bureau of Latvia and it was provided by the DaGoB partner: Freeport of Riga Authority. Exact maritime transport statistics on dangerous goods were not available, but some calculations were made based on information received also from the Central Statistical Bureau of Latvia.

5.2 Transport of Dangerous Goods by Road

In 2005 the total volume of road transportations of dangerous goods was a little bit over 1.2 million tonnes.

In 2005 the largest proportion of transportations were those of class 3 (flammable liquids), at about 82%. The distribution of all classes of goods is not available, but there is a distribution between gases, flammable liquids and other hazardous cargoes shown in Table 16. There is also distribution between commercial and non-commercial traffic made in the table.

Table 16 Dangerous Goods Transport by Road in Latvia in 2005 (Source: Central Statistical Bureau of Latvia)

	Hazardous cargoes Classification code	Transferred cargoes, thousand tonnes			Cargo turnover, million tonne-km		
		total	including		total	including	
			Non-Commercial traffic	Commercial traffic		Non-Commercial traffic	Commercial traffic
explosives	1	3.2	3.2	-	0.2	0.2	-
compressed, liquified or dissolved under pressure gas	2	207.9	111.6	96.3	30.7	12.6	18.1
highly inflammable liquids	3	1,015.9	537.1	478.8	116.6	53.8	62.8
corrosive substances	8	10.6	1.8	8.8	1.2	0.2	1.0
various hazardous cargoes, that are not included elsewhere	9	2.6	-	2.6	0.1	-	0.1
Total		1240.2	653.7	586.5	148.8	66.8	82.0

5.3 Transport of Dangerous Goods by Rail

In 2005 the total volume of dangerous goods transported by rail was 19.4 million tonnes.

The majority of transportations consisted of class 3 (flammable liquids). The next largest classes transported were class 2 (gases) and 4.2 (substances liable to spontaneous combustion). The distribution of all classes of goods is shown in Table 17.

Table 17 Transport of Dangerous Goods by Road in Latvia in 2005 (Source: Central Statistical Bureau of Latvia)

	Dangerous goods class	Transferred cargoes (thousand tonnes)	Cargo turnover (million tonne-km)
including those according to the relevant hazardous cargo classification group :			
explosives	1	0.2	0.0
compressed, liquified or dissolved under pressure gas	2	1,020.0	333.2
highly inflammable liquids	3	16,871.0	5,511.8
highly inflammable solid substances and materials	4.1	-	-
self-inflammable substances	4.2	997.2	325.8
substances, that emit flammable gas when in contact with water	4.3	-	-
oxidizing substances	5.1	472.0	171.2
organic peroxides	5.2	-	-
toxic substances	6.1	8.5	2.8
infectious substances	6.2	-	-
radioactive substances	7	-	-
corrosive substances	8	19.5	6.4
various hazardous cargoes, that are not included elsewhere	9	-	-
TOTAL		19,388.4	6,351.2

5.4 Transport of Dangerous Goods by Sea

There are no exact statistics available from the Latvian dangerous goods sea transport, but from the following table we can calculate an estimate figure.

Table 18 Goods loaded and unloaded in Latvian ports in 2005 (in thousand tonnes) (Source: Central Statistical Bureau of Latvia)

Cargoes loaded – total	55,890
Oil products (cargoes loaded)	20,094
Oil (cargoes loaded)	423
Dry chemicals (cargoes loaded)	6,537
Liquid chemicals (cargoes loaded)	1,114
Cargoes unloaded – total	4,152
Oil products (cargoes unloaded)	503

From the Table 18 we can make an estimate that approximately 25 million tonnes of dangerous goods was transported by sea in Latvia in 2005. At least half of the dry chemicals can be considered to be dangerous and most part of the oil products and liquid cargo as well. This adds up to 25 million tonnes.

6 LITHUANIA

6.1 Introduction

The Lithuanian part has collected the data of Dangerous Goods transported in Lithuania during the years 2003-2005. It includes information on dangerous goods road, rail and maritime transport.

The data on road and rail transportations was obtained from Lithuanian statistics department. The data on sea transport was obtained from the Klaipeda seaport authorities. All the data was provided by the DaGoB partner: Klaipeda State Seaport Authority.

6.2 Transport of Dangerous Goods by Road

In 2005 the total volume of road transportations of dangerous goods was 2.0 million tonnes. The largest proportion of transportations was those of class 3 (flammable liquids). Next largest was class 2 (gases), followed by class 4.1 (flammable solids, self-reactive substances and solid desensitized explosives) and class 8 (corrosive substances). The total share of all other dangerous goods was below 1%. The distribution of all classes of goods is shown in Table 19.

Table 20 presents the transportation performance in tonne-kilometres distributed by classes.

Table 19 Transport of dangerous goods by road in Lithuania in 2003-2005 (in thousand tonnes) (Source: Lithuanian statistics department)

Transportation class	2003	2004	2005
1	45,7	2,8	7,0
2	390,8	299,6	337,6
3	1227,8	975,6	1283,2
4.1	667,4	997,4	46,0
4.2	1,9	1,8	2,9
4.3	3,8	-	-
5.1	7,3	0,2	3,0
5.2	0,8	0,4	0,4
6.1	5,9	3,3	3,1
6.2	-	-	-
7	18,7	10,9	-
8	2,2	29,4	29,7
total	2581,5	2430,0	2002,4

Table 20 Transportation performance of dangerous goods by road in Lithuania in 2003-2005 (in million tonne-km) (Source: Lithuanian statistics department)

Transportation class	2003	2004	2005
1	21.7	0.9	2.2
2	62.0	55.3	61.2
3	225.6	184.8	227.9
4.1	770.3	836.7	8.9
4.2	0.7	3.5	0.3
4.3	5.8	-	-
5.1	2.5	0.1	2.1
5.2	0.8	0.2	0.2
6.1	3.5	4.8	5.0
6.2	-	-	-
7	1.2	0.0	-
8	1.1	6.6	12.1
total	1,173.8	1,153.3	383.8

6.3 Transport of Dangerous Goods by Rail

The total volume of dangerous goods transported in 2005 by rail was 14.9 million tonnes.

The majority of transportations consisted of class 3 (flammable liquids), at about 80%. The next largest classes transported were class 5.1 (oxidising substances) and class 2 (gases). The distribution of all classes of goods is shown in Table 21.

Table 21 Transport of dangerous goods by rail in Lithuania in 2005 (Source: Lithuanian statistics department)

Transportation class	Transportation volume 2005 (in thousand tonnes)	Transportation performance 2005 (in million tonne-km)
1	32.8	8.9
2	709.4	150.7
3	11921.8	2,841.2
4.1	433.7	80.9
4.2	318.7	99.8
4.3	89.9	27.0
5.1	1246.5	314.9
5.2	-	-
6.1	6.6	2.0
6.2	-	-
7	-	-
8	121.4	25.8
9	0.1	0.0
total	14,880.8	3,551.3

6.4 Transport of Dangerous Goods by Sea

The following data was received from the Klaipeda State Seaport Authority, but from these statistics we cannot calculate the total volume of dangerous goods sea transport in Lithuania. There are however interesting information on Klaipeda seaport’s dangerous goods transport amounts.

Table 22 Packaged dangerous goods transportation volumes in the port of Klaipeda in 2005 (in tonnes) (Source: Klaipeda State Seaport Authority)

Transportation class	Transportation volume
1	214.0
2	7,340.3
3	55,743.5
4.1	561.4
4.2	103.9
4.3	4,249.2
5.1	4,566.0
5.2	252.1
6.1	17,369.7
6.2	-
7	-
8	51,194.3
9	21,394.8
total	162,989.3

Table 23 Crude oil and oil product export volumes in the port of Klaipeda (in thousand tonnes) (Source: Klaipeda State Seaport Authority)

Name	Transportation volume 2004	Transportation volume 2005
Fuel oil	2,812.3	2,317.9
Diesel oil	1,279.5	1,544.2
Gasoline	983.5	1,469.7
Vacum gasoline	-	62.5
Orimulsion	-	60.8
Fuel aviation turbine engine	332.3	388.7
total	5,407.6	5,843.8

Table 24 Dangerous goods bulk cargo export volumes in the port of Klaipeda (in thousand tonnes) (Source: Klaipeda State Seaport Authority)

Name	Transportation volume 2004	Transportation volume 2005
Amonium nitrate	628.9	1,201.9
Ferrosolicon with 30 % or more but less than 90 % silicon	13.5	30.3
Calcium amonium nitrate	180.2	-
Urea nitrate solution (liquid)	925.1	1,201.9
Ethylene glycol	-	8.5
Ammonium sulphate	76.9	-

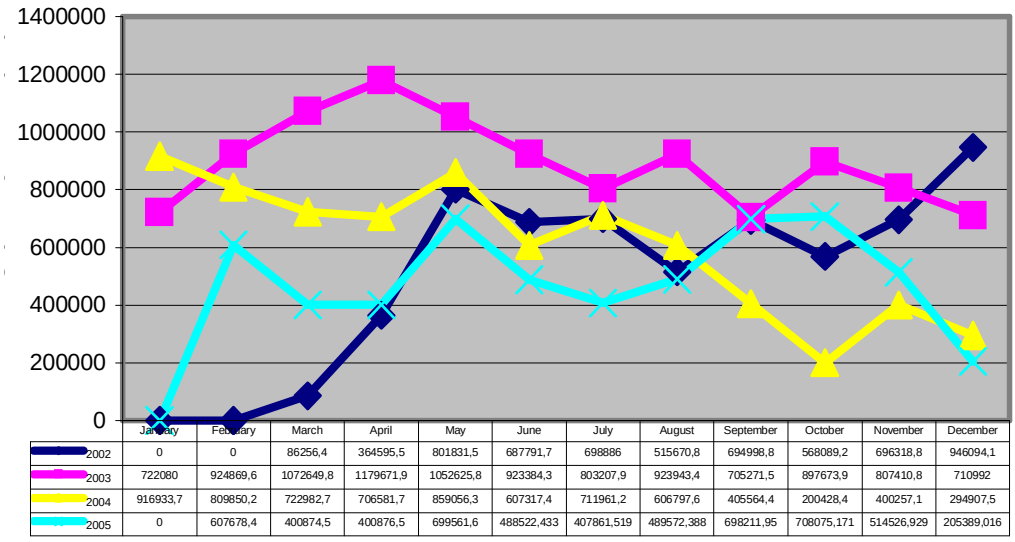


Figure 17 Butinge oil terminal cargo activity 2002-2005 (in tonnes/month) (Source: Klaipeda State Seaport Authority)

There are no exact statistics available from the Lithuanian dangerous goods sea transport, but from the following table we can calculate an estimate figure.

Table 25 Goods loaded and unloaded in Lithuanian ports in 2005 (in 1000 tonnes) (Source: Lithuanian statistics department)

Cargoes loaded – total	22,283.7
Liquid bulk (cargoes loaded)	13,206.4
Dry bulk (cargoes loaded)	5,391.9

Cargoes unloaded – total	5,637.2
Liquid bulk (cargoes unloaded)	135.1
Dry bulk (cargoes unloaded)	2,071.0

From the Table 25 we can make an estimate that approximately 16 million tonnes of dangerous goods was transported by sea in Lithuania in 2005. Most part of the liquid bulk is considered to be dangerous goods and also some part of the dry bulk. This adds up to approximate of 16 million tonnes.

7 SWEDEN

7.1 Introduction

As a part of DaGoB project, Statistics Sweden (SCB) has carried out a survey of the transport of dangerous goods in Sweden during September 2006. This part of the report presents some of the results of that report and some other Swedish statistics as well. The whole report “Survey of the dangerous goods transport in Sweden”, is published in the DaGoB publication series with number 4:2007, and can be downloaded from the DaGoB website.

The survey was commissioned by the Swedish Rescue Services Agency, DaGoB work package 2 leader. The survey covers transport by road, rail, sea and air, but in this BSR report we have left the air statistics out. The survey has been extended in the case of sea transport to show the ports in the Baltic Sea Region from which dangerous goods are transported to Sweden, and to which dangerous goods are transported from Sweden.

Information has been collected by questionnaires posted to participants and from databases held by companies and authorities. Participation in the survey has been on a voluntary basis.

The reply frequency for the questionnaires distributed was:

- road: 81%
- rail: 87.5%
- sea: 66.7%
- air: 78.3%

The aim of the Swedish survey has been to obtain better knowledge concerning the amount of dangerous goods that is transported and the transport routes that are used.

7.2 Transport of Dangerous Goods by Road

7.2.1 Methods

Information has been principally collected by questionnaires posted to companies that handle dangerous goods in the company’s own vehicles.

Some information has been collected electronically, from, for example, suppliers of petroleum products.

A total of 3,915 companies took part in the investigation. The selection of companies was taken from the register held by the Swedish Rescue Services Agency of companies with a registered safety advisor, supplemented by 25 companies nominated by the Swedish Radiation Protection Authority. These companies have subsequently been compared with information in the statistical register of vehicles in order to exclude companies that do not possess their own vehicles. Such companies have not carried out the transport under their own control.

The basis of the investigation has been the companies that transported dangerous goods under their own control during September 2006, where the term “under their own control” is used to denote the use of the company’s own vehicles. This method has been used in order to obtain as accurate an image as possible of the transport routes by which the goods have been transported.

Most transport of dangerous goods consists of the transport of flammable liquids. For this reason, the six largest suppliers of petroleum products in Sweden were asked to provide information electronically detailing the amounts of diesel, heating oil, petrol and kerosene that had been transported.

The investigation covered September 2006, and 3,909 questionnaires were distributed.

The information that the questionnaire requested was:

- the UN number of the goods
- the quantity transported, measured in kg or m3
- nuclides, the total activity and number of packages for the transport of radioactive substances
- location of despatch, including postal code
- location of reception, including postal code, and
- transport routes (whether European road, national trunk road, minor road).

The quantity transported was specified in kg or m3 as follows:

- packages: gross weight (including the packaging)
- tank transport: net weight or volume
- bulk transport: net weight
- explosive substances and articles: net weight of explosive substance.

The investigation was carried out subject to the following limitations:

- transport that did not require the vehicle to be marked with an orange-coloured plate, such as transport of limited quantities and transport in accord with 1.1.3.6 I ADR (a maximum of 1,000 points) was not included in the investigation.
- transport of empty, uncleaned, packaging and tanks was not included in the investigation.
- transit transport, where both the consignor and the consignee of the goods were located outside of Sweden, could be investigated.
- companies outside of Sweden were not included in the investigation.
- companies that act solely as consignors, without transporting the goods under their own control, were not included in the investigation.
- companies that transported diesel, heating oil, petrol and kerosene for Hydro, JET, OKQ8, Preem, Shell or Statoil were not included in the investigation, since information about such transport had already been obtained from the companies. Companies that transported goods for the companies listed above as what is known as “collection transport” were, on the other hand, included in the investigation.

7.2.2 Results

Responses were received for 81% of the questionnaires distributed. The suppliers of petroleum products are not included in this figure.

All six suppliers of petroleum products to whom enquiries were addressed supplied information. A total of 22 companies supplied information electronically.

The replies to the distributed questionnaires showed that just over 63% of the companies had not carried out road transport of dangerous goods during the month of September.

Just over 91% of the companies that had carried out transport during September provided information about the transport routes. These companies, however, corresponded to only one fifth of the quantity of information collected. This means that approximately 28,000 of the 35,000 entries in the investigation lack information about transport route. The transport routes have been estimated for this 80% of entries with the aid of a route planning system.

The results from the road investigation are presented by maps that display the principal flows. The flows are shown as total flows, and they show the total quantities of dangerous goods in both directions along each stretch of

road. The figures presented for quantities of goods refer to the gross weight for the transport of packages, the net weight for transport by tanks or in bulk, and the net weight of explosive substance for the transport of explosive substances. The quantity of goods has been classified into groups according to the quantity of goods, and colours have been used to display the flows within the various intervals. The road information map published by the Swedish Road Administration forms the basis for storage in the database.

The maps show the quantity in tonnes of dangerous goods that have been transported in various intervals, for each class of dangerous goods. The method used to create intervals of quantity for the road maps gave intervals of equal size. The appearance of the flows depends on the method of defining intervals. It is considered that the use of intervals of equal size gives an appropriate image of the flows. The number of intervals in each map differs, and it has been determined according to the magnitude of the quantity of goods.

One map is also presented for transport within a number of urban areas. These transports concern goods that have been transported within the limits of the relevant urban area. The despatch location and the reception location are the same in these cases. Most of these transports are transports of flammable liquids. Intervals have been defined in the map of transports within urban areas using the equal counts method.

The maps present solely the flows of dangerous goods. The dangerous goods classes describe the properties of the dangerous goods. The degree of danger and the quantity transported have not been combined in a weighted manner. This means that it is not possible to draw any conclusions concerning the locations in Sweden at which the risks are highest, based on the flows of dangerous goods.

It is not possible to add the quantities of dangerous goods transported along various stretches on the maps to obtain the total quantity of dangerous goods within one geographical region. This is because the same goods can be recorded on several stretches, and such goods would be counted double if the addition were carried out. The maps may solely be used to obtain an estimate of the quantities of dangerous goods that are transported along individual stretches of road.

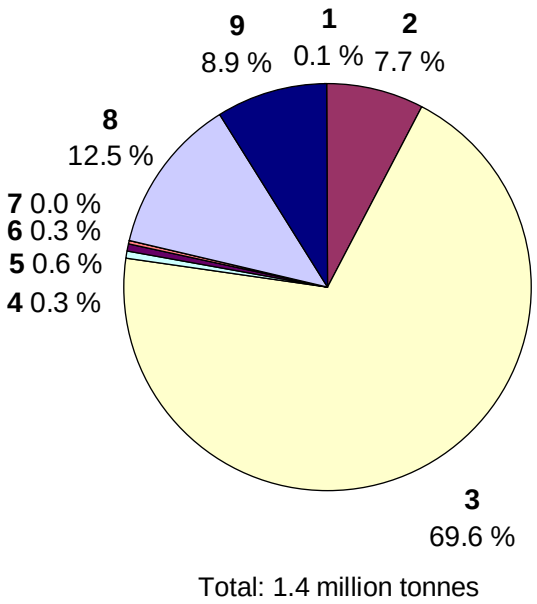


Figure 18 Distribution of dangerous goods road transport by class in Sweden in September 2006 (Source: Statistics Sweden)

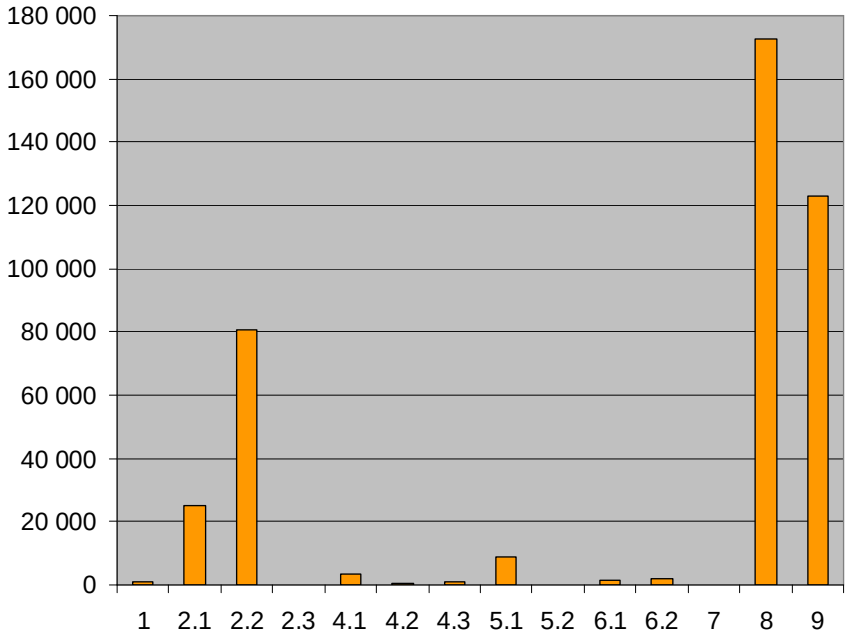


Figure 19 Quantities of dangerous goods transported by road in Sweden in September 2006 according to class (in tonnes) (excluding Class 3) (Source: Statistics Sweden)

7.2.2.1 Comparison with other sources of information

The figures collected have been compared with delivery statistics from the Swedish Petroleum Institute (SPI) for diesel, heating oil, petrol and kerosene for September 2006. The comparison shows that the investigation has obtained reliable information about the flows of these substances.

Table 26 Comparison with delivery volumes from SPI, September 2006.

Product	UN no.	Delivery volume from SPI (1,000 m^3)	Quantity of goods transported (1,000 m^3)	Difference (%)
Petrol	1,203	454	469	3%
Diesel (including heating oil)	1,202	476	487	2%

Source: www.spi.se

7.3 Transport of Dangerous Goods by Rail

7.3.1 Methods

Information has been collected by questionnaires posted to participants and by electronic data collection from databases held by companies. All 16 railway operators active in Sweden have participated in the investigation.

The investigation covered September 2006, and 15 questionnaires were distributed.

The information that the questionnaire requested was:

- the UN number of the goods
- the quantity transported, measured in kg or m3
- the total activity, with respect to the transport of radioactive substances
- despatch location
- reception location, and
- transport routes (the line of the railway network).

The quantity transported was specified in kg or m3 as follows:

- packages: gross weight (including the packaging)
- tank transport: net weight or volume
- bulk transport: net weight
- explosive substances and articles: net weight of explosive substance.

The investigation was carried out subject to the following limitations:

- transport of small quantities of dangerous goods, defined as “limited quantities”, was excluded from the investigation in order to reduce the amount of work required from the companies.
- transport of empty, uncleaned, packaging and tanks was not included in the investigation.

7.3.2 Results

The degree of response was 87%. It should be noted that information from databases constitutes a large majority of the total information about transports carried out during the month. Approximately 99% of the information comes from databases. Information concerning quantity obtained from databases is given in net weight.

The replies to the distributed questionnaires showed that 75% of these had not carried out rail transport of dangerous goods during the month of September.

The results from the rail investigation are presented by maps that display the principal flows. The flows are shows as totals for the two directions, and show the total quantity, measured as net weight in tonnes, for each section of line. The quantity of goods has been classified into groups according to the quantity of goods, and colours have been used to display the flows within the various intervals. The description of the railway network predicted for 2008 published by Swedish Rail Administration forms the basis for storage in the database.

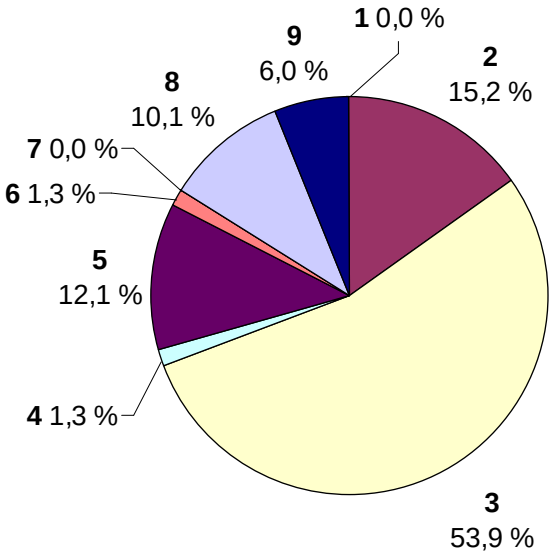
The maps show the quantity in tonnes of dangerous goods that have been transported in various intervals, for each class of dangerous goods. The method used to create intervals of quantity for the rail maps gave intervals of equal size. The appearance of the flows depends on the method of defining intervals. It is considered that the use of intervals of equal size gives an appropriate image of the flows. The number of intervals in each map differs, and it has been determined according to the magnitude of the quantity of goods. The intervals used for the map displaying the total quantity of goods

and displaying Class 3 have been rounded off to give two or three significant figures.

The maps present solely the flows of dangerous goods. The dangerous goods classes describe the properties of the dangerous goods. The degree of danger and the quantity transported have not been combined in a weighted manner. This means that it is not possible to draw any conclusions concerning the locations in Sweden at which the risks are highest, based on the flows of dangerous goods.

It is not possible to add the quantities of dangerous goods transported along various stretches on the maps to obtain the total quantity of dangerous goods within one geographical region. This is because the same goods can be recorded on several stretches, and such goods would be counted double if the addition were carried out. The maps may solely be used to obtain an estimate of the quantities of dangerous goods that are transported along individual stretches.

No transport of substances in Class 6.2, Infectious Substances, took place during September. Only the quantity, measured in tonnes, of substances in Class 7, Radioactive Materials, is specified. No information was received concerning the total activity. The quantity of material in Class 7 transported during September was 27.5 tonnes.



Total: 208.3 thousand tonnes

Figure 20 Distribution of dangerous goods rail transport by class in Sweden in September 2006 (Source: Statistics Sweden)

7.4 Transport of Dangerous Goods by Sea

7.4.1 Methods

The information is principally based upon the vessel reporting system (FRS) of the Swedish Maritime Administration. Everything that is loaded or unloaded at Swedish ports, with some exceptions, is to be reported to this system. Twelve shipping companies were exempt from the requirement to report to the vessel reporting system at the time of the investigation, and questionnaires were posted to these companies.

The investigation covered September 2006, and 12 questionnaires were distributed.

The information that the questionnaire requested was:

- the UN number of the goods
- the quantity despatched, measured in kg or m3
- the total activity despatched, with respect to the transport of radioactive substances
- the quantity received, measured in kg or m3
- the total activity received, with respect to the transport of radioactive substances
- the despatching port, and
- the receiving port.

The quantity transported was specified in kg or m3 as follows:

- packages: gross weight (including the packaging)
- tank transport: net weight or volume
- bulk transport (tankers excluded): net weight
- explosive substances and articles: net weight of explosive substance.

The investigation was carried out subject to the following limitations:

- tankers have been excluded from the investigation
- transport of empty, uncleaned, packaging and tanks was not included in the investigation.
- dangerous goods that have left Sweden or arrived at Sweden are reported for ports in the Baltic Sea region (excluding Swedish ports).

7.4.2 Results

The degree of response was 67% for the questionnaires distributed by post. This figure does not include information obtained from the vessel reporting system. It should be noted that information from the vessel reporting system constitutes a large majority of the total information about sea transport carried out during the month. Approximately 70% of the information comes from the vessel reporting system. Information concerning quantity obtained from the vessel reporting system is given in net weight.

The replies to the distributed questionnaires showed that all of the companies had carried out transport of dangerous goods during September.

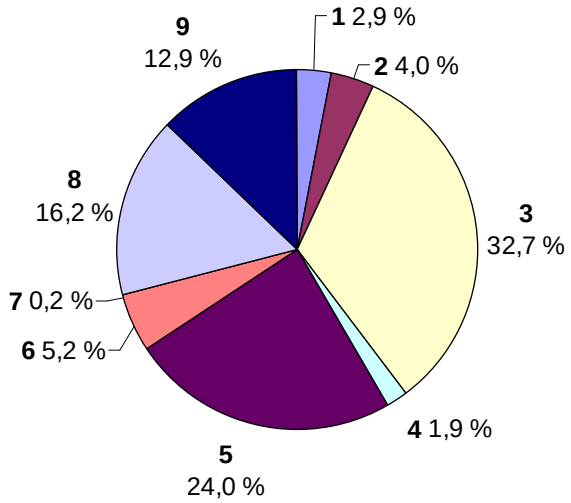
The results from the investigation are presented by maps that display the ports that have loaded and unloaded dangerous goods. The method used to create intervals of quantity for the maps of ports gave intervals containing equal counts. The appearance of the maps depends on the method of defining intervals. It is considered that the use of intervals of equal counts in this case gives an appropriate image of the flow. Furthermore, each port is presented in tables showing the quantities of dangerous goods loaded, unloaded and in total, and showing the quantities of goods in transit that passed the port. Goods in transit means goods that pass the port without being handled: they are neither loaded nor unloaded in the port.

It should be noted that the results presented do not include transport by tanker ships. One consequence of this is that large quantities of petroleum products are excluded from the results.

Only the quantity, measured in tonnes, of radioactive substances is specified, with the exception of information for individual ports presented in tables. The vessel reporting system does not contain information about total activity. The replies received from the posted questionnaires included information about two transports of radioactive materials, and the total activities of these are presented as a footnote in the tables containing port information.

The maps describe the situation for Swedish ports. Information is also presented for the handling of dangerous goods that have left Sweden or arrived at Sweden to or from ports in the Baltic Sea region. The dangerous goods classes describe the properties of the dangerous goods. The degree of danger and the quantity transported have not been combined in a weighted manner. This means that it is not possible to draw any conclusions concerning the locations in Sweden at which the risks are highest, based on the flows of dangerous goods.

Seasonal variations may change the result. The results provide an image of the transport flows for a single month, September 2006, and they cannot be scaled up to give annual figures. Scaling up to give annual figures would require making unjustified assumptions. One such assumption is that the period of the investigation was representative for other periods of the year. Another such assumption is, that no changes take place with respect to transport structure during the year, nor does the demand for dangerous goods change.



Total: 154.7 thousand tonnes

Figure 21 Distribution of dangerous goods handled at ports[2] by class in September 2006 (Source: Statistics Sweden)

7.5 Annual Transport Volume of Dangerous Goods

In addition to Swedish survey representing September 2006 flows we have also collected the annual statistics of the dangerous goods flows in Sweden, to be able to compare BSR countries with each other. These statistics are also provided by the Swedish Rescue Services Agency, except for the sea statistics, which were collected by the Turku School of Economics from the Swedish shipping statistics published by SIKA (Statens institute för kommunikationsanalys).

[2] Within the Baltic Sea region: ports in Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, Germany and Denmark.

7.5.1 Transport Volume of Dangerous Goods by Road

The total quantity of ADR transportations with Swedish registered lorries in 2004 was 12,459 thousand tonnes. Table 27 shows the volumes of road transportations by transportation class, and their shares of the total volume. Also driven tonne-kilometres and kilometres as well as number of haulages are presented in the table.

Table 27 National road goods transported with Swedish registered lorries according to ADR 2004 (Source: Swedish Rescue Services Agency)

Class	% of total quantity	Quantity 1000 tons	Tonne-kilometres millions	Driven kilometres with load 1000 km	Number of haulages with load, 1000
1 Explosive substances and articles	0,3	32	4	500	2
2 Gases	6,7	840	184	10361	49
3 Flammable liquids	70,6	8800	1009	60738	597
4.1 Flammable solids, self-reactive substances and solid desensitized explosives	0,3	39	9	268	1
4.2 Substances liable to spontaneous combustion	0,9	113	3	387	6
4.3 Substances which, in contact with water, emit flammable gases	*	*	*	*	*
5.1 Oxidizing substances	2,5	313	69	2006	9
5.2 Organic peroxides	*	*	*	*	*
6.1 Toxic substances	*	*	*	*	*
6.2 Infectious substances	0,0	4	1	452	2
7 Radioactive material	*	*	*	*	*
8 Corrosive substances	14,2	1775	252	12180	78
9 Miscellaneous dangerous substances and articles	4,4	543	57	1753	17
	100,0	**12459**	**1588**	**88645**	**761**

*) No information

7.5.2 Transport Volume of Dangerous Goods by Rail

In 2005 the total volume of dangerous goods transported by rail was 2.1 million tonnes. Table 41 (in Appendices) shows the volumes of rail transportations during the years 2001–2005.

In 2005 the majority of transportations consisted of class 3 (flammable liquids), at least if you look at the number of units transported. The next largest classes transported were class 2 (gases) and class 5.1 (oxidising substances). The distribution of units of all classes of goods is shown in Table 42 (in Appendices).

About 70 000 units of dangerous goods is transported every year on rail in Sweden. There has been slight upward trend in the transport amounts. There is a growth in number of units, in mass as well as in tonne-kilometres.

7.5.3 Transport Volume of Dangerous Goods by Sea

There are no annual statistics available from the Swedish dangerous goods maritime transport by class. From amounts presented in the following table you can however calculate some kind of an estimate.

Table 28 Goods loaded and unloaded in Swedish foreign trade by ships and shipping of goods between Swedish ports in 2006 (in thousand tonnes) (Source: SIKA)

Goods	Loaded and unloaded goods in foreign trade	Unloaded goods in domestic traffic
Solid mineral fuels	4,096	90
Crude petroleum	19,330	-
Petroleum products	30,715	5,158
Natural and chemical fertilizers	900	46
Coal chemicals, tar	1,183	-
Chemicals other than coal chemicals and tar	3,023	386

From the Table 28 we can make an estimate that approximately 55 million tonnes of dangerous goods was transported by sea in Sweden in 2006. Most parts of the crude petroleum, petroleum products and chemicals are considered to be dangerous goods and also some parts of the solid mineral fuels and fertilizers. This adds up to approximate of 55 million tonnes. You can also have a look at the amount of tonne-kilometres transported in the Table 43, which is shown in the Appendix II.

8 SUMMARY

The main objective of this report has been the collection of data on dangerous goods transport in the Baltic Sea Region. Thus the vital element of the work was to collect the data on dangerous goods transport volumes, it however quickly became clear that obtaining data requires a lot of work, inquiries and contacts. There was no joint data bank for this purpose, and in order to understand the situation, the validity of the data should be checked and cross-checked. It was clearly shown that different bodies collect and document dangerous goods transport data in various ways.

The amount of Dangerous Goods transported in the BSR countries varies quite much. This is clearly shown in the Table 29. However the data collection is not comprehensive and we cannot make extensive implications from it. We were not able to collect all the statistics needed from the competent authorities and ministries, so we had to make some calculations by ourselves based on national information from the statistical offices. Even existing statistics are not totally comparable. The obvious reason for the unclear data seems to be the lack of harmonised reporting and collecting of data.

Table 29 Baltic Sea Region Dangerous Goods transport flows (in million tonnes) (Source: Competent authorities and ministries in the Baltic Sea Region)

Mode / Country	Road	Rail	Sea	***Total***
Estonia (2005/06)	2.0	31.3	33.2	**66.5**
Finland (2002)	12.3	6.1	39.2	**57.6**
Germany (2004)	156.2	53.9	124.0 (1	**334.1**
Latvia (2005)	1.2	19.4	25.0	**45.6**
Lithuania (2005)	2.0	14.9	16.0	**32.9**
Sweden (2004/05/06)	12.5 (2	2.1	55.0	**69.6**
Total	**186.2**	**127.7**	**292.4**	**606.3**

(1 Including inland waterways

(2 Only Swedish registered lorries

Germany is in different category compared to other BSR countries and the split between transport modes is different also. In Germany the largest dangerous goods transport mode is road transport, where annual transport

amount is about 156 million tonnes of Dangerous Goods. In other BSR countries the sea mode is the largest transport mode. Finland and Sweden has quite similar amounts of goods transported annually by road and rail, but the volume of sea transport is larger in Sweden. In the Baltic states the rail transport is much more significant than in other BSR countries because of the dangerous goods flows from the Russia. For example Estonian Railway Inspectorate reports that 71% of their total railway transport is in fact dangerous goods transport, which is also clearly shown in the table.

From the transport figures above, we can see that the transport amounts of dangerous goods are significant in the Baltic Sea Region. However the data collection of dangerous goods transport flows is still very inconsistent and varies between countries. The purpose of this report was to collect the first BSR-wide overview on volume of dangerous goods flows. At the same time we have also found out the current situation in dangerous goods data collection and reporting. The aim in the future should be harmonisation of the reporting and collection of data.

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APPENDIX I DANGEROUS GOODS CLASSES

Other than class 1, 2, 5.2, 6.2 and 7 substances and class 4.1 self reactive substances has defined packing group based on their danger characteristics:

- Packing group I: High danger substances;
- Packing group II: Medium danger substances; and
- Packing group III: Low danger substances.

Following definitions of Dangerous Goods classes has been taken from the Recommendations on the Transport of Dangerous Goods, published by the United Nations (2005).

Class 1 - Explosives

Definitions and general provisions

Class 1 comprises:

a) Explosive substances (a substance which is not itself an explosive but which can form an explosive atmosphere of gas, vapour or dust is not included in Class 1), except those that are too dangerous to transport or those where the predominant hazard is appropriate to another class;
b) Explosive articles, except devices containing explosive substances in such quantity or of such a character that their inadvertent or accidental ignition or initiation during transport shall not cause any effect external to the device either by projection, fire, smoke, heat or loud noise; and
c) Substances and articles not mentioned under (a) and (b) which are manufactured with a view to producing a practical, explosive or pyrotechnic effect. Transport of explosive substances which are unduly sensitive or so reactive as to be subject to spontaneous reaction is prohibited.

Definitions

For the purposes of these Regulations, the following definitions apply:

a) Explosive substance is a solid or liquid substance (or a mixture of substances) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic substances are included even when they do not evolve gases;
b) Pyrotechnic substance is a substance or a mixture of substances designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative self-sustaining exothermic chemical reactions;
c) Explosive article is an article containing one or more explosive substances.

Divisions

Class 1 is divided into six divisions as follows:

a) Division 1.1 Substances and articles which have a mass explosion hazard (a mass explosion is one which affects almost the entire load virtually instantaneously);
b) Division 1.2 Substances and articles which have a projection hazard but not a mass explosion hazard;
c) Division 1.3 Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. This division comprises substances and articles: (i) which give rise to considerable radiant heat; or (ii) which burn one after another, producing minor blast or projection effects or both;
d) Division 1.4 Substances and articles which present no significant hazard This division comprises substances and articles which present only a small hazard in the event of ignition or initiation during transport. The effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire shall not cause virtually instantaneous explosion of almost the entire contents of the package;
e) Division 1.5 Very insensitive substances which have a mass explosion hazard This division comprises substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport;

f) Division 1.6 Extremely insensitive articles which do not have a mass explosion hazard This division comprises articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.

Class 2 - Gases

Definitions and general provisions

A gas is a substance which:

a) At 50 °C has a vapour pressure greater than 300 kPa; or
b) Is completely gaseous at 20 °C at a standard pressure of 101.3 kPa.

The transport condition of a gas is described according to its physical state as:

a) Compressed gas – a gas which when packaged under pressure for transport is entirely gaseous at -50 °C; this category includes all gases with a critical temperature less than or equal to -50 °C;
b) Liquefied gas – a gas which when packaged under pressure for transport is partially liquid at temperatures above -50 °C. A distinction is made between: High pressure liquefied gas – a gas with a critical temperature between -50 °C and +65 °C, and Low pressure liquefied gas – a gas with a critical temperature above +65 °C;
c) Refrigerated liquefied gas – a gas which when packaged for transport is made partially liquid because of its low temperature; or
d) Dissolved gas – a gas which when packaged under pressure for transport is dissolved in a liquid phase solvent.

The class comprises compressed gases, liquefied gases, dissolved gases, refrigerated liquefied gases, mixtures of one or more gases with one or more vapours of substances of other classes, articles charged with a gas and aerosols.

Divisions

Substances of Class 2 are assigned to one of three divisions based on the primary hazard of the gas during transport.

a) Division 2.1 Flammable gases. Gases which at 20 °C and a standard pressure of 101.3 kPa: (i) are ignitable when in a mixture of 13 per cent or less by volume with air; or (ii) have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit. Flammability shall be determined by tests or by calculation in accordance with methods adopted by ISO (see ISO 10156:1996). Where insufficient data are available to use these methods, tests by a comparable method recognized by a national competent authority may be used;
b) Division 2.2 Non-flammable, non-toxic gases. Gases which: (i) are asphyxiant - gases which dilute or replace the oxygen normally in the atmosphere; or (ii) are oxidizing - gases which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does; or (iii) do not come under the other divisions;
c) Division 2.3 Toxic gases. Gases which: (i) are known to be so toxic or corrosive to humans as to pose a hazard to health; or (ii) are presumed to be toxic or corrosive to humans because they have an LC50 value equal to or less than 5000 ml/m3 (ppm).

Gases and gas mixtures with hazards associated with more than one division take the following precedence:

a) Division 2.3 takes precedence over all other divisions;
b) Division 2.1 takes precedence over Division 2.2.

Gases of Division 2.2, other than refrigerated liquefied gases, are not subject to these Regulations if they are transported at a pressure less than 280 kPa at 20 °C.

Class 3 - Flammable Liquids

Definition and general provisions

Class 3 includes the following substances:

a) Flammable liquids

b) Liquid desensitized explosives

Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60 °C, closed-cup test, or not more than 65.6 °C, open-cup test, normally referred to as the flash point. This class also includes:

a) Liquids offered for transport at temperatures at or above their flash point; and
b) Substances that are transported or offered for transport at elevated temperatures in a liquid state and which give off a flammable vapour at a temperature at or below the maximum transport temperature.

Liquids with a flash point of more than 35 °C which do not sustain combustion need not be considered as flammable liquids for the purposes of these Regulations. Liquids are considered to be unable to sustain combustion for the purposes of these Regulations (i.e. they do not sustain combustion under defined test conditions) if: (a) They have passed a suitable combustibility test (b) Their fire point according to ISO 2592:2000 is greater than 100 °C; or (c) They are water miscible solutions with a water content of more than 90% by mass. Liquid desensitized explosives are explosive substances which are dissolved or suspended in water or other liquid substances, to form an homogeneous liquid mixture to suppress their explosives properties.

Table A Hazard grouping based on flammability

Packing group	Flash point (closed-cup)	Initial boiling point
I	--	≤ 35 °C
II	< 23 °C	> 35 °C
III	≥ 23 °C ≤ 60 °C	> 35 °C

Class 4 - Flammable Solids; Substances Liable to Spontaneous Combustion; Substances which in Contact with Water Emit Flammable Gases

Definitions and general provisions

Class 4 is divided into three divisions as follows:

a) Division 4.1 Flammable solids. Solids which, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction; self-reactive substances which are liable to undergo a strongly exothermic reaction; solid desensitized explosives which may explode if not diluted sufficiently;
b) Division 4.2 Substances liable to spontaneous combustion. Substances which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire;
c) Division 4.3 Substances which in contact with water emit flammable gases. Substances which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

Division 4.1 - Flammable solids, self-reactive substances and solid desensitized explosives

Division 4.1 includes the following types of substances:

a) Flammable solids
b) Self-reactive substances and
c) Solid desensitized explosives.

Division 4.1 Flammable solids

Definitions and properties

Flammable solids are readily combustible solids and solids which may cause fire through friction. Readily combustible solids are powdered, granular, or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source, such as a burning match, and if the flame spreads rapidly. The danger may come not only from the fire but also from toxic combustion products. Metal powders are especially dangerous because of the difficulty of extinguishing a fire since normal extinguishing agents such as carbon dioxide or water can increase the hazard.

Division 4.1 Self-reactive substances

Definitions and properties

For the purposes of these Regulations: Self-reactive substances are thermally unstable substances liable to undergo a strongly exothermic decomposition even without participation of oxygen (air). Substances are not considered to be self-reactive substances of Division 4.1, if:

a) They are explosives according to the criteria of Class 1;
b) They are oxidizing substances according to the classification procedure for Division 5.1 except that mixtures of oxidizing substances which contain 5.0% or more of combustible organic substances shall be subjected to the classification procedure defined in Note 3;
c) They are organic peroxides according to the criteria of Division 5.2;
d) Their heat of decomposition is less than 300 J/g; or
e) Their self-accelerating decomposition temperature (SADT) is greater than 75 °C for a 50 kg package.

The decomposition of self-reactive substances can be initiated by heat, contact with catalytic impurities (e.g. acids, heavy-metal compounds, bases), friction or impact. The rate of decomposition increases with temperature and varies with the substance. Decomposition, particularly if no ignition occurs, may result in the evolution of toxic gases or vapours. For certain self-reactive substances, the temperature shall be controlled. Some self-reactive substances may decompose explosively, particularly if confined. This characteristic may be modified by the addition of diluents or by the use of appropriate packagings. Some self-reactive substances burn vigorously.

Division 4.1 Solid desensitized explosives

Definition

Solid desensitized explosives are explosive substances which are wetted with water or alcohols or are diluted with other substances, to form a homogeneous solid mixture to suppress their explosive properties. Substances that: (a) have been provisionally accepted into Class 1 according to Test Series 1 and 2 but exempted from Class 1 by Test Series 6; (b) are not self-reactive substances of Division 4.1; (c) are not substances of Class 5; are also assigned to Division 4.1.

Division 4.2 - Substances liable to spontaneous combustion

Definitions and properties

Division 4.2 includes: (a) Pyrophoric substances, which are substances, including mixtures and solutions (liquid or solid), which even in small quantities ignite within five minutes of coming in contact with air. These are the Division 4.2 substances are the most liable to spontaneous combustion; and (b) Self-heating substances, which are substances, other than pyrophoric substances, which in contact with air without energy supply are liable to self-heating. These substances will ignite only when in large amounts (kilograms) and after long periods of time (hours or days). Self-heating of substances, leading to spontaneous combustion, is caused by reaction of the substance with oxygen (in the air) and the heat developed not being conducted away rapidly enough to the surroundings. Spontaneous combustion occurs when the rate of heat production exceeds the rate of heat loss and the auto-ignition temperature is reached.

Division 4.3 - Substances which in contact with water emit flammable gases

Definitions and properties

Certain substances in contact with water may emit flammable gases that can form explosive mixtures with air. Such mixtures are easily ignited by all

ordinary sources of ignition, for example naked lights, sparking handtools or unprotected light bulbs. The resulting blast wave and flames may endanger people and the environment. The test method referred to in 2.4.4.2 is used to determine whether the reaction of a substance with water leads to the development of a dangerous amount of gases which may be flammable. This test method shall not be applied to pyrophoric substances.

Class 5 - Oxidizing Substances and Organic Peroxides

Definitions and general provisions

Class 5 is divided into two divisions as follows:

a) Division 5.1 Oxidizing substances. Substances which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material. Such substances may be contained in an article;
b) Division 5.2 Organic peroxides. Organic substances which contain the bivalent -0-0- structure and may be considered derivatives of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. Organic peroxides are thermally unstable substances, which may undergo exothermic self-accelerating decomposition. In addition, they may have one or more of the following properties: (i) be liable to explosive decomposition; (ii) burn rapidly; (iii) be sensitive to impact or friction; (iv) react dangerously with other substances; (v) cause damage to the eyes.

Division 5.1 - Oxidizing substances

Oxidizing solids

Assignment of packing groups

Solid oxidizing substances are assigned to a packing group according to the test procedure in the Manual of Tests and Criteria, in accordance with the following criteria:

a) Packing group I: any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time less than the mean burning time of a 3:2 mixture, by mass, of potassium bromate and cellulose;
b) Packing group II: any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 2:3 mixture (by mass) of potassium bromate and cellulose and the criteria for packing group I are not met;
c) Packing group III: any substance which, in the 4:1 or 1:1 sample-to-cellulose ratio (by mass) tested, exhibits a mean burning time equal to or less than the mean burning time of a 3:7 mixture (by mass) of potassium bromate and cellulose and the criteria for packing groups I and II are not met;
d) Not Division 5.1: any substance which, in both the 4:1 and 1:1 sample-to-cellulose ratio (by mass) tested, does not ignite and burn, or exhibits mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose.

Oxidizing liquids

Assignment of packing groups

Liquid oxidizing substances are assigned to a packing group according to the test procedure in the

Manual of Tests and Criteria, in accordance with the following criteria:

a) Packing group I: any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, spontaneously ignites; or the mean pressure rise time of a 1:1 mixture, by mass, of substance and cellulose is less than that of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose;
b) Packing group II: any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chlorate solution and cellulose; and the criteria for packing group I are not met;
c) Packing group III: any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, exhibits a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1

mixture, by mass, of 65% aqueous nitric acid and cellulose; and the criteria for packing groups I and II are not met;

d) Not Division 5.1: any substance which, in the 1:1 mixture, by mass, of substance and cellulose tested, exhibits a pressure rise of less than 2070 kPa gauge; or exhibits a mean pressure rise time greater than the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose.

Division 5.2 - Organic peroxides

Properties

Organic peroxides are liable to exothermic decomposition at normal or elevated temperatures. The decomposition can be initiated by heat, contact with impurities (e.g. acids, heavy-metal compounds, amines), friction or impact. The rate of decomposition increases with temperature and varies with the organic peroxide formulation. Decomposition may result in the evolution of harmful, or flammable, gases or vapours. For certain organic peroxides the temperature shall be controlled during transport. Some organic peroxides may decompose explosively, particularly if confined. This characteristic may be modified by the addition of diluents or by the use of appropriate packagings. Many organic peroxides burn vigorously. Contact of organic peroxides with the eyes is to be avoided. Some organic peroxides will cause serious injury to the cornea, even after brief contact, or will be corrosive to the skin.

Class 6 - Toxic and Infectious Substances

Definitions

Class 6 is divided into two divisions as follows:

a) Division 6.1 Toxic substances. These are substances liable either to cause death or serious injury or to harm human health swallowed or inhaled or by skin contact;

b) Division 6.2 Infectious substances. These are substances known or reasonably expected to contain pathogens. Pathogens are defined

as micro-organisms (including bacteria, viruses, rickettsiae, parasites, fungi) and other agents such as prions, which can cause disease in humans or animals.

Division 6.1 - Toxic substances

Definitions

For the purposes of these Regulations:

- LD50 (median lethal dose) for acute oral toxicity is the statistically derived single dose of a substance that can be expected to cause death within 14 days in 50 per cent of young adult albino rats when administered by the oral route. The LD50 value is expressed in terms of mass of test substance per mass of test animal (mg/kg).
- LD50 for acute dermal toxicity is that dose of the substance which, administered by continuous contact for 24 hours with the bare skin of albino rabbits, is most likely to cause death within 14 days in one half of the animals tested. The number of animals tested shall be sufficient to give a statistically significant result and be in conformity with good pharmacological practice. The result is expressed in milligrams per kg body mass.
- LC50 for acute toxicity on inhalation is that concentration of vapour, mist or dust which, administered by continuous inhalation to both male and female young adult albino rats for one hour, is most likely to cause death within 14 days in one half of the animals tested. A solid substance shall be tested if at least 10% (by mass) of its total mass is likely to be dust in a respirable range, e.g. the aerodynamic diameter of that particlefraction is 10 microns or less. A liquid substance shall be tested if a mist is likely to be generated in a leakage of the transport containment. Both for solid and liquid substances more than 90% (by mass) of a specimen prepared for inhalation toxicity shall be in the respirable range as defined above. The result is expressed in milligrams per litre of air for dusts and mists or in millilitres per cubic metre of air (parts per million) for vapours.

Assignment of packing groups

Substances of Division 6.1, including pesticides, are allocated among the three packing groups according to their degree of toxic hazard in transport as follows:

a) Packing group I: Substances and preparations presenting a very severe toxicity risk;
b) Packing group II: Substances and preparations presenting a serious toxicity risk;
c) Packing group III: Substances and preparations presenting a relatively low toxicity risk.

In making this grouping, account shall be taken of human experience in instances of accidental poisoning and of special properties possessed by any individual substance, such as liquid state, high volatility, any special likelihood of penetration, and special biological effects. In the absence of human experience the grouping shall be based on data obtained from animal experiments. Three possible routes of administration shall be examined. These routes are exposure through:

a) Oral ingestion;
b) Dermal contact; and
c) Inhalation of dusts, mists, or vapours.

When a substance exhibits a different order of toxicity by two or more of these routes of administration, the highest degree of danger indicated by the tests shall be assigned. The criteria to be applied for grouping a substance according to the toxicity it exhibits by all three routes of administration are presented in the following paragraphs. The grouping criteria for the oral and dermal routes as well as for inhalation of dusts and mists are as shown in the following table.

Table B Grouping Criteria for Administration through Oral Ingestion, Dermal Contact and Inhalation of Dusts and Mists

Packing group	Oral toxicity LD50 (mg/kg)	Dermal toxicity LD50 (mg/kg)	Inhalation toxicity by dusts and mists LC50 (mg/l)
I	≤ 5.0	≤ 50	≤ 0.2
II	> 5.0 and ≤ 50	> 50 and ≤ 200	> 0.2 and ≤ 2.0
III	> 50 and ≤ 300	> 200 and ≤ 1000	> 2.0 and ≤ 4.0

Division 6.2 - Infectious substances

Definitions

For the purposes of these Regulations:

- Infectious substances are substances which are known or are reasonably expected to contain pathogens. Pathogens are defined as micro-organisms (including bacteria, viruses, rickettsiae, parasites, fungi) and other agents such as prions, which can cause disease in humans or animals.
- Biological products are those products derived from living organisms which are manufactured and distributed in accordance with the requirements of appropriate national authorities, which may have special licensing requirements, and are used either for prevention, treatment, or diagnosis of disease in humans or animals, or for development, experimental or investigational purposes related thereto. They include, but are not limited to, finished or unfinished products such as vaccines.
- Cultures are the result of a process by which pathogens are intentionally propagated. This definition does not include human or animal patient specimens.
- Patient specimens are human or animal materials, collected directly from humans or animals, including, but not limited to, excreta, secreta, blood and its components, tissue and tissue fluid swabs, and body parts being transported for purposes such as research, diagnosis, investigational activities, disease treatment and prevention.
- Genetically modified micro-organisms and organisms are micro-organisms and organisms in which genetic material has been

purposely altered through genetic engineering in a way that does not occur naturally.

- Medical or clinical wastes are wastes derived from the medical treatment of animals or humans or from bio-research.

Class 7 - Radioactive Material

Definition of Class 7

Radioactive material means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified. The following radioactive materials are not included in Class 7 for the purposes of these Regulations:

a) Radioactive material that is an integral part of the means of transport;
b) Radioactive material moved within an establishment which is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads or railways;
c) Radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment;
d) Radioactive material in consumer products which have received regulatory approval, following their sale to the end user;
e) Natural material and ores containing naturally occurring radionuclides which are either in their natural state, or have only been processed for purposes other than for extraction of the radionuclides, and which are not intended to be processed for use of these radionuclides provided the activity concentration of the material does not exceed 10 times the values specified;
f) Non-radioactive solid objects with radioactive substances present on any surfaces in quantities not in excess of the limit set out in the definition for “contamination”.

Class 8 - Corrosive Substances

Definition

Class 8 substances (corrosive substances) are substances which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport.

Assignment of packing groups

Substances and preparations of Class 8 are divided among the three packing groups according to their degree of hazard in transport as follows:

a) Packing group I: Very dangerous substances and preparations;
b) Packing group II: Substances and preparations presenting medium danger;
c) Packing group III: Substances and preparations presenting minor danger.

Allocation of substances listed in the Dangerous Goods List to the packing groups in Class 8 has been made on the basis of experience taking into account such additional factors as inhalation risk and reactivity with water (including the formation of dangerous decomposition products). New substances, including mixtures, can be assigned to packing groups on the basis of the length of time of contact necessary to produce full thickness destruction of human skin in accordance with the criteria. Liquids, and solids which may become liquid during transport, which are judged not to cause full thickness destruction of human skin shall still be considered for their potential to cause corrosion to certain metal surfaces in accordance with the criteria.

A substance or preparation meeting the criteria of Class 8 having an inhalation toxicity of dusts and mists (LC50) in the range of packing group I, but toxicity through oral ingestion or dermal contact only in the range of packing group III or less, shall be allocated to Class 8.

Packing groups are assigned to corrosive substances in accordance with the following criteria:

a) Packing group I is assigned to substances that cause full thickness destruction of intact skin tissue within an observation period up to 60 minutes starting after the exposure time of three minutes or less;

b) Packing group II is assigned to substances that cause full thickness destruction of intact skin tissue within an observation period up to 14 days starting after the exposure time of more than three minutes but not more than 60 minutes;
c) Packing group III is assigned to substances that: (i) cause full thickness destruction of intact skin tissue within an observation period up to 14 days starting after the exposure time of more than 60 minutes but not more than 4 hours; or (ii) are judged not to cause full thickness destruction of intact skin tissue but which exhibit a corrosion rate on steel or aluminium surfaces exceeding 6.25 mm a year at a test temperature of 55 °C.

Class 9 – Miscellaneous Dangerous Substances and Articles

Definitions

Class 9 substances and articles (miscellaneous dangerous substances and articles) are substances and articles which, during transport present a danger not covered by other classes. Genetically modified micro-organisms (GMMOs) and genetically modified organisms (GMOs) are micro-organisms and organisms in which genetic material has been purposely altered through genetic engineering in a way that does not occur naturally.

Assignment to Class 9

Class 9 includes, inter alia:

a) environmentally hazardous substances which are not covered by other classes;
b) elevated temperature substances (i.e. substances that are transported or offered for transport at temperatures equal to or exceeding 100°C in a liquid state or at temperatures equal or exceeding 240°C in a solid state);
c) GMMOs or GMOs which do not meet the definition of infectious substances but which are capable of altering animals, plants or microbiological substances in a way not normally the result of natural reproduction. They shall be assigned to UN 3245. GMMOs

or GMOs are not subject to these Regulations when authorized for use by the competent authorities of the Governments of the countries of origin, transit and destination.

Environmentally hazardous substances (aquatic environment)

General definitions

Environmentally hazardous substances include, inter alia, liquid or solid substances pollutant to the aquatic environment and solutions and mixtures of such substances (such as preparations and wastes). The aquatic environment may be considered in terms of the aquatic organisms that live in the water, and the aquatic ecosystem of which they are part1. The basis, therefore, of the identification of hazard is the aquatic toxicity of the substance or mixture, although this may be modified by further information on the degradation and bioaccumulation behaviour.

Definitions and data requirements

The basic elements for classification of environmentally hazardous substances (aquatic environment) are:

- acute aquatic toxicity;
- potential for or actual bioaccumulation;
- degradation (biotic or abiotic) for organic chemicals; and
- chronic aquatic toxicity.

While data from internationally harmonised test methods are preferred, in practice, data from national methods may also be used where they are considered as equivalent. In general, freshwater and marine species toxicity data can be considered as equivalent data and are preferably to be derived using OECD Test Guidelines or equivalent according to the principles of Good Laboratory Practices (GLP). Where such data are not available, classification shall be based on the best available data.

APPENDIX II TRANSPORT STATISTICS

Table 30 Total volume of dangerous goods road transportations in Finland in 2002 (in thousand tonnes) (Source: Ministry of Transport and Communications Finland)

Transportation class	Transportation volume	Share of total volume (%)
1	10.3	0.1
2	647.4	5.3
3	8,294.0	67.5
4.1	56.6	0.5
4.2	2.1	0.0
4.3	6.9	0.1
5.1	591.8	4.8
5.2	15.0	0.1
6.1	581.6	4.7
6.2	0.0	0.0
8	1,877.9	15.3
9	213.8	1.7
Total	12,297. 5	100.0

Table 31 Total volume of dangerous goods rail transportations in Finland in 2002 (in thousand tonnes) (Source: Ministry of Transport and Communications Finland)

Transportation class	Transportation volume	Share of total volume (%)
1	0.1	0.0
2	693.0	11.4
3	4,218.0	69.4
4.1	53.9	0.9
4.2	0.0	0.0
4.3	3.4	0.1
5.1	121.7	2.0
5.2	0.0	0.0
6.1	71.6	1.2
6.2	0.0	0.0
7	0.0	0.0
8	899.6	14.8
9	17.9	0.3
Total	6,079.1	100.0

Table 32 Dangerous Goods Road Transport with German Vehicles in Germany in 2001-2004

In 1,000 tonnes

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall	2,869,903		2,705,150		2,728,180		2,750,000	
Dangerous Goods Transport [1)]	167,056	5.8%	144,064	5.3%	145,955	5.3%	146,824	5.3%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	801	0.5%	1,798	1.2%	1,822	1.2%	1,574	1.1%
2. Gases	6,527	3.9%	5,977	4.1%	5,546	3.8%	7,672	5.2%
3. Flammable Liquid	104,927	62.8%	93,233	64.7%	101,273	69.4%	99,872	68.0%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	13,810	8.3%	5,665	3.9%	2,224	1.5%	2,620	1.8%
4.2 Spontaneously liable to spontaneuous combustion	2,955	1.8%	2,245	1.6%	787	0.5%	757	0.5%
4.3 Substances which in contact with water emit flammable gases	1,434	0.9%	713	0.5%	783	0.5%	578	0.4%
5.1 Oxidizing Substances	786	0.5%	957	0.7%	958	0.7%	1,073	0.7%
5.2 Organic Peroxides	44	0.0%	48	0.0%	52	0.0%	52	0.0%
6.1 Toxic Substances	16,012	9.6%	15,262	10.6%	13,653	9.4%	13,382	9.1%
6.2 Infectious Substances	326	0.2%	321	0.2%	1	0.0%	3	0.0%
8 Corrosive Substances	12,386	7.4%	13,333	9.3%	14,748	10.1%	14,966	10.2%
9 Miscellaneous dangerous substances and articles	7,048	4.2%	4,512	3.1%	4,107	2.8%	4,275	2.9%
1) Without Class 7								

In million tonne-km

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall								
Dangerous Goods Transport [1)]	282,879		278,026		283,788		298,053	
	17,310	6.1%	15,944	5.7%	16,435	5.8%	16,872	5.7%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	163	0.9%	373	2.3%	373	2.3%	374	2.2%
2. Gases	1,225	7.1%	1,161	7.3%	986	6.0%	1,398	8.3%
3. Flammable Liquid	10,031	57.9%	9,427	59.1%	10,068	61.3%	9,951	59.0%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	1,504	8.7%	617	3.9%	286	1.7%	339	2.0%
4.2 Spontaneously liable to spontaneuous combustion	396	2.3%	288	1.8%	116	0.7%	108	0.6%
4.3 Substances which in contact with water emit flammable gases	166	1.0%	142	0.9%	147	0.9%	117	0.7%
5.1 Oxidizing Substances	126	0.7%	127	0.8%	137	0.8%	136	0.8%
5.2 Organic Peroxides	8	0.0%	8	0.1%	12	0.1%	12	0.1%
6.1 Toxic Substances	1,456	8.4%	1,478	9.3%	1,663	10.1%	1,682	10.0%
6.2 Infectious Substances	58	0.3%	54	0.3%	0	0.0%	1	0.0%
8 Corrosive Substances	1,758	10.2%	1,996	12.5%	2,363	14.4%	2,456	14.6%
9 Miscellaneous dangerous substances and articles	418	2.4%	273	1.7%	285	1.7%	299	1.8%
1) Without Class 7								

Source : Preparation for the statement of Dangerous Goods Transport for Year 2001/2002 and 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate

Table 33 Dangerous Goods Road Transport with Foreign Vehicles in Germany in 2001-2004

In 1,000 tonnes

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall	162,103		160,373		160,904		223,151	
Dangerous Goods Transport [1)]	9,063	5.6%	8,274	5.2%	7,820	4.9%	9,516	4.3%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	140	1.5%	252	3.0%	231	3.0%	282	3.0%
2. Gases	565	6.2%	626	7.6%	368	4.7%	474	5.0%
3. Flammable Liquid	3,709	40.9%	3,243	39.2%	3,516	45.0%	3,983	41.9%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	1,032	11.4%	751	9.1%	722	9.2%	934	9.8%
4.2 Spontaneously liable to spontaneuous combustion	237	2.6%	184	2.2%	20	0.3%	25	0.3%
4.3 Substances which in contact with water emit flammable gases	127	1.4%	119	1.4%	109	1.4%	142	1.5%
5.1 Oxidizing Substances	127	1.4%	119	1.4%	98	1.3%	185	1.9%
5.2 Organic Peroxides	10	0.1%	9	0.1%	8	0.1%	11	0.1%
6.1 Toxic Substances	1,159	12.8%	1,119	13.5%	1,090	13.9%	1,146	12.0%
6.2 Infectious Substances	33	0.4%	29	0.4%	0	0.0%	0	0.0%
8 Corrosive Substances	1,622	17.9%	1,695	20.5%	1,558	19.9%	2,140	22.5%
9 Miscellaneous dangerous substances and articles	303	3.3%	129	1.6%	100	1.3%	193	2.0%
1) Without Class 7								

In million tonne-km

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall	83,966		83,960		83,290		133,018	
Dangerous Goods Transport [1)]	3,996	4.8%	3,826	4.6%	3,929	4.7%	5,404	4.1%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	144	3.6%	138	3.6%	338	8.6%	399	7.4%
2. Gases	944	23.6%	287	7.5%	382	9.7%	656	12.1%
3. Flammable Liquid	1,721	43.1%	1,432	37.4%	1,418	36.1%	1,825	33.8%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	439	11.0%	257	6.7%	118	3.0%	184	3.4%
4.2 Spontaneously liable to spontaneuous combustion	136	3.4%	100	2.6%	9	0.2%	14	0.3%
4.3 Substances which in contact with water emit flammable gases	61	1.5%	55	1.4%	74	1.9%	110	2.0%
5.1 Oxidizing Substances	56	1.4%	53	1.4%	59	1.5%	93	1.7%
5.2 Organic Peroxides	247	6.2%	5	0.1%	5	0.1%	6	0.1%
6.1 Toxic Substances	565	14.1%	569	14.9%	567	14.4%	736	13.6%
6.2 Infectious Substances	334	8.4%	16	0.4%	0	0.0%	0	0.0%
8 Corrosive Substances	811	20.3%	864	22.6%	865	22.0%	1,251	23.1%
9 Miscellaneous dangerous substances and articles	109	2.7%	49	1.3%	93	2.4%	131	2.4%
1) Without Class 7								

Source : Preparation for the statement of Dangerous Goods Transport for Year 2001/2002 and 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate

Table 34 Dangerous Goods Rail Transport in Germany in 2001-2004

In 1,000 tonnes

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall	288,245		285,357		303,757		310,261	
Dangerous Goods Transport [1)]	46,936	16.3%	48,088	16.9%	52,062	17.1%	53,941	17.4%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	132	0.3%	142	0.3%	182	0.3%	165	0.3%
2. Gases	5,332	11.4%	5,791	12.0%	5,993	11.5%	5,450	10.1%
3. Flammable Liquid	28,788	61.3%	29,931	62.2%	31,669	60.8%	33,899	62.8%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	1,912	4.1%	1,644	3.4%	1,409	2.7%	1,319	2.4%
4.2 Spontaneously liable to spontaneuous combustion	944	2.0%	810	1.7%	1,175	2.3%	1,136	2.1%
4.3 Substances which in contact with water emit flammable gases	285	0.6%	229	0.5%	156	0.3%	256	0.5%
5.1 Oxidizing Substances	550	1.2%	975	2.0%	719	1.4%	651	1.2%
5.2 Organic Peroxides	9	0.0%	14	0.0%	26	0.0%	24	0.0%
6.1 Toxic Substances	4,074	8.7%	3,670	7.6%	3,103	6.0%	2,599	4.8%
6.2 Infectious Substances	9	0.0%	3	0.0%	0	0.0%	1	0.0%
8 Corrosive Substances	3,363	7.2%	3,331	6.9%	3,907	7.5%	4,320	8.0%
9 Miscellaneous dangerous substances and articles	1,539	3.3%	1,547	3.2%	3,723	7.2%	4,120	7.6%
1) Without Class 7								

In million tonne-km

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall	76,359		75,413		79,841		86,409	
Dangerous Goods Transport [1)]	12,697	16.6%	12,868	17.1%	13,863	17.4%	13,837	16.0%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	34	0.3%	41	0.3%	58	0.4%	56	0.4%
2. Gases	1,677	13.2%	1,783	13.9%	1,864	13.4%	1,763	12.7%
3. Flammable Liquid	7,462	58.8%	7,665	59.6%	7,764	56.0%	8,276	59.8%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	437	3.4%	375	2.9%	339	2.4%	334	2.4%
4.2 Spontaneously liable to spontaneuous combustion	163	1.3%	118	0.9%	176	1.3%	245	1.8%
4.3 Substances which in contact with water emit flammable gases	27	0.2%	33	0.3%	19	0.1%	52	0.4%
5.1 Oxidizing Substances	150	1.2%	270	2.1%	225	1.6%	223	1.6%
5.2 Organic Peroxides	3	0.0%	4	0.0%	8	0.1%	11	0.1%
6.1 Toxic Substances	1,231	9.7%	1,107	8.6%	960	6.9%	731	5.3%
6.2 Infectious Substances	1	0.0%	1	0.0%	0	0.0%	11	0.1%
8 Corrosive Substances	1,039	8.2%	1,020	7.9%	1,262	9.1%	1,299	9.4%
9 Miscellaneous dangerous substances and articles	475	3.7%	452	3.5%	1,189	8.6%	836	6.0%
1) Without Class 7								

Source : Preparation for the statement of Dangerous Goods Transport for Year 2001/2002 and 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate

Table 35 Dangerous Goods Inland Waterway Transport in Germany in 2001-2004

In 1,000 tonnes

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall	236,101		231,746		219,999		235,861	
Dangerous Goods Transport [1)]	53,084	22.48%	50,806	21.92%	47,268	21.49%	49,942	21.17%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	55	0.1%	55	0.1%	57	0.1%	56	0.1%
2. Gases	2,847	5.4%	2,609	5.1%	2,816	6.0%	2,996	6.0%
3. Flammable Liquid	43,469	81.9%	41,106	80.9%	37,704	79.8%	40,038	80.2%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	824	1.6%	588	1.2%	573	1.2%	574	1.1%
4.2 Spontaneously liable to spontaneuous combustion	932	1.8%	934	1.8%	894	1.9%	980	2.0%
4.3 Substances which in contact with water emit flammable gases	164	0.3%	29	0.1%	82	0.2%	95	0.2%
5.1 Oxidizing Substances	248	0.5%	82	0.2%	76	0.2%	60	0.1%
5.2 Organic Peroxides	1	0.0%	0	0.0%	1	0.0%	0	0.0%
6.1 Toxic Substances	743	1.4%	773	1.5%	897	1.9%	1,105	2.2%
6.2 Infectious Substances	0	0.0%	0	0.0%	0	0.0%	1	0.0%
8 Corrosive Substances	2,720	5.1%	3,129	6.2%	2,639	5.6%	2,693	5.4%
9 Miscellaneous dangerous substances and articles	1,080	2.0%	1,501	3.0%	1,528	3.2%	1,345	2.7%
1) Without Class 7								

In million tonne-km

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall	64,818		64,166		58,154		63,667	
Dangerous Goods Transport [1)]	15,241	23.51%	14,091	21.96%	12,963	22.29%	13,651	21.44%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	18	0.1%	18	0.1%	17	0.1%	19	0.1%
2. Gases	650	4.3%	596	4.2%	646	5.0%	711	5.2%
3. Flammable Liquid	12,572	82.5%	11,600	82.3%	10,275	79.3%	10,843	79.4%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	332	2.2%	114	0.8%	237	1.8%	249	1.8%
4.2 Spontaneously liable to spontaneuous combustion	341	2.2%	213	1.5%	317	2.4%	349	2.6%
4.3 Substances which in contact with water emit flammable gases	47	0.3%	12	0.1%	31	0.2%	38	0.3%
5.1 Oxidizing Substances	105	0.7%	33	0.2%	29	0.2%	25	0.2%
5.2 Organic Peroxides	0	0.0%	0	0.0%	0	0.0%	0	0.0%
6.1 Toxic Substances	195	1.3%	202	1.4%	207	1.6%	256	1.9%
6.2 Infectious Substances	0	0.0%	0	0.0%	0	0.0%	0	0.0%
8 Corrosive Substances	591	3.9%	680	4.8%	571	4.4%	589	4.3%
9 Miscellaneous dangerous substances and articles	391	2.6%	623	4.4%	633	4.9%	572	4.2%
1) Without Class 7								

Source : Preparation for the statement of Dangerous Goods Transport for Year 2001/2002 and 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate

Table 36 Dangerous Goods Sea Transport in Germany in 2001-2004 (in 1,000 tonnes)

Item	Total							
	2001	%	2002	%	2003	%	2004	%
Overall	242,156		242,546		251,300		268,205	
Dangerous Goods Transport [1)]	69,413	28.66%	66,754	27.52%	66,410	26.43%	74,061	27.61%
Amount of Dangerous Goods According to Classification								
1. Explosive Material and Items with explosive material	2,605	3.8%	2,506	3.8%	2,357	3.5%	3,781	5.1%
2. Gases	2,008	2.9%	1,910	2.9%	2,134	3.2%	2,007	2.7%
3. Flammable Liquid	59,485	85.7%	56,880	85.2%	56,348	84.8%	62,266	84.1%
4.1 Flammable Solid, self reactive substances and solid desensitised explosives	624	0.9%	673	1.0%	694	1.0%	751	1.0%
4.2 Spontaneously liable to spontaneuous combustion	438	0.6%	422	0.6%	428	0.6%	438	0.6%
4.3 Substances which in contact with water emit flammable gases	82	0.1%	88	0.1%	97	0.1%	110	0.1%
5.1 Oxidizing Substances	206	0.3%	156	0.2%	123	0.2%	115	0.2%
5.2 Organic Peroxides	9	0.0%	10	0.0%	10	0.0%	13	0.0%
6.1 Toxic Substances	1,010	1.5%	1,050	1.6%	1,078	1.6%	1,188	1.6%
6.2 Infectious Substances	36	0.1%	41	0.1%	22	0.0%	23	0.0%
8 Corrosive Substances	2,354	3.4%	2,519	3.8%	2,623	3.9%	2,810	3.8%
9 Miscellaneous dangerous substances and articles	555	0.8%	499	0.7%	496	0.7%	557	0.8%
1) Without Class 7								

Source : Preparation for the statement of Dangerous Goods Transport for Year 2001/2002 and 2003/2004 and the Creation of the Technical Program Preparation for the Future Yearly Certificate

Table 37 Quantities transported by road in Sweden in September 2006 (Source: Statistics Sweden)

Class	Weight (tonnes)	Percentage
1	1,100*	0.1
2.1	25,047	1.8
2.2	80,736	5.9
2.3	166	0.0
3	959,953	69.6
4.1	3,630	0.3
4.2	429	0.0
4.3	753	0.1
5.1	8,820	0.6
5.2	46	0.0
6.1	1,694	0.1
6.2	1,819	0.1
7	..**	..
8	172,767	12.5
9	123,163	8.9
Total	1,380,124	100

*The net weight is given for explosive substances

**Information about the number of packages was requested for transport in Class 7. This information is presented only in the maps in Appendix II in Transport of Dangerous Goods in Sweden -report.

Table 38 Quantities transported by rail in Sweden in September 2006 (Source: Statistics Sweden)

Class	Weight (tonnes)	Percentage
1	0.1*	0.0
2.1	23,178	11.1
2.2	814	0.4
2.3	7,750	3.7
3	112,370	53.9
4.1	147	0.1
4.2	120	0.1
4.3	2,385	1.1
5.1	25,039	12.0
5.2	213	0.1
6.1	2,721	1.3
6.2	0	0
7	27.5**	0.0
8	20,966	10.1
9	12,580	6.0
Total	208,311	100

**The net weight is given for explosive substances*

**No information was received concerning the total activity of material in Class 7.

Table 39 Quantities of each class handled at ports[3] in Sweden in September 2006 (Source: Statistics Sweden)

Class	Weight (tonnes)	Percentage
1	4,532*	2.9
2**	1,340	0.9
2.1	807	0.5
2.2	3,405	2.2
2.3	690	0.5
3	50,542	32.7
4.1	1,297	0.8
4.2	151	0.1
4.3	1,534	1.0
5.1	35,362	22.9
5.2	1,777	1.2
6.1	8,016	5.2
6.2	0	0
7	327***	0.2
8	25,009	16.2
9	19,913	12.9
Total	154,702	100

*The net weight is given for explosive substances.

**Quantities are presented for Class 2 in cases where the subclasses are not known.

***Only the quantity, measured in tonnes, of radioactive substances is specified. Activities, measured in Becquerel are not given.

[3] Within the Baltic Sea region: ports in Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, Germany and Denmark.

Table 40 Dangerous goods road transport with Swedish registered lorries in Sweden according to ADR 1987-2004 (Source: Swedish Rescue Services Agency)

Year	Quantity 1000 tons	Tonne-kilometres millions	Driven kilometres with load 1000 km	Number of haulages with load, 1000
1987	15318	1466	69697	875
1990	14975	1599	71014	780
1993	14296	1720	70172	688
1995	14575	1823	66162	588
1996	14163	1723	61565	585
1997	13982	1811	65902	591
1998	15785	2132	95844	607
1999	13574	1932	66644	499
2000	15379	2047	84915	730
2001	14070	1875	90579	752
2002	16482	2317	115210	882
2003	12971	1894	95521	821
2004	12470	1592	88806	762

Table 41 Dangerous goods rail transport in Sweden 2001-2005 (Source: Swedish Rescue Services Agency)

Year	Number of units	Thousand tonnes	Million km	Million tonne-km
2001	66,870	1,764.1	34.3	898.0
2002	65,216	1,766.9	33.9	895.1
2003	70,735	1,984.7	35.6	974.5
2004	71,755	2,048.8	36.3	993.5
2005	73,539	2,096.4	37.6	1,053.0

Table 42 Number of RID transport units transported in Sweden in 2005 (Source: Swedish Rescue Services Agency)

Class	Number of units
1	246
2	18,923
3	25,023
4.1	627
4.2	68
4.3	1,267
5.1	11,433
5.2	141
6.1	1,222
6.2	2
7	19
8	9,829
9	4,721

Table 43 Goods transported in Swedish foreign trade by ships and shipping of goods between Swedish ports in 2006 (in million tonne-km) (Source: Statistics Sweden)

Goods	Transport performance in foreign trade	Transport performance in domestic traffic
Solid mineral fuels	2,474	80
Crude petroleum	2,929	-
Petroleum products	4,280	3,554
Natural and chemical fertilizers	272	31
Coal chemicals, tar	205	-
Chemicals other than coal chemicals and tar	1,527	276

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This report has collected the transport data of Dangerous Goods in the Baltic Sea Region. The countries included are: Estonia, Finland, Germany, Latvia, Lithuania and Sweden. The statistics are from the years 1997-2006, concentrating on the latest possible data. Report includes information on dangerous goods road, rail and maritime transport modes.

This report is part of the Safe and Reliable Transport Chains of Dangerous Goods in the Baltic Sea Region –project. The project aims at improving the co-operations between public and private stakeholders related to DG transport in the BSR by connecting the stakeholders on different levels, providing up to date information on cargo flows, supply chain efficiency and risks related to DG transport.

The main objective of this report has been the collection of data on dangerous goods transport in the Baltic Sea Region. Thus the vital element of the work was to collect the data on dangerous goods transport volumes, it however quickly became clear that obtaining data requires a lot of work, inquiries and contacts. There was no joint data bank for this purpose, and in order to understand the situation, the validity of the data should be checked and cross-checked. It was clearly shown that different bodies collect and document dangerous goods transport data in various ways.

The amount of Dangerous Goods transported in the BSR countries varies quite much. Germany is in different category compared to other BSR countries and the split between transport modes is different also. In Germany the largest dangerous goods transport mode is road transport, where annual transport amount is about 156 million tonnes of Dangerous Goods. In other BSR countries the sea mode is the largest transport mode. Finland and Sweden has quite similar amounts of goods transported annually by road and rail, but the volume of sea transport is larger in Sweden. In the Baltic states the rail transport is much more significant than in other BSR countries because of the dangerous goods flows from the Russia.

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