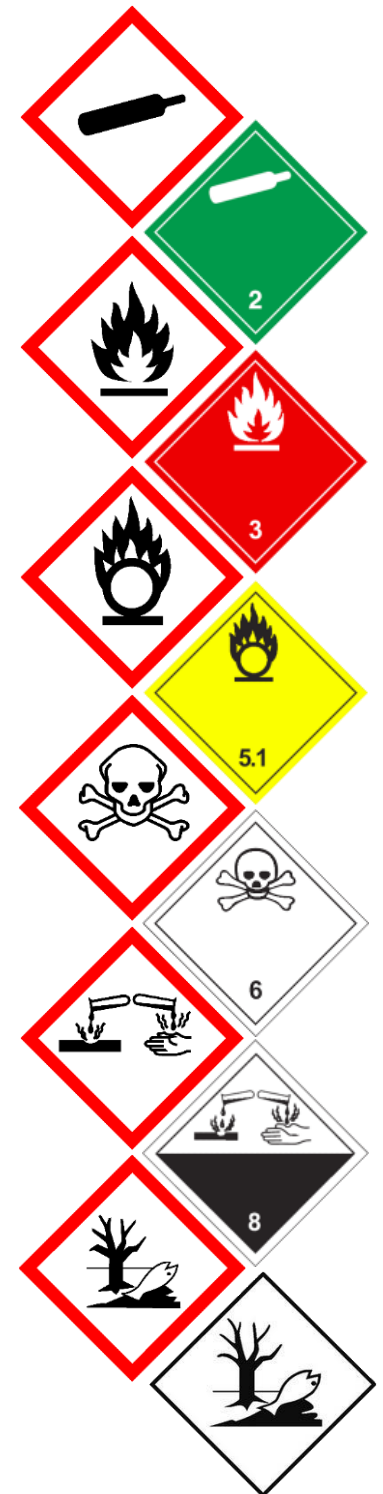


Symposium of ISSA Chemistry Section and ISSA Transportation Section
during the AICHEMA 2018, Frankfurt, 12 June 2018
„Health and Safety in the Supply Chain of Chemicals“

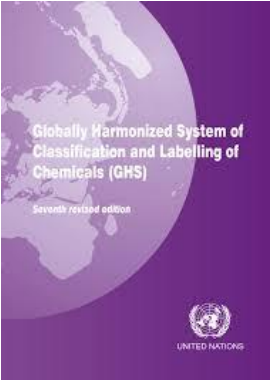

Dangerous good meets hazardous substance:
intersections regarding transport and handling –
responsibilities, congruency and differences

Gefahrgut trifft Gefahrstoff:
An der Schnittstelle von Beförderung und Umgang –
Verantwortlichkeiten, Gemeinsamkeiten und Unterschiede

JOACHIM BRAND
KARLSRUHER INSTITUT FÜR TECHNOLOGIE (KIT)



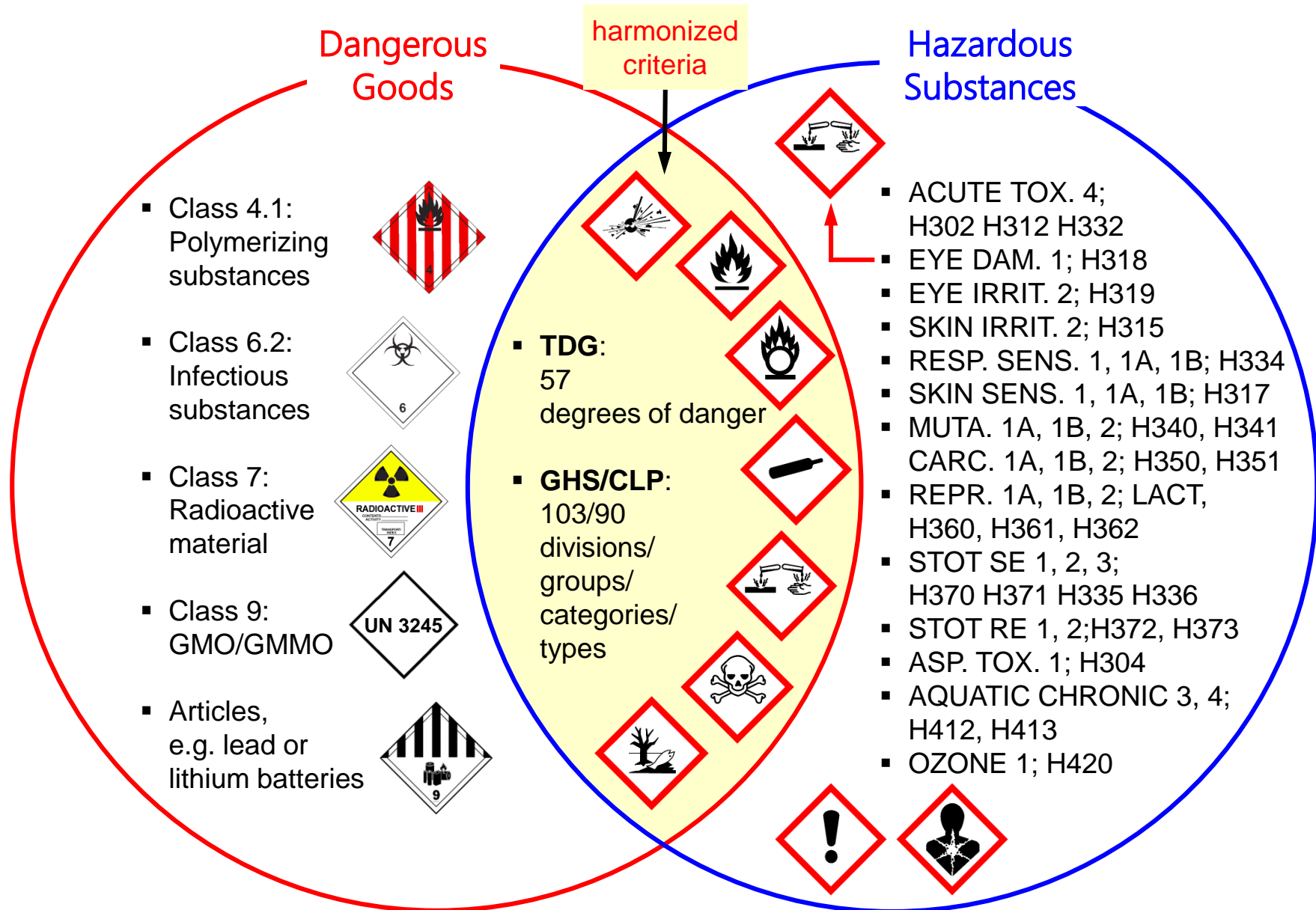
Hazardous substances and dangerous goods — significant issues

Issue	Chemical legislation	Transport legislation
Laws and provisions	<ul style="list-style-type: none"> ▪ UN: GHS („purple book“), Rev. 7 (2017)  <ul style="list-style-type: none"> ▪ EU: CLP Regulation, REACH Regulation 98/24/EC Directive 2004/37/EC Directive ▪ Germany: ChemG, GefStoffV, TRGS 	<ul style="list-style-type: none"> ▪ UN: Model Regulations TDG („orange book“), Rev. 20 (2017); Manual of Tests and Criteria, Rev. 6, Amend. 1 (2017) ▪ International: IMDG Code, ICAO-TI (IATA-DGR) ▪ „Europe“: ADR, RID, ADN ▪ EU: DG inland transport directive (road, rail, inland waterways), DG checks on transport directive (road) ▪ Germany: GGBefG, GGVSEB, GGVSee 
Definition „hazardous/ dangerous properties“	<ul style="list-style-type: none"> ▪ General in Germany: § 3a ChemG, § 2 (1) GefStoffV ▪ Specific: UN-GHS: Parts 2, 3, 4 and Annex I CLP: Art. 3, Annex I 	<ul style="list-style-type: none"> ▪ General in Germany: § 2 (1) GGBefG, § 2 Nr. 7 GGVSEB, § 2 (2) GGVSee ▪ Specific: Part 2 ADR, RID, ADN, IMDG Code, ICAO-TI (Part 3 IATA-DGR)

Hazardous substances and dangerous goods — significant issues

Issue	Chemical legislation	Transport legislation
Legal classification	<ul style="list-style-type: none"> ▪ Annex VI CLP („Hazardous substances list“) ▪ Harmonized classification related to specific hazards ▪ Non-exhaustive classification 	<ul style="list-style-type: none"> ▪ Part 3 UN-TDG („Dangerous goods list“) ▪ Obligatory classification/description for all hazard properties (ADR/RID/ADN/IMDG: except environmentally hazard) ▪ Exhaustive classification
Description, numeric	<ul style="list-style-type: none"> ▪ CAS No. ▪ INDEX No. ▪ EG No. ▪ REACH Registration No. ▪ Other, e.g. REACH authorisation No., C&L No. 	<ul style="list-style-type: none"> ▪ UN number, 4-digit
Description, textual	<ul style="list-style-type: none"> ▪ Product identifier: chemical name, IUPAC name, trivial name, ISO name, trade name (mixtures) 	<ul style="list-style-type: none"> ▪ Proper shipping name as single entry, generic entry, specific or general n.o.s. entry ▪ Additional hazardous compounds (technical name), if applicable
Classification elements	<ul style="list-style-type: none"> ▪ Hazard class ▪ Hazard category, group, type, division ▪ H, EUH Statements 	<ul style="list-style-type: none"> ▪ Dangerous goods class, subsidiary risks ▪ Packing group, if applicable ▪ Classification code, if applicable ▪ „ENVIRONMENTALLY HAZARDOUS“, if applicable



Dangerous Goods / Hazardous Substances: Congruency and Differences



Classification elements as per GHS, CLP and TDG

Hazard class	GHS (UN)		CLP (EU)		thereof relevant for DG
	Categories	H Codes	Categories	H Codes	
Explosives	7	6	7	6	6
Flammable gases	6	5	4	4	5
Aerosols	3	3	3	3	3
Oxidizing gases	1	1	1	1	1
Gases under pressure	4	2	4	2	4
Flammable liquids	4	4	3	3	3
Flammable solids	2	1	2	1	2
Selfreactive substances and mixtures	7	3	7	3	7
Pyrophoric liquids	1	1	1	1	1
Pyrophoric solids	1	1	1	1	1
Selfsubstances and mixtures	2	2	2	2	2
Substances and mixtures, which in contact with water, emit flammable gases	3	2	3	2	3
Oxidizing liquids	3	2	3	2	3
Oxidizing solids	3	2	3	2	3
Organic peroxides	7	3	7	3	7
Corrosive to metals	1	1	1	1	1
Desensitized explosives	4	3	0	0	2
Acute toxicity	5	12	4	9	3
Skin corrosion/irritation	5	3	4	2	3
Serious eye damage/eye irritation	3	3	2	2	0
Respiratory sensitization	3	1	3	1	0
Skin sensitization	3	1	3	1	0
Germ cell mutagenicity	3	2	3	2	0
Carcinogenicity	3	2	3	2	0
Reproductive toxicity	4	3	4	3	0
Specific target organ toxicity – single exposure	3	4	3	4	0
Specific target organ toxicity – repeated exposure	2	2	2	2	0
Aspiration hazard	2	2	1	1	0
Hazardous to the aquatic environment, short-term (Acute)	3	3	1	1	1 (ADN tank: 3)
Hazardous to the aquatic environment, long-term (Chronic)	4	4	4	4	2 (ADN tank: 3)
Hazardous to the ozone layer	1	1	1	1	0
Total	103	85	90	72	63

Hazardous substances and dangerous goods — significant issues

Issue	Chemical legislation	Transport legislation
Example description: Hexane	<ul style="list-style-type: none"> ▪ n-Hexane (IUPAC) ▪ CAS 110-54-3 ▪ EG 203-777-6 ▪ INDEX 601-037-00-0 	<ul style="list-style-type: none"> ▪ UN 1208 ▪ HEXANE
Example classification: Hexane	<ul style="list-style-type: none"> ▪ FLAM. LIQ. 2, H225 ▪ REPR. 2, H361f ▪ ASP. TOX. 1, H304 ▪ SKIN IRRIT. 2, H315 ▪ STOT SE 3, H336 ▪ STOT RE 2, H373 ▪ AQUATIC CHRONIC 2, H411 <div style="text-align: center;">  </div>	<ul style="list-style-type: none"> ▪ Class 3, no subsidiary risk ▪ Packing group II ▪ additional: ENVIRONMENTALLY HAZARDOUS <div style="text-align: right;">  </div>
Labelling: Packages, vessels	<ul style="list-style-type: none"> ▪ Hazard label ▪ Compulsory indications ▪ Assorted by languages, if applicable ▪ Label size depending on vessel/package volume 	<ul style="list-style-type: none"> ▪ Inscription (text), e.g. “UN” + UN no. ▪ Marks (EHS = fish and tree, orientation arrows, lithium battery) ▪ Specific handling labels (e.g. CAO) ▪ Dangerous goods labels ▪ Uniform size
Labelling: Vehicles, transport means/units	—	<ul style="list-style-type: none"> ▪ Placards ▪ Enlarged EHS mark (fish and tree) ▪ Special marks: temperature, LQ, EQ ▪ Orange-coloured plates (with or without identification numbers)

Hazardous substances and dangerous goods — significant issues

Issue	Chemical legislation	Transport legislation
Documents	<ul style="list-style-type: none"> ▪ Safety data sheet ▪ Chemical safety report, if applicable ▪ Risk assessment ▪ Explosion protection document ▪ Hazardous substance inventory ▪ Operating instructions 	<ul style="list-style-type: none"> ▪ Dangerous goods transport document ▪ Instructions in writing ▪ Container/vehicle packing certificate ▪ ADR training certificate (drivers) ▪ Means of identification (member of the vehicle crew) ▪ Vehicle certificate of approval (e.g. tank-vehicles) ▪ Shipment permits/approvals (e.g. class 1, class 7) ▪ Certificate of qualification (e.g. SprengG)
Documentation: formal requirements	<ul style="list-style-type: none"> ▪ Yes: Safety data sheet (Annex II REACH: 16 sections und sub-sections), Chemical safety report (Annex I, No. 7 REACH) ▪ No: Risk Assessment, Explosion protection document, Hazardous substance inventory ▪ Recommended: Operating instructions (3.1 (10) TRGS 555) 	<ul style="list-style-type: none"> ▪ Yes: Instructions in writing, ADR training certificate, Vehicle certificate of approval ▪ No: DG transport document (except air transport DGD) ▪ Recommended: IMDG transport document (IMO declaration)

Hazardous substances and dangerous goods — significant issues

Issue	Chemical legislation	Transport legislation
Participants, party to whom the standard is addressed	<ul style="list-style-type: none"> ▪ Actors in the supply chain, supplier ▪ Producer ▪ Vendor ▪ Distributor ▪ Importer ▪ Recipient ▪ Employer 	<ul style="list-style-type: none"> ▪ Client of the consignor/Shipper, Consignor ▪ Packer, Filler ▪ Loader ▪ Carrier ▪ Consignee, Unloader ▪ Other actors, as e.g. operator of a tank-container, packaging manufacturer
Responsible persons, employees, staff	<ul style="list-style-type: none"> ▪ Employer/entrepreneur ▪ Responsible persons ▪ Employees/workers ▪ „Hazardous substances officer/administrator“ („Gefahrstoffbeauftragter“), specialists for occupational safety and health, company doctors 	<ul style="list-style-type: none"> ▪ Entrepreneur/proprietor of a business ▪ Authorized (= responsible) persons ▪ Person acting at the direction ▪ „Other responsible persons“, e.g. driver ▪ Dangerous goods safety advisor („Gefahrgutbeauftragter“)

Hazardous substances and dangerous goods — significant issues

Issue	Chemical legislation	Transport legislation
Qualification measures EU, international	<ul style="list-style-type: none"> ▪ Competent Person(s) i.a. for safety data sheet, chemical safety report according to REACH ▪ Appropriate experience, training, refresher training 	<ul style="list-style-type: none"> ▪ Training ▪ 1.3, 1.7.2.5, 1.10.2, 5.5.2.2, 5.5.3.2.5 ADR/RID/ ADN, 8.2.3 ADR ▪ 1.3, 1.4.2.3, 5.5.2.2, 5.5.3.2.5 IMDG Code ▪ 1.4 ICAO-TI (1.5 IATA-DGR)
Qualification measures Germany	<ul style="list-style-type: none"> ▪ Information, instruction, advice § 14 (2) GefStoffV: prior to commencement of work, thereafter at least every year (records be kept for at least 2 years) ▪ Professional expertise („Fachkunde“): e.g. conducting risk Assessments, workplace measurements, compiling SDS, access to substances labelled/classified as GHS06, CM1A/1B, STOT 1 ▪ Expert knowledge („Sachkunde“): e.g. asbestos activities, „poison trading“ 	<ul style="list-style-type: none"> ▪ Training ▪ § 27 (5), § 29 (5) GGVSEB ▪ § 4 (11, 12) GGVSee ▪ records be kept for 5 years

Hazardous substance list / Dangerous goods list — Boon or Bane?


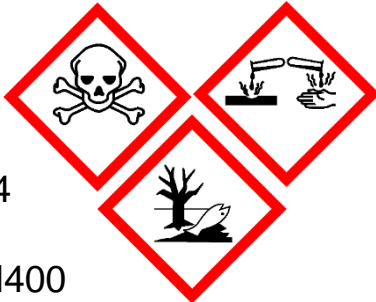


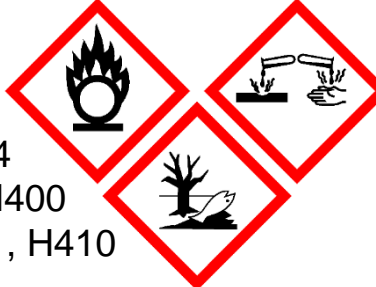


Dangerous goods		Hazardous substance (corrosion)
Classification less strict:		Classification stricter:
UN 1125 n-BUTYLAMINE	3 (8), II	SKIN CORR. 1A
UN 1154 DIETHYLAMINE	3 (8), II	SKIN CORR. 1A
UN 1198 FORMALDEHYDE SOLUTION, FLAMMABLE	3 (8), III	SKIN CORR. 1B
UN 1296 TRIETHYLAMINE	3 (8), II	SKIN CORR. 1A
UN 1764 DICHLOROACETIC ACID	8, II	SKIN CORR. 1A
UN 1779 FORMIC ACID (> 85 %)	8 (3), II	SKIN CORR. 1A
UN 1805 PHOSPHORIC ACID, SOLUTION	8, III	SKIN CORR. 1B
UN 1807 PHOSPHORUS PENTOXIDE	8, II	SKIN CORR. 1A
UN 1813 POTASSIUM HYDROXIDE, SOLID	8, II	SKIN CORR. 1A
UN 1823 SODIUM HYDROXIDE, SOLID	8, II	SKIN CORR. 1A
...
Curious:	Mixture of UN 1813, 8, II and UN 1823, 8, II = UN 3262, 8, I	
Also vice versa: It's stricter here!		
UN 1739 BENZYL CHLOROFORMATE	8, I	SKIN CORR. 1B
...

“ ... Enterprises should therefore benefit from the global **harmonization of rules for classification and labelling** and from consistency between, on the one hand, the rules for classification and labelling for supply and use and, on the other hand, those for transport.”

(4th recital of CLP Regulation)

Is it „harmonization“?

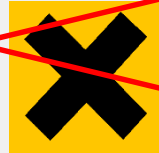
Examples

Substance	Hazardous Substance Annex VI CLP List	Dangerous Good Dangerous Goods List
Selenium (LD _{50, oral} = 6700 mg/kg)	INDEX 034-001-00-2 ACUTE TOX. 3, H301 ACUTE TOX. 3, H331 STOT RE 2, H373 AQUATIC CHRONIC 4, H413 	No dangerous good „UN 2658 SELENIUM, 6.1, III“ no longer exists since 02.08.1994 (ST/SG/AC.10/C.3/18/Add.1)
Bromoacetic acid (LD _{50, oral} = 50 mg/kg)	INDEX 607-065-00-X ACUTE TOX. 3, H301 ACUTE TOX. 3, H311 ACUTE TOX. 3, H331 SKIN CORR. 1A, H314 SKIN SENS. 1, H317 AQUATIC ACUTE 1, H400 	UN 3425, 8, II   since 01.01.2011
Silver nitrate self-classification →	INDEX 047-001-00-2 OX. SOL., H272 MET. CORR., H290 SKIN CORR. 1B, H314 AQUATIC ACUTE 1, H400 AQUATIC CHRONIC 1, H410 	UN 1493, 5.1, II   since 01.01.2011

A picture that would travel around the world ... Hydrogen peroxide solution, 35 %

~~... as Hazardous substance (formerly):~~

- Xn; R22-37/38-R41
- Harmful
- Irritant



... as Hazardous substance (CLP):

- SKIN IRRIT. 2; H315
- EYE DAM. 1; H318
- STOT SE 3; H335



... as Dangerous good:

- UN 2014 HYDROGEN PEROXIDE, AQUEOUS SOLUTION, 5.1 (8), II
- **Oxidizing**
- **Corrosive**



This despite the fact that the testing methods are equal!

→ **Harmonization?**



Source: Federal Criminal Police Office BKA, 2008