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Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods

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Item 3 of the provisional agenda
Listing, classification and packing

Transport of liquid organic hydrogen carrier - new special provision to UN 3082

Submitted by the expert from Germany*

I. Introduction

1. Hydrogen will play an important role in decarbonizing the energy systems. There are different options for transportation, one being the chemical binding of hydrogen molecules to chemical carriers. Rules for transporting hydrogen via different pathways will have to be adapted in the future.

2. Germany is convinced that the transport conditions when transporting liquid organic hydrogen carriers (LOHC) based on benzyltoluene (BT) could benefit from clarification. In addition, Germany is of the opinion that the interpretations and amendments proposed in this document lead to a higher level of protection for the transport of hydrogen when chemically bound to this carrier and result in more coherent measures. Currently, the *Model Regulations* do not properly define the levels of physically dissolved hydrogen for benzyltoluene as a hydrogen carrier. By introducing the requirements proposed below, Germany intends to increase safety when transporting hydrogen via this carrier.

3. This document was originally presented as a late informal document at the last session of Sub-Committee. Considering the positive feedback to this document, Germany decided to resubmit this proposal as a working document to provide the experts with more time for further review. In addition, Germany plans to promote the discussion by submitting a supporting informal document for the upcoming session of the Sub-Committee.

II. Discussion

4. Benzyltoluene (BT) can be used as a liquid organic hydrogen carrier (LOHC) when hydrogen is chemically bound to it. Benzyltoluene is classified in dangerous goods class 9 under UN 3082 (ENVIRONMENTALLY DANGEROUS SUBSTANCE, LIQUID, N.O.S. (Dibenzylbenzene, ar-methyl derivative). The chemically bound hydrogen cannot be released

* A/77/6 (Sect. 20), table 20.6

under transport conditions. For the release of the chemically bound hydrogen, a catalytic system and suitable temperatures are necessary. In addition to the chemically bound hydrogen, traces of hydrogen are dissolved physically in the LOHC due to high partial pressures of the hydrogen during the reaction. The phenomenon of the dissolution of gases with high partial pressures up to an equilibrium concentration is well known from other liquids.

5. To gain better insight into safety-related effects of physically dissolved hydrogen for LOHC transport, the PTB (Physikalisch Technische Bundesanstalt) was commissioned as an external institution to conduct basic tests. These tests examined the formation of a potentially explosive atmospheres above the liquid phase of the hydrogenated and dehydrogenated material due to the release of physically dissolved hydrogen during transport. To simulate a worst-case transport scenario, the samples (sample vessels 90 % filled) were cooled down to -30 °C and subsequently heated up to 70 °C. Ignition experiments of the overlaying gas phase revealed that there is a small risk of the formation of an explosive atmosphere if there is no previous treatment of the physically dissolved hydrogen in LOHC.

6. A result of these tests is that it is necessary to define a suitable limit for physically dissolved hydrogen to minimize transport risks and to prevent harmful situations. There is currently no regulation which takes this transport problem into account. It is therefore necessary to define an additional, specific special provision to UN 3082.

7. An existing regulation that could analogously be used as the limit for the formation of flammable gases (which can evolve from substances in contact with water) is class 4.3, which is defined as 1 L(gas)/kg(substance) per hour. To increase safety, since this can only be used analogously, Germany proposes a lower limit of 0.5 L(H_2)/kg(LOHC) (as an absolute limit instead of a degassing rate) for transport reasons.

8. This limit can be technically adhered to either via equilibration with overlying nitrogen or via a degassing process (proprietary or state of the art as vacuum degassing or stripping). The proof of this limit value can be achieved by a dissolved gas analysis (DGA), either via sampling of representative samples or via online analysis.

9. This document supports Sustainable Development Goal 13 – Climate Action of the UN Agenda 2030 by promoting the safe transport of alternative low-carbon fuels.

III. Proposal

10. Amend the Dangerous Goods List in chapter 3.2 as follows (new text is underlined):

UN No.	Name and description	Class or division	Subsi-diary hazard	UN packing group	Special provi-sions	Limited and excepted quantities		Packagings and IBCs		Portable tanks and bulk containers	
								Packing instruction	Special packing provisions	Instruc-tions	Special provisions
(1)	(2)	(3)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)
3082	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S	9		III	274 331 335 375 <u>XXX</u>	5 L	E1	P001 IBC03 LP01	PP1	T4	TP1 TP29

11. Amend chapter 3.3 by introducing the following special provision XXX:

"XXX Liquid organic hydrogen carriers (LOHC) based on benzyltoluene with physically dissolved hydrogen can be transported under this entry when the limit of physically dissolved hydrogen of 0.5 L (H_2)/kg (LOHC) is not exceeded."