ORGANISATION INTERGOUVERNEMENTALE POUR LES TRANSPORTS INTERNATIONAUX FERROVIAIRES

OTIF

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the Working Party on the Transport of Dangerous Goods
(Berne, 21 - 25 March 2011)

Agenda item 2: Tanks

Determination of a tank code for the carriage of UN 1402 Calcium carbide

Additional information from the International Union of Private Wagons (UIP)

1. The Calcium carbide industry put together some additional information concerning the specific behaviour of UN 1402 Calcium carbide.

2. This additional information seems to be important and relevant for the discussion in the tank working group of the Joint Meeting about document ECE/TRANS/WP.15/AC.1/2011/18 (OTIF/RID/RC/2011/18) submitted by Germany and UIP.

3. This is why UIP kindly asks the members of the tank working group to consider the content and conclusions of the attached document during their discussion.

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Annex

Report, established by AlzChem Trostberg GmbH as a member of the calcium carbide producing and transporting industry

Transport of calcium carbide (CaC_2) and of its mixtures – problems of self-decomposition of acetylene

Introduction

1. In contact with water, calcium carbide forms the flammable gas acetylene. The pure gas is colourless and odourless. Acetylene-air-mixtures are highly inflammable. In addition, this gas tends to explosive self-decomposition into the elements, a heavy exothermal process.

Hazard

2. Due to the rapid formation of acetylene in contact with water, calcium carbide is classified in packing group I. Apart from its flammability the gas bears the risk of self-decomposition. For this reason the European Industrial Gases Association (EIGA) has published a special document entitled "Code of Practice Acetylene" (IGC Doc 123/04/E) with a separate chapter on the decomposition of acetylene:

   Acetylene decomposition, the spontaneous reaction to elemental carbon and hydrogen, may occur at low or medium pressure as either a deflagration at a relatively slow reaction rate, or as a detonation at supersonic velocity. Deflagration produces final reaction pressures 10 to 11 times initial pressure from the energy released by the reaction. Detonation of high-pressure acetylene may produce pressure peaks up to 50 times original pressure. Detonation pressure peaks are short lived but shall be considered in designing a safe high-pressure acetylene system. Conventional pressure relief devices offer no protection as detonations proceed at supersonic velocity and they cannot react with sufficient speed.

3. The self-decomposition always starts with a deflagration in conjunction with a moderate surge. This exothermal self-decomposition, however, may lead to a detonation, associated with a nearly unlimited increase of pressure. Consequently the formation of a detonation has to be avoided under all circumstances. The risk of a deflagration turning into a detonation increases with rising pressure.

4. It can be concluded that the failure of a 10 bar tank due to self-decomposition leads to a considerably higher risk potential than the rupture of a 4 bar tank. The pressure relief device has to be designed with a spring-loaded pressure valve. Rupture disks are not suitable because in the case of failure, rain water can enter, thus leading to a much increased risk potential.

Result

5. If a deflagration turns into a detonation, high pressure peaks occur that cannot be controlled with conventional safeguarding (e.g. rupture disks). For this reason the rupture of a tank is of less risk if the self-decomposition happens as a moderate deflagration and not as an uncontrollable detonation.

6. From the above follows that in the case of self-decomposition of acetylene, the danger caused by an S10AN tank is substantially higher than the danger caused by an S4AN tank.

7. A comparable solution was found in the RID/ADR Regulations for ammonium nitrate emulsions (UN 3375). In this case a portable tank with tank instruction T 1 is required.

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