Notification concerning „IBCs and flammable liquids“

At two meetings, on 9.12.10 and 27.1.11, the subject was examined by experts from the VCH Working Group "Technik und Umwelt". The following information was compiled by Dr. Ulrich von Pidoll from the Physikalisch Technische Bundesanstalt, Braunschweig (national metrology institute providing scientific and technical services) on the basis of the expert discussions of the working group.

General

- The subject of the technical safety considerations are the electrostatic properties of the IBCs (see here appendix 1.) their filling and the associated filling equipment; not however the stability, fire load and diffusion properties of IBCs.

- Electrostatically relevant hazards arise from ex-proof plastic and metal IBCs due to the fact that liquids are filled into IBCs when already in a charged condition. When considering the filling procedure from an electrostatic point of view, first and foremost the filling devices (filling pipes and their composition / grounding) are of decisive importance. The danger of charging increases with diminishing pipe diameters, longer pipe lengths and increasing flow rates. Filling equipment is particularly unsuitable when it is composed of combinations of conductive and non-conductive materials because „insulated conductors“ can result which can be easily charged to dangerous levels.

- As a rule, the water miscibility of liquids is also an indication of their conductivity. Non-miscible liquids (e.g. hydrocarbons („benzenes“) are characterised by a very low conductivity, whereas typically miscible substances (e.g. alcohols, acetone) can be classified in the middle of the conductivity spectrum. As conductivity decreases, the charging capacity increases. Even when liquids are grounded, depending on the conductivity of the liquids, discharging can take several hours. Without grounding, depending on the circumstances, liquids can remain in a charged condition for several weeks. This also applies to metal IBCs which are not grounded, for example because they are standing on an insulating surface (e.g. wooden pallet).

- The static relaxation time of charged liquids with low conductivity in a suitably grounded ex-proof plastic IBC amounts to 3 - 5 hours and in a metal IBC to about 1 hour. Dr. v. Pidoll is however, not aware of any incidents - where all other circumstances were similar - which were caused by using ex-proof plastic IBCs instead of metal IBCs. – Depending on the circumstances, the relaxation time of (non-ex-proof) plastic IBCs can last several weeks. (Regarding IBC types and their effect on electrostatic discharge, see appendix 2).

- Regarding the question of dissipating charged conditions in liquids, a functioning grounding point is of cardinal importance with ex-proof plastic IBCs. This is a metal contact surface in the form of a pin, plate or ring which penetrates outwards through the moulded container body wall connecting with the metal construction of the IBC using a metal cable (green-yellow insulation). The bleeding off to ground takes place through this cable (via an attached grounding cable and, if need be, also by placing the metal feet of the container on an electrically conductive floor).
- With ex-proof plastic IBCs, an electrically conductive layer on the outer wall of the container body (e.g. sheet metal coating, carbon black layer) deactivates any charge in the inner container wall. The dissipation of the charge from the liquid takes place almost exclusively through the grounding pin not however via the container wall. The dissipation of a charge does take place through the wall of a metal IBC however, because the larger contact surface permits faster dissipation.

- The static charge danger for metal and ex-proof plastic IBCs of charges flowing down their inner walls is, as a rule, low. Shaking movements and swinging about during the transport of IBCs does not lead to large charge build-ups which are relevant for ex-protection. There is also only a low risk of charge increases during the emptying of grounded IBCs via their lower outlet. Ex-proof plastic IBCs, or rather their contents, can however be charged to dangerous levels through misuse (e.g. mixing, stirring).

The results of the discussions are as follows:

1. Only metal or approved, ex-proof plastic IBCs may be used for flammable and highly flammable liquids. With „simple“ (standard) plastic IBCs, both their walls - interior and exterior - and the contents can be charged to dangerous levels. Therefore, according to TRBS 2153 (Technical Regulations on Industrial Safety and Health), the use of these simple containers for flammable and highly flammable liquids is prohibited.

2. There is no significant increase in safety if metal IBCs are used for highly flammable liquids (including those with low conductivity) instead of correctly manufactured ex-proof plastic IBCs which have a properly fitted static dissipation system (grounding cable). Therefore, a self-imposed commitment proposal or recommendation to the industry from the VCH (Chemical Traders Association) is not justifiable.

3. From the point of view of technical working safety, the construction of the ex-proof plastic IBC is not an important factor in the filling process. What is important is that static diversion via the pin and grounding cable is in good working order so that any charge which occurs in the liquid during filling can be safely bled off to ground. This also applies to IBCs coated with carbon black where static dissipation via a pin and grounding cable remains an indispensable component.

4. Filling devices (filling pipes) should be made exclusively of static conductive or dissipative material and care should be taken that they are grounded correctly. "Do-it-yourself" constructions (combinations of conductive and non-conductive materials "insulated conductors" ) should be avoided. Static charging is also reduced by filling from below the liquid level using an immersion pipe.

5. Even when handling uncharged and conductive liquids, a fast and repeated filling and emptying cycle of ex-proof plastic IBCs should be avoided, thus excluding any residual charging hazard. A notification regarding "rest periods" could/should be included in the operating instructions if necessary.

6. The requirements of TRBS 2153 „Avoiding ignition hazards as a result of electrostatic charging“ must be observed.

7. When taking samples – in particular directly after filling – only non-conductive materials should be used preferably wood, textured plastic or glass.

8. In view of the information described above, if necessary, regular instruction courses should be considered for the personnel involved in the filling processes: If required, the VCH could offer a course for technical managers provided by Dr. von Pidoll.
Appendices

Appendix 1: Principal processes in electrostatics

Charging:
A charge separation occurs through (dynamic) frictional contact between two different materials whereby at least one of the partners is (electrostatically) non-conductive. The larger the contact surface, the larger (more effective) the charge separation and the larger the kinetic friction (flow speed) becomes.

Discharging:
There are mainly two types of discharge:

- If the potential difference is high enough (charge separation between two media), equilibrium is restored by a sparkover via the air (gas) space between the two media at the (almost) contact point. In this case, as a rule, the spark serves as the source of ignition for any flammable vapour/air mixture which may be present.

- In a medium which is not electrostatically conductive, or only to a low degree (usually a liquid), the charge preponderance can be slowly diffused to another medium via the contact surface (relaxation). In this case, there are no phenomena such as sparks etc. If the second medium is electrostatically conductive, the transport of the charge from inside the non-conductive medium to the contact surface is the determinant of the speed of the process.

- With grounded metal conductors, or similarly highly conductive materials, the discharge to ground occurs almost immediately.

Appendix 2: Construction forms of different IBCs and discharging processes within them

- „Simple“ plastic IBCs

These containers have a completely non-conductive moulded plastic body. The diffusion of any charge from liquids, which are stored in the container and which were previously electrostatically charged, only takes place very slowly via the non-conductive plastic body, via (conductive) traces of contaminants or through the air. Discharging times last from several weeks to months.

- „Ex-proof plastic IBCs:

These containers have a metal contact surface inside the moulded body (as a rule near the lower outlet) in the form of a pin, a plate or a ring which penetrates through the container wall and which is then connected outside the container by a metal cable (yellow-green insulation) with the metal frame of the IBC. From this, the diffusion of any charge takes place via an attached conductor cable to ground. This construction is responsible for the discharge of any electrostatically charged liquid which has been filled into the container. The following discharge times can be expected: For fluids with low conductivity (non-miscible with water) about 3 - 5 hours. These IBCs also have a conductive layer on the outer wall of the plastic body, (e.g. in the form of a sheet metal coating or an outer layer of conductive carbon black or graphite pigments), so that static charge separations from frictional contact within the container body during filling or transport (see above) are at least partially inactivated by induction
(dipole formation). The charge forming on the inner container wall is compensated by a corresponding countercharge on the (conductive) outer wall, thus neutralising any dangerous effect.

- Metal IBCs („CTC“):

These have similar electrostatic properties as the ex-proof plastic IBCs (q.v.) only that here the discharge takes place via the metal (and grounded) container wall which has a much larger contact surface with the liquid than is the case with a metal pin in a plastic IBC. Correspondingly, faster discharge times may be measured but the difference is not really significant (see following overview).

### Average Discharge times

<table>
<thead>
<tr>
<th>IBC-Type</th>
<th>Discharge time of liquids with low conductivity (non-water miscible)*</th>
<th>Discharge time of liquids with medium conductivity (water miscible)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>„Simple“ plastic IBC</td>
<td>Several weeks/months</td>
<td>Several weeks/months</td>
</tr>
<tr>
<td>„Ex-proof grounded plastic IBC</td>
<td>3 – 5 hours</td>
<td>A few seconds</td>
</tr>
<tr>
<td>Metal grounded IBC (CTC)</td>
<td>about 1 hour</td>
<td>A few seconds</td>
</tr>
</tbody>
</table>

* Typical non-water miscible liquids are e.g. hydrocarbons, particularly aliphatic compounds.

** Typical water miscible liquids are e.g. aliphatic alcohols, acetone and other ketones.

(stand: 14.3.11)