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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

Twenty-seventh session, 4-8 July 2005
Item 4 (c) of the provisional agenda

PACKAGINGS (INCLUDING IBCS AND LARGE PACKAGINGS)

Approval of IBCs

UV Resistance of plastics used in IBCs

Transmitted by the expert from Australia

SCOPE

This proposal aims to recommend a method of identifying the level of resistance to UV of plastic used in composite and rigid plastic IBCs.

RELATED DOCUMENTS

UN/SCETDG/23/INF.23 - (Australia) Approval of Intermediate Bulk Containers.
ST/SG/AC.10/C.3/2003/56 - (Australia) Approval of Intermediate Bulk Containers.
UN/SCETDG/26/INF.41 - (Australia) Approval of Intermediate Bulk Containers.
ST/SG/AC.10/C.3/52 – Report of the Sub-Committee of Experts on its twenty-sixth session

Introduction

1. During the twenty-sixth session, the expert from Australia presented INF.41 relating to the strength of single trip and multi trip composite IBCs. Included within this paper was a discussion concerning the impact of UV on the plastic elements of a composite IBC when carried in an open “Transport Unit”. A lack of effective UV stabilisation of a rigid plastic IBC or the inner plastic receptacle

of a composite IBC would not present a significant problem where the package is carried in a Closed Transport Unit but where such packages are:

- (a) Transported in the open or in an open transport unit and exposed to sunlight; or
- (b) Stored in a location where the unit is exposed to direct sunlight.

Then there is potential for degradation of the plastic. While short-term exposure should not present a problem, the cumulative effect of exposure to UV over the life of a packaging (up to five years) can result in a reduction of the effective strength to the point where the first evidence may be failure of the plastic receptacle.

2. The expert from Australia is of the opinion that the level of UV resistance of a rigid plastic IBC or the inner receptacle of a composite IBC should be identified. This would assist in indicating which packages are more able to withstand exposure to UV and also provide an aid to inspection and test organisations in focussing the inspection of plastic elements of IBCs on the basis that there is a higher risk of UV degradation with plastics that have limited UV resistance.

UV Protection¹

3. While some monomer units that go to make up polymers do not absorb ultraviolet light (UV) (e.g. the monomer units of PVC, PMMA and PS), these polymers almost invariably contain impurities. These impurities are chromophoric groups² or carbonyl groups³ that are capable of absorbing UV and as a result most polymers require light stabilisers. Long-term exposure to light causes ageing of the polymer due to the breaking of polymer bonds, cross linking or oxidation. The consequences are embrittlement and cracking which have implications in so far as packagings are concerned but may also cause changes in colour or transparency. Hindered amine light stabilisers (HALS) and carbon black are frequently used as UV stabilisers although some work is being carried out on the use of nanometre sized particles of metal oxides (transparent metal oxides⁴) as stabilisers but the information to hand indicates this material is currently only in use for resins and sun screens. Coatings may also be applied to provide UV protection.

¹ Much of the information in this section was sourced from the material information site www.azom.com and www.csiro.gov.au.

² Such as carbon-carbon (C=C) double bonds.

³ Covalent C=O double bond although information to hand suggests it is somewhat misleading to write the carbonyl group as a covalent C=O double bond. The difference between the electronegativities of carbon and oxygen is large enough to make the C=O bond moderately polar.

⁴ Developed by the CSIRO and currently being marketed for use in resins used in timber treatment and sunscreens.

Material	Not Stabilised		Stabilised	
	Rating	Resist. to weather ⁺ (years)	Rating	Resist. to weather ⁺ (years)
PE	Poor	1	Good*	>1
PTFE	Very Good	-	-	-
PP	Poor	1	Good*	10-20
POM	Poor	0.25	Good*	-
PS	Poor	0.5	-	-
PA#	Poor	1	Good*	>1
PC	Moderate	2	Good	>5
CAB	-	-	Good	>1
ABS	Moderate	0.5-2	Good*	>1
SAN	Moderate	1-2	Moderate /Good	-
PVC	Poor	1	Good	>1
PMMA	Very Good	5-25	-	-

* = stabilised with carbon black, # = weathering restricted to surface layer, + = resistance to weathering.

Table 1. Resistance to weathering (data for guidance only)

(PE – Polyethylene, PTFE - Polytetrafluoroethylene, PP - Polypropylene, POM - Polyoxymethylene, PS - Polystyrene, PA - Polyamide, PC - Polycarbonate, CAB - Cellulose Acrylo Butyrate, ABS - Acrylonitrile Butadiene Styrene, SAN - Styrene Acrylonitrile, PVC – Polyvinylchloride, PMMA - Polymethylmethacrylate).

4. As indicated in Table 1 the level of UV resistance varies depending on the nature of the material and the stabiliser being used. It is not possible within the limits of this paper to describe all methods of providing UV resistance rather an effective measure is required to quantify the level of resistance to UV, or protection from UV, in a given material. On the basis of the information provided in table 1 and the test and certification requirements of IBCs it appears reasonable to group UV resistance into a number of categories:

Level 0	- Unprotected or poor resistance	- <0.5 years resistance to weathering
Level 1	- Moderate protection or resistance	- 0.5 to 2 years resistance to weathering
Level 2	- Good protection or resistance	- 2 to 5 years resistance to weathering
Level 3	- Very Good protection or resistance	- >5 years resistance to weathering

5. Good or very good protection would appear to be the minimum standard for IBCs that are intended for use for transport or storage where UV exposure is very likely. Level 0 protection would only be suitable for IBCs that are carried in closed transport units.

Proposal

6. As already noted Australia is of the opinion that where a Composite or Rigid Plastic IBC has effective UV resistance or protection there would be considerable benefit in identifying the fact. Further, an IBC that may be exposed to sunlight should be able to withstand prolonged exposure to UV without degradation of the plastic receptacle. Alternatively where the package has limited resistance to, or no protection from, UV exposure then the inner receptacle should be identified as such and have its employment restricted to Closed Transport Units.

7. The expert from Australia recommends the adoption of an indicator within packaging marking in 6.5.2.2 as an additional marking as 6.5.2.2.5 to the effect that:

“6.5.2.2.5 For rigid plastic IBCs and plastic inner receptacles of composite IBCs the level of UV resistance/protection, as determined by a weathering test, is to be marked as indicated below:

UV0 - Unprotected or poor resistance (<0.5 years resistance to weathering)

UV1 - Moderate protection or resistance (0.5 to 2 years resistance to weathering)

UV2 - Good protection or resistance (2 to 5 years resistance to weathering)

UV3 - Very Good protection or resistance (>5 years resistance to weathering)

6.5.2.2.5.1 Resistance to weathering should be determined using one of the methods described in ISO 877:1994 to reproduce, or simulate, exposure up to 5 years or until degradation is noted in the sample of material tested. Assessment of the degradation of the material tested should be carried out in accordance with ISO 4582:1998 although the period where any reduction in strength or any evidence of cracking, crazing, deformation or delamination is noted should be considered the effective life of the material in respect of UV resistance. ”

8. Consideration be given to adding a new 4.1.2.5 to address the employment of rigid plastic or composite IBCs with poor or moderate UV resistance/protection to the effect that:

“6.1.2.5 Where the resistance to UV of the inner receptacle of a composite IBC or the resistance to UV of a rigid plastic IBC is marked as poor (UV0) or Moderate (UV1) these IBCs must be transported in a Closed (cargo) Transport Unit.”
