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Institute for Applied Ecology

Fraunhofer Institut Zuverlässigkeit und Mikrointegration

Adaption to scientific and technical progress under Directive 2002/95/EC

Results previous evaluation
Exemption No. 21

"Lead and cadmium in printing inks for the application of enamels on borosilicate glass"

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The next documents were submitted or referenced in documents submitted to Ökoinstitut and Fraunhofer IZM during the RoHS exemption review process:

11. Report “ERA opto coupler analysis Aug 2007-new.pdf”, received in August 2007 via e-mail from Euan Davidson, Chromotechnic Ltd. (testing laboratory: ERA),
12. Report “RT079366_R2.pdf”, received in August 2007 via e-mail from Stephen Leung, Macron.
13. RoHS Enforcement Guidance Document, Version 1 – issued May 2006, (http://www.rohs.gov.uk/Docs/Links/RoHS%20Enforcement%20Guidance%20Document%20-%20v.1%20May%202006.pdf); the document is informative and advisory, but has no legal authority.

5.4 “Pb and Cd in printing inks for the application of enamel on glasses, such as borosilicate and soda lime glasses” (set 7, request no. 1a, ELCF)

5.4.1 Requested exemption

The European Lamp Companies Federation (ELCF) has submitted this request for a change in wording of an existing exemption: entry no. 21 of the Annex to the RoHS Directive reads “Lead and cadmium in printing inks for the application of enamels on borosilicate glass”. ELCF requests to have following new wording for entry no. 21:

“Lead and cadmium in printing inks for the application of enamel on glasses, such as borosilicate and soda lime glasses.”

According to the applicant, lead is used in printing inks on parts of the outer surface of lamps (e.g. fluorescent lamps). These markings are essential for product identification, as requested by safety standards. The marking has several functions, during entire life cycle:

- To identify the producer,
- to identify lamp type and wattage, which is relevant for safety, correct lamp replacement and recycling,
- CE, WEEE marking.

The applicant states:

“Product identification is required by the relevant product safety standards, which are the basis of the CE Marking according to the LVD Directive (2006/95/EC). Product identification must be legible for the consumer or other stakeholders during the entire life cycle of the product (safety, replacement, recycling etc.)

Intensive heat and light during lamp operations result in quality challenges for the marking of a lamp. Some luminaries, state a maximum wattage in order to avoid excessive heat. If a mark is not properly legible for the user, the user might place the wrong lamp into a luminaire

with the consequence of a high safety risk. […] Moreover, marking of lamps at the end of life is also required by the WEEE Directive."

The amount of lead for the marking is about 0,25 mg for a normal fluorescent lamp (i.e. order of 1 ppm of glass tube by weight) and 1 mg for a relatively big mark on an incandescent lamp. The lead-based marking contains as such 20 % lead-oxide. Total EU market quantity for this application is assumed to be 1-2 tons of lead per year. For the marking of lamps, ELCF Member Companies do not need mercury.

5.4.2 Summary of justification for exemption

The applicant justifies his request for exemption with juridical and technical arguments:

- Until now, RoHS compliance is given since ELCF considers the marking as being part of the glass1 and thus considers the marked glass as homogeneous material containing lead below the maximum concentration limit of 0,1% by weight.
- Since the European Special Glass Association (ESGA) had submitted a request for exemption (cf. http://circa.europa.eu/Public/irc/env/rohs/library?l=/requests_exemptions/crystal_crystal_crystal_&vm=detailed&sb=Title) under a previous stakeholder consultation leading to entry no. 21 in the RoHS Annex, ELCF claims to also need an exemption for the same type of application in order to have legal certainty and thus requests the current wording to be enlarged to soda lime glasses.
- "ELCF Member Companies are committed to phase-out the use of hazardous substances like lead". The applicant claims that results of tests showed that using lead-free printing inks on lamps does not meet the above-mentioned requirements.
- "To some extent elimination of lead in marking has been shown to be feasible for some kind of lamps but not for all products. […] Especially for long-life products […] or products having a hot external surface during lamps operation […], attempts to eliminate lead in marking have not yet been successful." The applicant has not provided an exhaustive list of applications concerned by this statement.
- "Several years" would be needed by the applicant to completely substitute lead in the concerned application.
- A critical review of the documents made available by the applicant lead to the following observations and conclusions:
- ELCF did not take the opportunity to participate in the initial discussion around ESGA's initial exemption request; no objection has been received at that time concerning ESGA's

[1] „In the marking process the lead oxide based printing ink is heated that results in a moulding or melting diffusion process with the glass surface." The mark is then "intrinsically" bonded to the glass.

interpretation of the fact that glass marked with lead-containing printing inks cannot be considered a homogeneous material.

- ELCF uses the same argumentation concerning technical impracticability of lead substitution in glass marking as ESGA did; thus this argumentation line is consistent.
- ELCF shows some inconsistency when stating on the one hand that marked glass containing lead from the printing ink is considered a homogeneous material and on the other hand states that "one has to resort to intensive abrasion or chemical dissolution to separate the from the glass", i.e. a statement that includes both definitions of homogeneous and not homogeneous material. However, the official position published on ELCF's website is that "the mark becomes part of the lamp glass. Therefore the marked glass is considered as a homogeneous material below the maximum concentration limit of 0.1% by weight.2"
- It is not known to the contractor whether ESGA and other relevant stakeholders would in the meantime agree to this position. A separate consultation would be needed to gather information and evaluate this aspect.
- There are only two conclusions possible from the above-mentioned argumentation:

1. The current exemption under entry no. 21 of the RoHS Annex should be deleted since all relevant stakeholders could now agree on the fact that the marked glass is to be considered a homogeneous material OR
2. The current entry no. 21 of the RoHS Annex should be enlarged to soda lime glasses since the same justification applies to soda lime glass as to borosilicate glass.

5.4.3 Final recommendation

With a view to simplify EU regulations, deleting an exemption from the Annex is rather recommendable. However, since it is not known whether relevant stakeholders would as by today agree to ELCF's interpretation on marked glass as being a homogeneous material, it is recommended to grant this exemption and to thus change the existing wording of entry no. 21 of the RoHS Annex as follows:

"Lead and cadmium in printing inks for the application of enamel on glasses, such as borosilicate and soda lime glasses."

However, it is strongly recommended to review this exemption in the context of the upcoming review of the RoHS Annex including the following aspects:

- Do ESGA and ELCF represent all relevant stakeholders in this field of application or which other relevant stakeholders can be identified?

[2] See: http://www.elcfed.org/uploads/documents/-7-elc_guidance_document_on_rohs_market_surveillance.pdf

- Can all relevant stakeholders agree on the interpretation of glass marked with lead (and cadmium) containing inks as being a homogeneous material? Is this possibly valid only for only lead or cadmium?
- Can cadmium-free printing inks also be used on borosilicate glass for applications ESGA initially requested an exemption for (e.g. coffee jugs)?
- If an exemption appears to be further needed, it should be checked with stakeholders whether borosilicate and soda lime glass applications concerned – for which substitution is not feasible – can be listed exhaustively in order to narrow down the scope of the exemption.

5.5 "Lead in Silver rings on the exterior lamp surface of induction-type fluorescent lamps." (set 7, request no. 1b, ELCF)

5.5.1 Requested exemption

ELCF requests an exemption for the use of lead as lead oxide in a silver paste used to coat QL 165 W induction-type fluorescent lamps with silver rings in order to meet electromagnetic compatibility (EMC) requirements[3] ("Induction-type lamps may contain conductive rings, on the exterior of the glass surface") (see picture below).

Figure 10: QL 165 W induction-type fluorescent lamps with silver rings

Such lamps have to perform, for a long designed operating lifetime of up to 100.000 hrs (about 15 years of continuous operation is demanded).

Composition of the conductive rings is about 93 % Ag and 7% PbO. The ring is applied via a coating process, but later baked into the glass material via a heating process using flame burners. One lamp weighs about 0.175 kg. Total weight of the (5) rings is about 0.47 g

[3] European standards EN 55015 "Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment" and EN 55020 "Electromagnetic immunity of broadcast receivers and associated equipment".

material, which means about 33 mg PbO (about 188 ppm related to lamp weight). The number of lamps put on the market each year is about 15.000. This equals to about 7 kg material of Ag and about 0.5 kg PbO.

Most of the QL 165W lamp systems are used in a luminaire with a metal reflector. This reflector screens the radio-interference so that the EMC-requirements are not exceeded. Thus, not all such lamps need such conductive rings: only those lamps that are unshielded, i.e. a lamp system not inside a (partly) metal housing, and cannot ensure EMC by themselves, should have conductive rings on their surface to suppress the radiointerference and thus comply with EMC requirements.

However, the applicant has considered different design options and concluded that for the sake of simplicity for the user as well as connected safety during use of lamp, all QL 165 W induction-type fluorescent lamps should have such rings.

Currently, ELCF considers to be RoHS-compliant since “In the coating or pasting process of the silver rings, the silver and lead oxide based printing ink is heated, which results in a moulding or melting diffusion process with the glass surface. Due to the fact, that the mark is intrinsically bonded to the glass, the ELC concludes that: The silver ring becomes part of the lamp glass. Therefore the glass is considered as a homogeneous material below the maximum concentration limit of 0.1% by weight.”

However, the applicant states that this interpretation is in conflict with current entry no. 21 of the RoHS Annex and that in order to have legal certainty, would like to request an exemption nevertheless.

5.5.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

- The existing supplier of the silver and lead-based paste went out of business.
  - Since no other suitable supplier could be found, the manufacturing of this paste had to be taken up at the applicant in-house.
  - A potential supplier has been selected. However, substitute materials require a higher melting temperature, which the supporting glass surface has to withstand. This supplier has not yet released the material for continuous production.
  - The applicant could not give an exact time frame but stated that an alternative will not become available before 2009. ELCF’s Member Companies aim to finalise research and development efforts by 1 July 2010.
- The way forward towards a lead-free solution needs to look first at whether a suitable adhesion can be maintained during the long lamp life. Here, overlapping exists with exemption request no. 1a with regard to lead-containing glass marking in general (see section 5.4). As a next step, upon introducing the silver component, sufficient electrical

conductivity needs to be ensured. A few substitutes have been studied, with negative results:

- "The PbO acts as a melting glass to ensure good adhesion of the conductive rings on the lamp. In order to have effective suppression of electromagnetic interference, proper adhesion of the silver ring must be realised initially. So far no technically proven solution has been found to substitute PbO. Organic solutions cannot be applied due to detrimental effect of high temperatures combined with a long-term exposure to a relatively minor UV part of the emitted light radiation.
- A studied copper paste cannot fulfil the temperature requirements during the extreme long lifetime of 100.000 hr. Large and unreliable shortening of product life would be the result.
- Lead free marking ink has shown so far insufficient conductive properties: Potential appropriate lead-free solutions could be silicone-based. This composition has been tested for the substitution of lead oxide based marking inks for general lamp marking. The electrical conduction properties however are not sufficient for adequate suppression of electromagnetic fields. This causes inadequate suppression of electromagnetic radiation."

A critical review of the documents made available by the applicant lead to the following observations and conclusions:

- The amount of lamps containing lead-based silver pastes to coat the glass surface of QL 165 W induction-type fluorescent lamps could be reduced, since the necessity of reducing radio interference only applies to those lamps that are unshielded.
- The same argumentation applies as described in section 5.4 above on request 1a: if stakeholders could agree on the fact that lead contained in glass marking (and in this case coating) is exempted if the marked/coated glass is considered a homogeneous material, there would be no need for an exemption.
- The applicant did neither provide evidence on the point of time he started investigations on substitutes nor on time details regarding a substitution roadmap.
- The current technical impracticability of substitution, nevertheless, was described in comprehensible and rather comprehensive way.

5.5.3 Final recommendation

With a view to simplify EU regulations, deleting an exemption from the Annex is rather recommendable. However, since it is not known whether relevant stakeholders would agree as by today to ELCF's interpretation on marked/coated glass as being a homogeneous material, it is recommended to grant this exemption and to thus change the existing wording of entry no. 21 of the RoHS Annex as follows (taking the recommendation on exemption request 1a in section 5.4.3 into account):

Lead and cadmium in printing inks of enamel and in silver pastes used to coat QL 165 W induction-type fluorescent lamps with silver rings in order to meet electromagnetic compatibility (EMC) requirements for the application on glasses, such as borosilicate and soda lime glasses. The use of lead in silver pastes is limited until 1 July 2010.

This wording, however, would need to be agreed upon by all relevant stakeholders. Due to time constraints, this could unfortunately not take place within the duration of the current contract.

Thus, it is strongly recommended to review this exemption in the context of the upcoming review of the RoHS Annex.

5.6 "Exemption request for use mercury in plasma displays" (set 7, request no. 2, Babcock Inc.)

5.6.1 Requested exemption

Babcock (La Mirada, U.S.) requests an exemption for the use of mercury in Babcock's DC plasma displays which it considers to belong to category 4 WEEE Directive ("consumer electronics"). This request had already been submitted to the Commission before and has been subject to an online consultation as well as to a subsequent evaluation (set 5 no. 23). In this context a final recommendation could not be given due to the fact that an additional round of questions would have been necessary though exceeding the contractor's contract duration (cf. http://ec.europa.eu/environment/waste/weee/studies_en.htm, "Adaptation to scientific and technical progress under Directive 2002/95/EC; Final report, July 2006"; section 6.40). Babcock therefore was advised by the Commission to re-submit an exemption request.

According to the applicant, other plasma display manufacturers use AC technology, which does not require use of mercury. Both types of Plasma Display Panels (PDP) are already subject to entry no. 25 of the Annex to the RoHS Directive, which exempts the use of lead in such applications from restriction of use.

The particularity of DC driven Plasma technology is that they do not use phosphors to generate visible spectrum. During the manufacturing process of DC PDPs, a small amount of mercury is added to the DC plasma display to inhibit sputtering, which is a phenomenon that reduces life of PDPs (mercury is used to coat the cathode conductor and to inhibit the cathode conductor's material being sputtered onto the anode).

According to the applicant, this functionality can be summarised as follows:

- "Mercury is hermetically sealed in the DC plasma display and is used to retard the cathode sputter onto the anode electrodes. Without the use of mercury in DC plasma display the sputtering of cathode will completely deplete the cathode material. The sputtered cathode materials deposited on the anode electrodes will also cover the pixel