BROMINATED AROMATIC SUBSTANCES AND SUBSTANCES WITH INHERENT HAZARDOUS PROPERTIES IN ENVIRONMENTAL LABELS – CASE STUDY PRINTERS AND COPIERS

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Introduction

Today, a considerable share of chemical exposure and release to the environment has their origin in chemicals used in consumer products. Brominated flame retardants (BFRs) are one of best documented chemical group resulting in exposure and releases in different life cycle stages[1 - 4]. This is of relevance in the context of developing the criteria for an EU Ecolabel for imaging equipment (i.e. printers, copiers and multifunctional devises (MFDs)) which is currently underway. However, the discussion is of relevance for other product groups and other schemes as well. In conducting background research for a label for imaging equipment at EU level, a technical analysis undertaken encompassed environmental impacts along the product life cycle and environmental savings due to improved paper management, higher energy efficiency, increased product recyclability, reusability and durability, and prevention of use of hazardous substances. It also addressed other human health related aspects like indoor air and noise emissions. In this paper the discussion on criteria regarding the use of hazardous substances in the final product and on substances which raise concerns to human health and the environment, particularly in the product end-of-life phase are described with an emphasis on halogenated organic substances.

The EU Ecolabel scheme constitutes a tool of the sustainable consumption and production policy of the European Union, which aims at reducing the negative impact of consumption and production on the environment, health, climate and natural resources[i]. It is an EU wide voluntary label for products and services intended to promote products with a reduced environmental impact during their entire life cycle. It shall provide consumers with accurate, non-deceptive, science-based information on the environmental impact of products. The EU Ecolabel aims also at providing a market-based incentive to companies to make improvements to the environmental performance of their products, going beyond compliance with environmental legislation. The Ecolabel approach targets indicatively the top 10-20% best performing products of the EU market.
Like other schemes, the label consists of a set of criteria established for specific product groups or services, based on technical analyses conducted. One of the aspects, which is of particular importance in the EU Ecolabel and also in other environmental labelling schemes like the Nordic Swan or the Blue Angel is related to restrictions of substances which are hazardous to the environment. The aim is to reduce the burden that chemicals may cause to the environment and human health and is proactive regarding the use of hazardous substances or substances which raise environmental concerns. The guiding principle is the exclusion of substances with problematic inherent properties and substitution of low environmentally performing substances as far as it is technically feasible and economically possible.

Results and Discussion

Approach for development of key environmental areas of EU Ecolabel for imaging equipment

The development of criteria under the EU Ecolabel is based on an environmental technical analysis, which is accompanied by stakeholder consultation. In the example of imaging equipment product group, first a preliminary technical investigation regarding the environmental performance of imaging equipment is conducted. This covers analysis from streamlined life cycle assessments and from product oriented environmental performance assessment (covering areas that cannot be captured in an LCA e.g. indoor air

[i] EU Ecolabel Regulation 66/2010

emission). As a result, the following key environmental areas have been determined for imaging equipment: 1) Paper management, 2) Energy efficiency, 3) Design of product. Preventing the use of hazardous substances, 4) Design of Product: Promotion of Reuse, Recycling and sound End-of-life management, 5) Indoor air quality and noise emissions, 6) Requirements related to ink and toner consumables. Further a more comprehensive investigation focusing on the identified key environmental areas was undertaken in order to derive and formulate the criteria proposal. With regard to requirements on substances present in the imaging equipment the following key areas have been investigated further: preventing the use of hazardous substances in the final product and promotion of reuse, recycling and sound end-of-life management. These are further described in more detail.

Criterion: Preventing the use of hazardous substances and mixtures in the final product

The proposal regarding the Ecolabel criterion related to the use of hazardous substances in the final product aims at substances (and mixtures) which have inherent hazardous properties. Substances fall under the criterion if they meet the requirements to be classified with one or more hazard and risk statement (known also as H- and R-phrases) out of a certain list of 35 H-/R- phrases related to risks for human health and for the environment. (see Table 1) or if they are referred to in Article 57 of the REACH Regulation (EC) No 1907/2006.The rules for H-/R- classification are the ones applied in the Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures (CLP Regulation) and are based on the Globally Harmonised System of classification and labelling of chemicals (GHS) and the European Union Dangerous Substances Directive 67/548/EEC.

If a substance is classified with one or more of these H-/R- phrases it should not be present in the final ecolabelled product in concentration above 0.1% w/w. This requirement reflects article 6.6 of EU Ecolabel Regulation 66/2010. The list of R- phrases covered is longer compared with EU Ecolabel criteria developed in previous years for other product groups as well compared with Ecolabel criteria from other European countries like Nordic Swan and Blue Angel. The application of this criterion results to an inventory and screening through the 35 H-and R-phases of table 1 of the substances used in the product. Derogation can be accepted for substances under certain restrictive conditions and based on the fact that alternatives are not available under technically and economically viable conditions.

Further, the criterion excludes from the Ecolabel scheme products containing substances classified as substances of very high concern (SVHC) listed in accordance with Article 59(1) of Regulation (EC) No 1907/2006 and article 6.7 of EU Ecolabel Regulation 66/2010.

Along the Ecolabel criteria development process for imaging equipment industry stakeholders submitted requests for exempting certain substances (mainly chemical additives) from the above presented restriction. A technical analysis on these exemptions based on available information regarding concentration of substances used, physical and chemical properties, hazardous characteristics and health impacts, direct environmental impacts as well as life cycle considerations and potential substitutes was undertaken. Further, outcomes of recent scientific reports regarding the potential of substitution of these substances were also considered[5]. The outcomes of this analysis and the discussion regarding derogation proposals has been summarised in technical reports[5].

Criteria regarding "Design of Product: Promotion of Reuse, Recycling and sound End-of-life management

A technical and scientific basis was built and substances and materials which raise environmental concerns in the end-of-life of the imaging equipment products were identified. Among them there are brominated aromatic flame retardants used in plastic parts[ii] (excluding printed circuit boards). The discussion around the use of brominated aromatic flame retardants in imaging devices is related to their negative impacts and potential human and environmental risks in the end-of life of the products. An analysis of different end-of-life scenarios and the associated problems follows:

1. Incineration of plastics containing aromatic brominated flame retardants:

A large proportion of brominated flame retarded materials are combusted. Depending on the quality of combustion, high levels of brominated dioxins and furans can be formed and released as a result of the dioxin precursor properties of aromatic brominated flame retardants. In particular, open burning of e-waste is estimated

[ii] In Blue Angel labelled products the use of all halogenated flame retardants is excluded for the external plastic casing parts. However no detailed scientific reasoning was established for this. In our approach the scientific reasoning for exclusion of brominated aromatic flame retardants was established.

to globally generate polybrominated and polyhalogenated dibenzo-p-dioxins and dibenzofurans (PBDD/PBDFs and PXDD/PXDFs) on a scale of tonns and for many geographical areas can be considered as common practice[1,2]. While brominated flame retardants in plastics can be destroyed with high efficiency if the plastics are treated in incinerators constructed and operating with best available techniques (BAT) and according to best environmental practices (BEP). However, in this case the costs per tonne of incinerated material are considered high (in the order of EURO 80/t).

2. Disposal of plastics containing aromatic brominated flame retardants at landfills

Additionally, a large portion of BFR-treated products end-up in landfills and there is growing evidence and concern that brominated flame retardants including POPs/PBDEs are leaching from landfills and contaminating the environment in industrial countries as well as in developing/transition countries[1,2,6]. Only in engineered landfills with bottom liners, leachates that escape to the environment can be collected and treated to reduce the flow of contaminants to ground and surface water for some time but such treatments are expensive and not state-of-the art. Because of their persistence, POPs/PBDEs will remain in landfills for decades and probably centuries and are expected to be eventually released to the environment as the landfill engineering systems (basal/capping liners, gas/leachate collection systems) will inevitably degrade and lose their ability to contain the contaminants. Therefore, landfilling does not appear to be a sustainable solution for long-term containment of BFR-treated materials[1,2,6].

3. Recycling of plastics containing aromatic brominated flame retardants

Plastic containing brominated aromatic substances has a negative influence on the recycling of imaging equipment as the plastic fraction containing BFRs needs to be removed from any separately collected WEEE and disposed of or recovered with specific requirements based on the provisions of Directive 2002/96/EC on waste electrical and electronic equipment (WEEE)[iii] [7].

The challenges which arise with regard to reuse and recycling of polymers from imaging equipment were highlighted and discussed along the criteria development process It has been analysed whether a proposal of requiring a minimum of total 10% of reused and/or recycled polymers used in manufacturing of the imaging equipment products, which should be the frontrunners from the environmental point of view, is feasible. It has been identified that reuse is not a common practise yet, despite the fact that there are companies operating e.g. in Japan which have managed for certain models marketed business-to-business to achieve up to 80% of reuse rate[11]. In the framework of analysis conducted it has been seen that, although imaging equipment manufacturers emphasize that recycling is considered a desirable approach but that the proposed 10% threshold is currently high. Further, leading manufacturers in the sector of electronic equipment highlighted in this respect that plastic containing brominated flame retardants are currently not recycled back to be used again in imaging equipment products, mainly due to RoHS regulation and the presence of restricted PBDEs in WEEE polymers. A member of the Bromine Science and Environmental Forum (BSEF) mentioned that from technical perspective BFR-containing plastics can be recycled. Nevertheless, the common praxis is that currently WEEE polymers and in particular bromine containing polymers are often down-cycled partly in sensitive uses e.g. toys.[1,2]

The above given reasoning underlines the critical aspects of using brominated flame retardants in imaging equipment products which should be ecolabelled. These products should be frontrunners in their markets and should contribute to more sustainable consumption, reducing the environmental impacts of this product group along the life cycle, i.e. also in the end-of-life phase. Furthermore the technical need to use brominated aromatic additives used as flame retardants in plastics can be questioned, as alternative materials and substitutes, which have lower heath and environmental concerns, are available[8-10]..

Acknowledgements and disclaimer

We thank the stakeholders for their contribution. The project is funded by the European Commission DG Environment and DG Joint Research Center.

The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

[iii] Recast of Directive 2002/96/EC on waste electrical and electronic equipment (WEEE) is currently ongoing but there is no change regarding the provision for brominated flame retardants s.
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Table 1. List of hazard statements and risk phrases considered in the EU Ecolabel proposal

Hazard statement[iv]	**Risk Phrase**[v]
H300 Fatal if swallowed	R28
H301 Toxic if swallowed	R25
H304 May be fatal if swallowed and enters airways	R65
H310 Fatal in contact with skin	R27
H311 Toxic in contact with skin	R24
H330 Fatal if inhaled	R23/26
H331 Toxic if inhaled	R23
H340 May cause genetic defects	R46
H341 Suspected of causing genetic defects	R68
H350 May cause cancer	R45
H350i May cause cancer by inhalation	R49
H351 Suspected of causing cancer	R40
H360F May damage fertility	R60
H360D May damage the unborn child	R61
H360FD May damage fertility. May damage the unborn child	R60/61/60-61
H360Fd May damage fertility. Suspected of damaging the unborn child	R60/63
H360Df May damage the unborn child. Suspected of damaging fertility	R61/62
H361f Suspected of damaging fertility	R62
H361d Suspected of damaging the unborn child	R63
H361fd May damage fertility. May damage the unborn child	R62-63
H362 May cause harm to breast fed children	R64
H370 Causes damage to organs	R39/23/24/25/26/27/28
H371 May cause damage to organs	R68/20/21/22
H372 Causes damage to organs	R48/25/24/23
H373 May cause damage to organs	R48/20/21/22
H400 Very toxic to aquatic life	R50/50-53
H410 Very toxic to aquatic life with long-lasting effects	R50-53
H411 Toxic to aquatic life with long-lasting effects	R51-53
H412 Harmful to aquatic life with long-lasting effects	R52-53
H413 May cause long-lasting effects to aquatic life	R53
EUH059 Hazardous to the ozone layer	R59
EUH029 Contact with water liberates toxic gas	R29
EUH031 Contact with acids liberates toxic gas	R31
EUH032 Contact with acids liberates very toxic gas	R32
EUH070 Toxic by eye contact	R39-41

([iv]) As provided for in Regulation (EC) No 1272/2008.

([v])As provided for in Council Directive 67/548/EEC (OJ 196, 16.8.1967, p. 1).