E B F R I P EUROPEAN BROMINATED FLAME RETARDANT INDUSTRY PANEL

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REVIEW OF THE EXPLANATORY MEMORANDUM

TO THE EUROPEAN COMMISSION PROPOSALS

ON WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT

DG Environment Explanatory Memorandum	EBFRIP Comments
4.1.2 Landfilling of WEEE Page 10: "when brominated flame retarded plastic . . . are landfilled, . . . polybrominated diphenylethers (PBDEs) . . . may leach into the soil and groundwater."	• It is not clear which brominated flame retardants (BFRs) are being referred to here. Indeed the broad term "BFRs" is mixed and confused here with the term "PBDEs", which only refers to three commercial PBDEs. • The proposal does not give any evidence or scientific reference to potential soil or groundwater problems. • Extensive experiments have been carried out looking at leaching behaviour of plastics containing PBDEs. These experiments (conducted according to generally accepted protocols) indicate an extremely low potential of BFRs to leach from landfills. (APME[1], Norris[1 2] et al.) • In fact, the physical/chemical properties of the PBDEs indicate they are unlikely candidates for leaching. For example, the water solubility of Deca-BDE is <0.1 ug/L and therefore has no propensity to move into groundwater. In addition, Deca-BDE ether is expected to absorb strongly to soil which will effectively limit its movement.
4.1.3 Recycling Page 11: "Due to the risk of generating dioxins and furans, recyclers usually abstain from recycling flame	• New studies show that recycling of plastics containing the PBDE flame retardant Deca-BDE is possible, e.g. that a HIPS/Deca-BDE plastic (one of

[1] M. Norris, J. W. Ehrmantraut, C. L. Gibbons, R. J. Kociba, B. A. Schwetz, J. Q. Rose, C. G. Humiston, et. al. Toxicological and environmental factors involved in the selection of decabromodiphenyloxide as a fire retardant chemical, Applied Polymer Symp., 22, 195-219 (1973)

[2] Norris et. al. Evaluation of decabromodiphenyloxide as a flame retardant-chemical, Chem. Human Health Environ., 1, 100-116 (1975)

retarded plastics from WEEE."	the highest volume plastic FR combinations) can be recycled several times and still comfortably meets the German Dioxin Ordinance. [3]
	• Another study looked into workplace exposure during recycling of HIPS/Deca plastic: this study demonstrated that the extrusion process complies with the strictest German workplace regulations[4].
Page 11: " In view of the lack of proper identification of plastic containing FR and the inherent difficulty in distinguishing FR plastic form ordinary plastic, most recyclers do not process any plastic from WEEE."	• New methods for automatic identification of FR-plastic combinations are available[5]. The real reason that recyclers do not tend to process much WEEE plastics is because there is no market for these materials when recycled.
Page 15:"5-8- and 10BDE are mainly used in printed circuit boards, in plastic covers . . . ".	• Printed wiring boards (PWB) typically do not contain any of the three commercial PBDE flame retardants. PWBs are almost exclusively flame retarded with TBBPA, which is not under examination here
5. Legislation on Hazardous substances **5.2 Risks proposed by the targeted substances**	
Page 15: " … that PBDEs formed the toxic polybrominated disbenso furans (PBDFs) and polybrominated disbenso dioxins (PBDDs) during extrusion, which is part of the plastic recycling process."[6]	• The mentioned experiment was looking at PBT plastic. This plastic type requires high extrusion temperatures and is thus more susceptible to D/F formation. Hence the results of that study can not be extrapolated to other plastic FR combinations extruded at lower temperatures.
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	comfortably meets the German Dioxin Ordinance. [7]
Page 16: " . . . high concentrations of PBDE have been found in the blood of workers in recycling plants."	• The use of the term "high" in this instance is debatable. The reported amounts were in the range of ng/g lipid weight (that is 0.000000001 g/g lipid.). Given the extremely low toxicity of Deca-BDE and the minimal exposure, no adverse effects are expected. • The EU Human Health Risk Assessment on Deca-BDE has assessed the risk of workers exposed to Deca-BDE. Even in a worst-case scenario that assumed Deca-BDE exposures about 10,000 times higher than those measured at the recycling plant, it was concluded that there is no risk to workers (margin of safety of >216).
"Various scientific observations indicate that PBDEs might act as endocrine disruptors."	• No scientific references are given to justify this point. • It is also not clear which PBDE flame retardant or component is being referred to. • PBBs are the only brominated flame retardants referred to in an initial Commission screening list of potential endocrine disrupting chemicals.
Page 16: "The presence of polybrominated biphenyls (PBB) in Arctic seal indicates a wide geographic distribution . . ."	• The production of PBB has been phased out.

ANNEX IV : Memorandum on Scientific Evaluation **15. Dose (concentration)-Response (effect) Assessment** **15.1 Adverse effects on human health** **- PBB and PBDE**	• PBBs and the three PBDEs have diverse toxicological properties and should not be discussed together.
Page39: " . . . lower brominated technical PBDE compounds show effects above all on the liver but also on thyroid hormone and affect the behaviour of experimental animals…The highly brominated compounds included in technical Octa-BDE and Deca-BDE are persistent, have effects on reproduction and can cause tumour formation in the liver."	• It is not clear what is exactly meant by "lower brominated technical PBDE compounds" and "highly brominated compounds". • Extensive testing has determined that Deca-BDE does not cause effects on reproduction. • The commercial Octa-BDE product has not been tested for carcinogenicity so that the statement "can cause tumour formation" is incorrect. • Deca-BDE has been tested for carcinogenicity in two species at tremendously high doses by the US National Toxicology Program (NTP)[8]. The results showed no conclusive evidence of carcinogenicity. Deca-BDE is not listed as a carcinogen by IARC, OSHA or NTP. • In the same paragraph it is mentioned that "these compounds" are persistent and that they can be transformed to lower-brominated compounds. This argumentation is contradictory and inconsistent.
"There are scientific data which support the assumption that these compounds can be transformed into lower-brominated compounds."	• There is at present no evidence that Deca-BDE (assuming that is what the authors mean by "highly brominated compounds") is debrominating under environmentally relevant conditions.
Page 40:" Lower brominated PBB are highly toxic . . ."	• The production of PBB has been terminated.
15.2 Adverse effects on the environment **- Brominated Flame Retardants**	• This subtitle is inconsistent in that it refers to all BFRs where previous titles referred to the PBB and (three) PBDE flame retardants only.
Page 40: "Octa- and Deca-BDE are persistent, both microbially and biotically in water and air. Successive debromination in UV light and sunlight has, however, been demonstrated for Deca-BDE."	• The argumentation is inconsistent. The same paragraph states that Deca-BDE is persistent and, at the same time, that it is degraded. • No references are given to prove that Deca-BDE debrominates. Studies published in literature, that found decomposition of Deca-BDE under the influence of light have been using unrealistic conditions: the compound had been dissolved in an organic solvent (e.g. toluene) before irradiation. Conditions typically encountered in the environment do not involve the presence of organic solvents.

[8] National Toxicology Program, Technical report no 309, 1986

	• Within the framework of the EU Risk Assessment on Deca-BDE, two extensive studies are underway on possible debromination (anaerobic sediment and solid surface photolysis) of Deca-BDE. Results are expected in 2001.
16. Exposure Assessment **- PBB and PBDE** Page 42: " The presence of PBB . . ." " . . . with food as the major source. . . . There are indications that diet is another exposure source for PBDEs."	• The production of PBB has been stopped • Diet has not been determined to be the source of PBDEs detected in various biological samples. Several studies have attempted to draw correlations between body levels and diet and none have been able to find a correlation.
17. Risk Characterisation **- PBB and PBDE** Page 44: " Elevated blood concentrations of Octa-BDE have been shown in occupational categories of people handling computers.	• No reference is given to prove this. • In case the authors refer to a publication by Sjodin et al: The major PBDE congeners determined in blood of recycling workers was BDE 183 and BDE 209 = Octa-BDE and Deca-BDE. The EU Human Health Risk Assessment on Deca-BDE used a worst-case scenario of 5 mg/m3 to estimate the risk associated with that exposure. This level is higher by a factor of 50 000 than the exposure levels experimentally determined for Swedish recycling workers. The Risk Assessors concluded that even at these worst-case concentrations of 5 mg/m3, there is no risk posed to the workers with a large margin of safety.

18. Contribution of WEEE to the General Risks **18.1 Current use in EEE of the substances under examination** **- PBDE and PBB**	
Page 44: " Polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs) account for approximately 1% and 9% respectively.	• The production of PBB has been stopped.
" The use (of PBDE) is mainly in four applications: in printed wiring boards, . . ."	• PBDEs are not used to flame retard printed wiring boards. These are almost exclusively flame retarded with TBBPA, which is not under examination here.
18.2 Problems associated with current management of WEEE **- Brominated Flame Retardants**	• The heading's reference to BFRs is inconsistent and confusing
Page46: " . . . polybrominated dibenzofurans and dibenzo –p-dioxins can be formed from PBDEs and PBBs under certain conditions. . . .However, data from municipal waste incinerators in the Netherlands did not show any significant relationship between dioxin formation and the bromine content of the waste. However further research is necessary . . ." " . . . further research is necessary in order to assess this issue. In particular, . . . assess the threshold above which the content of halogenated substances would influence the formation of Dioxins"	• As the authors confirm, in standard municipal waste incinerators there is no relationship between the bromine content of the waste and dioxin formation. • There are additional studies that prove that WEEE can be safely added to municipal waste incinerators and that even artificially high bromine concentrations did not affect dioxin formation.[9] This study has not been considered by the proposal.
Landfilling of WEEE **- Brominated Flame Retardants**	• This sub-heading is inconsistent and confusing in that it refers to all BFRs where previous titles referred to the PBB and (three commercial) PBDE flame retardants only.
Page 47: " Although leaching of the compounds from plastics on a short-term scale is small . . . The time scale of the exposure scenario can therefore reach hundreds of years.	• Within this time frame anything might or might not happen. It is suggested to work with a realistic timeframe which can be scientifically assessed.
Recycling of WEEE **- Brominated Flame Retardants**	• This subtitle is inconsistent in that it refers to all BFRs where previous titles referred to the PBB and (three) PBDE flame retardants only.
Page 48: " . . . during recycling of plastics containing brominated flame retardants, brominated dibenzofurans and brominated dibenzo-p-dioxins may be formed."	• New studies show that plastics containing Deca-BDE can be safely recycled, and that the potential formation of brominated dibenzofurans and

[9] Electrical and electronic waste co-combustion with Municipal Solid Waste for energy recovery, APME report, Jurgen Vehlow, Frank E. Mark, Feb. 1997

	brominated dibenzo-p-dioxins is minimal.[10] [11]
" Various studies suggest that the risk of generation of dioxins is a reason for the complete lack of recycling of plastics containing brominated flame retardants."	• No references are given to prove that statement. • The overriding reason why plastics containing brominated flame retardants are currently not being recycled is due to economics: There is currently no market for recycled plastics of this type. The lack of the market is not due to the presence of brominated flame retardant in the plastic.
" . . .personnel at an electronics-dismantling plant showed . . . exposure of high levels of PBDE . . ."	• No references are given to prove that statement. • In case the authors refer to a paper by Sjodin et al: Personnel at the electronics dismantling plant in question did not show evidence of exposure to high levels of PBDE. In fact, the measured air levels were very low and the measured blood levels (in the ng/g lipid range) were exceedingly low. • The major PBDE congener that those workers were exposed to was Deca-BDE. The EU Human Health Risk Assessment on Deca-BDE used a worst-case exposure of 0.5 mg/kd*d to estimate the risk associated with that exposure. This level is higher by orders of magnitude than the exposure levels experimentally determined for Swedish recycling workers. The Risk assessors concluded that even at those artificially high concentrations there is no risk posed to workers.
" … special protective measures could be implemented … coherent enforcement of such measures … cannot be ensured."	• There already exist regulations for occupational exposure to hazardous compounds in place. Any issues related to occupational exposure should be handled under existing EU worker safety protocols.

[10] Analysis of a Decabromodiphenyloxide blend, a HIPS plastic, the HIPS plastic containing the DecaBDPO and Sb2O3, and the repeatedly recycled HIPS/Sb2O3/DecaBDPO plastic for partially brominated Diphenylethers and 8 polybrominated Dibenzo(p)dioxin and Dibenzofuran congeners; Report No. 60425-001-B01 by S. Hamm, GfA Gesellschaft fuer Arbeitsplatz- und Umweltanalytik mbH

[11] Determination of Polybrominated Diphenyl Ethers and PBDD/Fs during the Recycling of High Impact Polystyrene Containing Decabromodiphenylether and Antimony Oxide. S. Hamm, M. Strikkeling, P. Ranken, K.P. Rothenbacher; Chemosphere, accepted for publication

19. Risk Reduction Strategy by Substitution **Alternatives to the substitution** Page 49, first paragraph: "Clearly, the substitution of the concerned substances would provide the best protection of the concerned (recycling) workers."	• This implies: a) that recycling workers' health is being put at risk by the presence of the substances listed in the RoHS proposal, for which there is no evidence; b) that standard worker health and safety preventative measures are somehow not applicable; and c), if the DG Environment wishes to be consistent, that any substance found at any level in a recycling plant should be phased-out, which of course would make the production of electrical and electronic equipment impossible in the first place.
Substitutes "The targeted hazardous substances are already competing against other safe or less dangerous materials for a large number of applications."	• No evidence is given for this statement. We do not know whether or not other flame retardants are safe or less dangerous, because there is only limited available information on their toxicology. • Whereas the data set on the commercial PBDE flame retardants is quite extensive, there is little knowledge about the effects of so-called "alternative" flame retardants. • The independent Swedish consultancy Orango concludes that " there is a definite risk that some companies may chose alternative, non-halogen flame retardants that actually may turn out to be worse from an environmental standpoint than the BFRs they substitute."[12] • Further, the US National Academy of Sciences emphasized the critical fire prevention role of FRs and cautioned against "too conservative" an approach to environmental and health impacts: "Overestimating risks from FRs might result in a net adverse effect on public health if the uses of FRs that could reduce the risks of death and injury from fires were avoided because of minor toxicologic risks estimated through such conservative assumptions".[13] The NAS reviewed the toxicology of decabromodiphenyl oxide in this report and found it suitable for use in upholstered furniture.

[12] P. Hedemalm et al., "Brominated Flame Retardants, A global status report", Orango AB, March 2000
[13] "Toxicological Risks of Selected Flame-Retardant Chemicals", National Academy of Sciences, April 2000