



EUROPEAN COMMISSION  
DIRECTORATE-GENERAL HEALTH AND CONSUMER PROTECTION  
Directorate C - Scientific Opinions  
Unit C2 – Management of Scientific Committees; scientific co-operation and networks  
**Scientific Committee on Toxicity, Ecotoxicity and the Environment**

Brussels, C2/AST/csteep/**Decabromophenyl Hum & Env 31102002/D(02)**

**SCIENTIFIC COMMITTEE ON TOXICITY, ECOTOXICITY AND  
THE ENVIRONMENT (CSTEE)**

**Opinion on the results of the Risk Assessment of:**

**Bis(pentabromophenyl)ether**

**Environmental and Human Health Part**

**CAS No.: 1163-19-5**

**EINECS No.: 214-604-9**

**Carried out in the framework of Council Regulation (EEC) 793/93 on  
the evaluation and control of the risks of existing substances<sup>1</sup>**

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<sup>1</sup> Regulation 793/93 provides a systematic framework for the evaluation of the risks to human health and the environment of those substances if they are produced or imported into the Community in volumes above 10 tonnes per year. The methods for carrying out an in-depth Risk Assessment at Community level are laid down in Commission Regulation (EC) 1488/94, which is supported by a technical guidance document.

## Terms of reference

In the context of regulation 793/93 (Existing Substances Regulation) and on the basis of the examination of the Risk Assessment Report provided by the European Chemicals Bureau, The CSTEE is invited to examine the following issues.

- Appendix D of the report indicates that PBDEs can contain and, when heated, form extremely toxic brominated dioxins and furans (PBDD/F). The blending of deca-BDE with thermoplastic polymers takes place in the temperature range 200°C to 300°C, the final products being shaped using high-temperature extrusion or injection moulding. What are the potential risks to workers in the plastics/rubber industries arising from exposure to PBDD/F?
- Does the weight of available scientific data indicate that more bioavailable and toxic lower brominated degradation products of deca-BDE are being formed in the environment?
- What tests (if any) would be needed to test conclusively for the formation of lower brominated degradation products of deca-BDE in the environment?
- What are the possible health and environmental effects of indirect exposure to more bioavailable and toxic lower brominated degradation products of deca-BDE?

## BACKGROUND

Decabromodiphenyl ether (DBDE) is used as flame retardant in plastics and textiles. The technical products contain mainly decabromodiphenyl ether, but also some nona- and octabromodiphenyl ethers. The products may also contain traces of brominated dioxins and furans. The flame retarded polymers contain 10 – 15 % of the retardant and are mainly used in electrical and electronic equipments.

DBDE is an extremely lipophilic compound with very low water solubility and vapour pressure. These properties, and the size of the molecule, make the distribution and fate of the substance difficult to predict. The uptake in biological systems is slow, but reductive debromination has been reported to give lower brominated diphenyl ethers, which are more readily accumulated in biota.

Polybrominated dioxins and furans (PBDD/F) have similar properties as the chlorinated counterparts, which are regarded as the most toxic substances of anthropogenic origin. In addition to the amounts of PBDD/F present in the technical DBDE products, there is a risk for formation of these toxic substances when DBDE is heated or incinerated. Incineration may also form dioxins and furans containing both chlorine and bromine.

## GENERAL COMMENTS

The CSTEE gave its Opinion on a previous draft of the environmental section of this report in June 2000 and on the human health section in February 2002. The present version of the RAR is an update of these earlier drafts (especially the environmental part), which includes recent published data. These include new studies on debromination processes and a new appendix on risk assessment associated with PBDD/F during industrial use of DBDE (Appendix D).

The CSTEE shares the assessor's suspicions that long-term effects of this persistent and, at least in some organisms, bioaccumulating substance can not be excluded. The same holds true for the probably more bioaccumulative lower brominated degradation products of DBDE. The CSTEE agrees with the conclusion i) for the environment but also concludes that this uncertainty is sufficient to warrant risk reduction measures directly (conclusion iii). As the same arguments hold for human health effects, the CSTEE does not agree with conclusion ii) for human exposure (NB In the CSTEE opinion on human health, dated 22-02-2002, the conclusion ii) was not based on indirect exposure to lower brominated degradation products as possible effects by these latter compounds was not covered in the October 2001 RAR).

## ANSWERS TO THE QUESTIONS

### Question 1

Appendix D of the report indicates that PBDEs can contain and, when heated, form extremely toxic brominated dioxins and furans (PBDD/F). The blending of deca-BDE with thermoplastic polymers takes place in the temperature range 200°C to 300°C, the final products being shaped using high-temperature extrusion or injection moulding. What are the potential risks to workers in the plastics/rubber industries arising from exposure to PBDD/F?

### Answer

The risk assessment of PBDD/Fs is difficult due to the limited amount of effects studies of these compounds. It is generally assumed that their toxicity is comparable with the polychlorinated dioxins and furans (PCDD/F) (WHO-IPCS, "Polybrominated dibenzo-*p*-dioxins and dibenzofurans", EHC 205, 1998). It is also difficult to do congener specific analyses of these substances, something which is needed due to the very different toxicity of isomers.

The toxic equivalent factors used in Appendix D are the i-TEFs developed by NATO. More common is to use the TEFs recommended by WHO, but this will only make minor changes in the final toxic equivalent values (TEQs). More surprising is that an old ADI of 10 pg TEQ/kg/day is used, as WHO has revised this to 1 – 4 pg TEQ/kg/day, and the EU recently decide on a TWI (tolerable weekly intake) of 14 pg TEQ/kg bw.

There is just one study reporting exposure to PBDD/F at workplaces handling DBDE, and it indicates air concentrations of 760 pg TEQ/m<sup>3</sup> (assuming that TEFs for brominated

compounds are similar to chlorinated ones). Assuming that this is in the form of a powder with particles smaller than 5 micrometer, and thus inhalable, and that 10 m<sup>3</sup> is inhaled during a work shift, the amount inhaled would 7600 pg TEQ. For a 70 kg person this gives an exposure exceeding the ADI more than 50 times. The CSTEE has therefore difficulties to agree with the conclusion ii) for occupational exposure.

There is also a risk for PBDD/F exposure, both for man and the environment, at the end-of-life of products containing DBDE. TV-sets in today's waste stream have been found to contain up to 130 mg total PBDD/F per kilo (Sakai, S., *Organohalogen Compounds*, 47, 210-213, 2000). Elevated levels of the DBDE have been found in people reclaiming this type of materials, and they are probably also exposed to the PBDD/Fs. Incineration of such material may also form PBDD/Fs, and also dioxins and furans containing both chlorine and bromine. The latter may even decrease the amount of PCDD/Fs in the emissions, compounds measured for compliance with specific permits.

## Question 2

Does the weight of available scientific data indicate that more bioavailable and toxic lower brominated degradation products of deca-BDE are being formed in the environment?

### Answer

The substitution of bromine atoms in the DBDE molecule gives lower brominated congeners of diphenyl ether. Two major routes are possible for this in the environment, photolytic and microbial degradation. Regarding the latter there seems to be no evidence that this is an important pathway.

There have been a number of experiments performed to study photolytic debromination of DBDE. It is obvious that a debromination takes place in solvents able to act as hydrogen donors. In some of these experiments the formation of PBDD/Fs has also been observed.

Several studies under more environmentally relevant conditions (using sand, soil and sediment) also show that daylight can produce congeners with seven to nine bromine atoms. Diphenyl ethers with lower bromination degree may also be formed, but further destroyed at the same rate. These results have also been confirmed in soil fertilised with sewage sludge (B. Jansson, unpublished results) where the same pattern as in the photolysis experiments with DBDE was found.

The photolysis studies performed by Jafvert and Hua (2001c) indicate a low debromination of DBDE. The original reports are not available to the CSTEE and it is difficult to scrutinise these studies. The dosed amount of the mother substance seems to be very high, as well as the variation (often more than an order of magnitude) in the results from duplicate experiments.

The conclusion of the CSTEE is that the present data indicate that lower brominated congeners are formed during photolysis in the environment.

### Question 3

What tests (if any) would be needed to test conclusively for the formation of lower brominated degradation products of deca-BDE in the environment?

#### Answer

Further soil studies are under way and may give more conclusive answers to this question. It would also be interesting to see if the concentrations of PBDD/Fs are higher at the surface of flame retarded goods than within the polymer after exposure to sunlight.

### Question 4

What are the possible health and environmental effects of indirect exposure to more bioavailable and toxic lower brominated degradation products of deca-BDE?

#### Answer

The degradation products we know so far are lower brominated diphenyl ethers and, possibly, brominated dioxins and furans. Absorption of these products will certainly be higher when compared to DBDE. It is not known at present which congeners are formed and thus it is impossible to answer this question. If it is the PBDE congeners present in the lower brominated products (penta-BDE and octa-BDE) it would be possible to refer to the RARs for these products, but to the knowledge of the CSTEE this is not the case.

#### N.B.

Before considering any substitution of decabromodiphenyl ether with alternative flame retardants, due consideration should be given to the potential human and environmental risks such substitutes could pose.