Environmental Group: Comments

Norbert Caspers, Bayer AG (16.04.2009):

Die zusammenfassenden Folien der Environment Group geben eher den wechselvollen Gang der Diskussion während der Veranstaltung als die konsolidierten Conclusions der Gruppe wieder. So werden in den Folien viele Aspekte erwähnt, die zwar breit diskutiert wurden, nicht jedoch als Schlussfolgerung der Veranstaltung zu verstehen sind. Als zusammenfassende Schlussfolgerung der Veranstaltung ist lediglich die Folie 18 zu betrachten, die BPA als „not currently of very high concern“ einstuft.
Die Folien 1-5 (Canadian Screening Risk Assessment) und Folie 6 (Mollusc activities) wurden nach meiner Erinnerung in dieser Form nicht bei der abschließenden Präsentation im Plenum vorgestellt. Sie geben zwar korrekt die Vorträge von John Pasternak (1-5) und Peter Matthiessen (6) wieder, spiegeln jedoch – im Falle der Folien 1-5 – nicht die breite Meinung und die Schlussfolgerungen der 16 Teilnehmer der Umweltdiskussion (z.B. bezüglich des Abbauverhaltens unter anaeroben Bedingungen sowie der Verwendung der Befunde der Lahnsteiner-Studie). Ich schlage vor, die Folien 1-6 als Zusammenfassung der Präsentationen der Vortragenden (Pasternak, Matthiessen) zu kennzeichnen.

John Pasternak, Environment Canada (16.04.2009):

John P's talk on Canadian RA for BPA

- John P's talk on Canadian RA for BPA
  - Ministerial Challenge programme
  - Part of 5-year plan to assess ~190 substances
  - WoE and precautionary approach (not just based on RCR)
  - Peer review and public consultation
- Met criterion for inherent ecotoxicity (chronic tox <0.1 mg/L)

Canadian concs

- Mostly below ug/L level
- Sludge – mostly above mg/kg level??
- Considered to be P under anaerobic conditions
- Does not meet B criterion

Canadian Ecotox

- Standard endpoints similar to those used in EU RAR
- ED
  - Extensive literature on this
  - Most effects between 1 to 1000 ug/L....but some data on effects below 1 ug/L – although some lack of consistency in results between organisms, study protocols, etc.

RCRs

- RCRs below 1 for most receptors/compartments
- RCR of 9.9 for pelagic orgs
  - CTV of 1.75 ug/L used (103d LOEC reduced semen quality) – felt more certain and more relevant to Canada then snail data
  - PEC = 1.???
- Secondary poisoning mamm receptors
  - RCR mink = 1.25 to 12.5
  - RCR otter = 4.2 to 42

Canadian next steps

- Not a prohibition
- Probably controls for pollution prevention & WWTP.
- 2 years after decision on assessment

Peter Matthiessen

- Presentation available
- Molluscs imp group
- OECD DRP under prep UK/Germany
- Partial & full lifecycle tests should be developed (not enough knowledge of mollusc endocrinology to allow diagnostic screens)
- Looked at 21 spp, candidates are
  - P. antipodarum (New Zealand mudsnail)
  - L. stagnalis (great pond snail)
  - C. gigas (Pacific oyster)
- DRP published in 2010 & validation probably take at least 5 years (e.g. to check on seasonality) – maybe 10 years to internationally validated test.

Is the EU hazard assessment of BPA up to date? If not, what do new studies show that might alter its conclusions

- Yes, up to date.
- Snails – what to do with Marisa data we have?
  - Further lab work probably not useful until have standardised method.
  - Should Oehlmann be funded further to re-run Marisa test in a larger, fully supervised study to see if results change? But is this just going over old ground – hasn't he already repeated studies sufficiently (published 2006)? Group divided on this.
  - We should use the existing "luxurious" Marisa data more effectively (e.g. in meta-analysis) to reach a conclusion on this species if possible. But why are the Oehlmann and Forbes data so different? Would info on snail tissue concs be useful in explaining this?
  - Would a mesocosm (flow through) study with snails be useful? But must consider dosing issues – can it be done in a way that resolves low dose issues (e.g. Macrophytes mopping up BPA, degradation can be very high - >90%)? Some concern that study would not produce clean & useful data.
  - Eco-epidemiology approach could be used to show if effects on prosobranchs occur in the field?
  - There is a general issue for regulatory authorities about how to build appropriate incentives for industry to perform tests into their decision-making about chemicals.

Any relevant lessons from mamm tox?

- Possibly use mamm tox data further for more detailed secondary poisoning assessment (e.g. Canadian approach)
- Some tissue specimen databanks available that might be used to support estimates of BPA uptake (Dreissena, bream, seagull eggs, brown algae, eelpout held by FHI).

Any important gaps in env haz assess?

- Why brown trout data critical to Canada not used? – several methodological issues for EU. Disagreement about how to treat it.
- Several fish studies (e.g. Secondary sexual characteristics in fatheads; swordtail tail length) should also be re-evaluated in WoE approach?

Are reliable field data available

- Not really....but no evidence of changes in e.g. Snail populations in nature (contrast with TBT and dogwhelks)

How reliable are in vitro/in vivo hazard data & what do they tell us about EA of BPA?

- Enough reliable data to tell us that BPA is clearly an ED for different taxa.
- Ecotoxicity in vivo data not conclusive about BPA potency.

Potential for additive effects with other EDCs in env?

- Yes, there is potential

Are all relevant environmental compartments covered?

- Water is most important compartment.
- Potential for accumulation in anaerobic sediments and WWTP sludges needs further assessment?

Is availability of exposure data adequate?

- BPA producers have collected data on exposure concentrations – mostly available for surface water. Some available on biota, sediment, soil data. Should be more investigation of sediment data that are available.
- Concentrations in Canada appear to be similar to Europe (although sometimes >1ug/L). Some apparent differences could be due to different LoDs.
- Should assume median WWTP efficiency of 66%. Some inefficiencies might be due to non-optimal microbes.....should be able to achieve up to 99%.

Potential for sources/releases from BPA derivative compounds?

- Have not considered all compounds (but have considered one in EU RAR).

Accumulation potential (food chain effects)?

- Look at Canadian approach to see why different conclusions to EU RAR on secondary poisoning.
- Binding to proteins and other factors affecting bioavailability may need to be considered in any feeding studies.

All covered adequately?

- Environmental compartments? Yes, (except sediments)
- Trophic levels? yes
- Receptor species? Yes (soils? But no further species to use? Microbes?)
- Endpoints & effects? General for EDCs – many organisms with “general” estrogen receptor (e.g. some annelids)
- Population relevant MoA? Yes

Is BPA of equivalent concern (SVHC)?

- It is widely used at high concs (and increasing) and released into env
- It is toxic at low concs
- It can be considered “pseudo-persistent” because continuously released plus it can be P in anaerobic sediment.
- Not B
- ....are ED-mediated effects on snails & fish sufficient to classify BPA as SVHC?....it’s not currently of VERY high concern.
- ....REACH submissions from manufacturers/importers will need to address outstanding issues in transitional dossiers.

Report on UBA workshop on Bisphenol A, 30-31 March 2009: Environmental Issues

Mark Crane
wca environment

Introduction

This brief report summarises the discussion and conclusions on environmental issues from a workshop on Bisphenol A (BPA; CAS#80-05-7) organised by the UBA and held in Berlin from 30-31 March 2009. The report begins by discussing the status of the European Union's environmental risk assessment of BPA. A similar evaluation by Canadian authorities is then described. Freshwater gastropod snails are one of the species that may be particularly sensitive to BPA exposure, and there is a summary of current work by the OECD to develop appropriate aquatic snail test methods. Finally, the views of environmental experts who attended the meeting are summarised on the environmental risks posed by BPA and, in particular, whether it should be classed as a substance of very high concern under the EU's REACH regulations.

EU risk assessment of BPA

Bisphenol A was prioritised for risk assessment in the EU in 1997 because of its widespread use and evidence that it is an endocrine active substance. A risk assessment by the UK rapporteur was published in 2003[1]. This identified a critical and sensitive multi-generational study on fathead minnow (*Pimephales promelas*) by Sumpter et al.[2] The no observed effect concentration (NOEC) for egg hatchability and vitellogenin production was 16 µg l^{-1}, but there was also some evidence of effects on spermatogenesis at the lowest test concentration of 1 µg l^{-1}.

Several studies on the prosobranch snails *Marisa cornuarietis* (freshwater ramshorn snail) and *Nucella lapillus* (marine dogwhelk)[3] were also reviewed in the risk assessment report. These seemed to show that BPA stimulates egg production and mass spawning at low concentrations, with a 60-d NOEC of 7.9 ng l^{-1} reported for stimulation of *M. cornuarietis* egg production. However, the ecological implications of this result were considered to be difficult to interpret, so a predicted no effect concentration (PNEC) for the aquatic compartment of 1.6 µg l^{-1} was recommended, based on fish egg hatchability and an assessment factor of 10. In parallel with this, a tentative PNEC aquatic of 0.1 µg l^{-1} based on possible effects on fish spermatogenesis was also used for "what if?" scenario analyses.

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[1] http://ecb.jrc.ec.europa.eu/esis/index.php?PGM=ora

[2] Sumpter JP, Tyler CR, Sherazi A. 2001. Bisphenol-A: Multigeneration study with the fathead minnow (*Pimephales promelas*). Brunel University. Later published as part of Sohoni P, Tyler CR, Hurd KS, Caunter JE, Hetheridge MJ, Williams TD, Woods C, Evans M, Toy R, Gargas M, Sumpter JP. 2001. Reproductive effects of long-term exposure to Bisphenol A in the fathead minnow (*Pimephales promelas*). Environ Sci Technol 35:2917-2925.

[3] Oehlmann J, Schulte-Oehlmann U, Tillmann M, Markert B. 2000. Effects of endocrine disruptors on prosobranch snails (Mollusca: Gastropoda) in the laboratory. Part I: Bisphenol-A and Octylphenol as xenoestrogens. Ecotoxicology 9:383-397.
Schulte-Oehlmann U, Tillmann M, Casey D, Duft M, Markert B, Oehlmann J. 2001. Östrogenartige Wirkungen von Bisphenol A auf Vorderkiemenschnecken (Mollusca: Gastropoda: Prosobranchia). -UWSF- Z Umweltchem Ökotox 13:319-333.

The 2003 environmental risk assessment recommended that further work on understanding environmental effects should include clarification of the concentrations at which effects on fish spermatogenesis occur, further investigation of effects on aquatic snails, and develop of appropriate analytical methods to use these results in an environmental risk assessment. These recommendations were taken forward by industry, who commissioned a series of tests including an extensive programme of studies with *M. cornuarietis*.

In 2008 the 2003 risk assessment report was updated with an addendum (also published at the address in footnote 1). This reported further work on fish spermatogenesis and reproduction, which produced a similar hatchability NOEC to the earlier study by Sumpter and co-workers reported in the 2003 risk assessment. In contrast, further work on spermatogenesis did not produce results as sensitive as those suggested by the earlier work. Extensive repeats of mollusc studies also produced less sensitive results than the earlier work of Oehlmann and co-workers. In the 2008 update it was also possible to plot a species sensitivity distribution of ecotoxicity results because sufficient data had become available to fulfil criteria stipulated by the European Commission's Technical Guidance Document on Risk Assessment[4].

Different possible aquatic PNECs are reported in the 2008 updated EU risk assessment:

- $PNEC_{aquatic}$ using an assessment factor approach of 1.6 µg l^{-1} based on fathead minnow hatchability (as in 2003). This does not take the Oehlmann et al. results into account, but would be protective of snails if based on industry–funded repeats of Oehlmann's work in which the reproduction NOEC was 25 µg l^{-1}. In addition to this, a recalculation of Oehlmann et al.'s data reported in the updated risk assessment suggests that the NOEC should be 2.1 µg l^{-1} and not the much lower reported value.
- However, the update states that German regulatory authorities believe that the lowest EC10 value of 0.0148 µg l^{-1} from a more recent study by Oehlmann et al.[5] is reliable. If an assessment factor of 10 is applied to this result the $PNEC_{aquatic}$ would be 1.48 ng l^{-1}.
- Applying an assessment factor of five to an HC5 derived from data in the 2008 update, including the higher values for snail reproductive effects, would give a $PNEC_{aquatic}$ of 3.0 µg l^{-1}.
- Using the recalculated result for the Oehlmann et al. data of 2.1 µg l^{-1} in the HC5 data set and an assessment factor of five gives a $PNEC_{aquatic}$ of 1.5 µg l^{-1}.

It is this last value that was preferred by the UK rapporteur for risk characterisation, given the possibility that the repeated snail studies might have missed an effect because the snails did not exhibit a seasonal breeding pattern in these experiments. It was also preferred because of its similarity to the $PNEC_{aquatic}$ derived using an assessment factor

[4] European Commission. 2003. Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment for new notified substances, Commission Regulation (EC) No. 1488/94 on Risk Assessment for Existing Substances and Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market. Ispra (IT): EC.

[5] Oehlmann J, Schulte-Oehlmann U, Bachmann J, Oetken M, Lutz I, Kloas W, Ternes TA. 2006. Bisphenol A induces superfeminization in the ramshorn snail *Marisa cornuarietis* (Gastropoda: Prosobranchia) at environmentally relevant concentrations. Environmental Health Perspectives 114:127-133

approach without consideration of the snail data, and because it is close to the lower limit of the 90th percentile confidence interval for the HC5 value.

In summary, the environmental conclusions of the 2008 update to the EU's BPA risk assessment are that there is still a need for further information and/or testing (a so-called "conclusion one" finding) for freshwater and marine aquatic compartments (including sediment, since an equilibrium partitioning approach was used to estimate effects for sediments). Although no risks were indicated using the freshwater and marine PNEC for any scenario, it was considered that there are still some uncertainties over the potential effects of BPA on snails, despite the industry-funded testing undertaken after the 2003 risk assessment.

An additional conclusion (a so-called "conclusion two") was that there is at present no need for further information and/or testing and no need for risk reduction measures beyond those which are being applied already for the terrestrial and atmospheric compartments, and for secondary poisoning through the aquatic, terrestrial and marine food chains. This conclusion also applies to risks to wastewater treatment plant micro-organisms. For these end points the conclusion applied to all life cycle steps.

Canadian Ecological Assessment for the Ministerial Challenge on Bisphenol A

The Government of Canada announced its intention to undertake the "Ministerial Challenge" in December 2006, as mandated by the Canadian Environmental Protection Act (CEPA 1999). This is a five year plan (2006-2011) for the assessment and management of 193 substances believed to be in commerce and identified as high priorities for action as a result of Categorization of the Canadian Domestic Substances List (DSL). The mandate includes:

- High priority substances that met:
  - each of the ecological categorisation criteria (persistence (P), bioaccumulation (B) and inherent toxicity to aquatic organisms (iT) and which are believed to be in commerce in Canada; and/or
  - the criteria for greatest or intermediate potential for exposure (GPE or IPE) and were identified as posing a high hazard to human health (evidence of carcinogenicity, mutagenicity, developmental toxicity or reproductive toxicity).

Categorisation criteria for Persistence and Bioaccumulation are identified in the Persistence and Bioaccumulation Regulations under CEPA 1999. A substance is considered persistent by the Canadian authorities if its transformation half-life satisfies the following criteria in any environmental medium or if it is subject to long-range transport: air ≥2 days (or Long Range Atmospheric Transport), water ≥6 months, sediment ≥1 year, and soil ≥6 months. A substance is considered bioaccumulative if its bioaccumulation or bioconcentration factor is ≥ 5000 or its log Kow is ≥ 5. A substance is considered to be "Eco Inherently Toxic" if it has an acute aquatic toxicity of <1 mg l^{-1}, or a chronic aquatic toxicity of <0.1 mg l^{-1}.

Bisphenol A was considered to be a high priority for action under the Ministerial Challenge. It met human health categorisation criteria because of its potential for

human exposure and because it has been classified on the basis of reproductive toxicity by the European Commission. It met ecological categorisation criteria because of its inherent toxicity to aquatic organisms.

The resulting Canadian assessment[6] considered BPA to be persistent because, although it degrades rapidly in water and soil under aerobic conditions, there is widespread detection in surface waters and wastewater treatment plant effluents, plus measurement of its presence in media without direct inputs (e.g. groundwater) indicating that it remains sufficiently long in the environment to move from its point of release into other environmental media. In addition to this, there appears to be negligible degradation under anoxic conditions, such as in sediments[7].

The Canadian assessment found that BPA does not meet Bioaccumulation criteria under CEPA 1999. Although it is bioavailable and can accumulate to some degree in organisms, BPA metabolism has been identified in fish, mammals, birds and plants, e.g. in fish BPA is transformed to glucuronides.

However, BPA does meet toxicity criteria, with several L(E)C50 values at, or approaching, 1 mg l^{-1} and chronic NOECs equal to or less than 0.1 mg l^{-1}. In addition to this there is an extensive literature indicating disruption to hormonal, reproductive and developmental processes for fish, aquatic invertebrates, amphibians and reptiles.

Risk quotients were calculated in the Canadian assessment as follows:

- Water column organisms
  - Predicted Environmental Concentration = 1.73 µg l^{-1} for surface water, based on an effluent concentration of 17.3 µg l^{-1} reported for wastewater treatment plant effluents in the Toronto area[8], plus a dilution factor of 10 to account for exposure in the immediate mixing zone.
  - Predicted No Effect Concentration = 0.175 µg l^{-1} based on a 103 day LOEC[9] for reduced semen quality and delayed ovulation in brown trout 1.75 µg l^{-1} and an assessment factor of 10.
  - Risk quotient = 9.9, so there is a potential adverse risk for pelagic organisms.
- Mammalian wildlife
  - Predicted Exposure Concentrations were estimated based on a calculation of the total daily intake (TDI) of BPA by sentinel species (PEC_{mink} = 9 µg kg^{-1} bw day^{-1}, PEC_{otter} = 21 µg kg^{-1} bw day^{-1}). An energetics model was used to calculate these values, based on the general exposure approach

[6] http://www.chemicalsubstanceschimiques.gc.ca/challenge-defi/batch-lot_2_e.html
[7] Ronen Z, Abeliovich A. 2000. Anaerobic-aerobic process for microbial degradation of tetrabromobisphenol A. Appl Environ Microbiol 66:2372-2377.
Voordeckers JW, Fennell DE, Jones K, Häggblom MM. 2002. Anaerobic biotransformation of tetrabromobisphenol A, tetrachlorobisphenol A and bisphenol A in estuarine sediments. Environ Sci Technol 36:696-701.
[8] Lee HB, Peart TE, Chan J, Gris G. 2004. Occurrence of endocrine-disrupting chemicals in sewage and sludge samples in Toronto, Canada. Water Qual Res J Can 39:57-63.
[9] Lahnsteiner F, Berger B, Kletzl M, Weismann T. 2005. Effect of bisphenol A on maturation and quality of semen and eggs in the brown trout, *Salmo trutta f. fario*. Aquat Toxicol 75:213-224.

for wildlife from the U.S. Environmental Protection Agency's Exposure Factors Handbook[10].

- Predicted No Effect Concentrations were from repeated oral dose toxicity data normalised to wildlife receptor on the basis of body weight ($PNEC_{mink}$ = 0.8 to 8 µg kg^{-1} bw day^{-1}, $PNEC_{otter}$ = 0.5 to 5 µg kg^{-1} bw day^{-1}).
- Risk quotient for mink = 1.25 to 12.5 and for otter = 4.2 to 42, so there is a potential adverse risk for mammalian wildlife.

Overall conclusions from the Canadian assessment are that BPA meets criteria in subsection 64 (a) of CEPA 1999: it enters the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity. It should therefore be added to Schedule 1 under CEPA 1999. This is not a prohibition on use, but will most likely lead to pollution prevention controls and improved wastewater treatment, using a life-cycle approach to minimise its release into the environment. A proposed Risk Management instrument on BPA will be published by the end of 2010, with a final instrument published by April 2012.

Freshwater snail sensitivity to BPA

The Canadian environmental assessment of BPA did not consider that the results from tests on freshwater prosobranch snails were of sufficient relevance to the Canadian environment to be considered as critical studies when deriving a PNEC. However, during the EU risk assessment the issue of snail sensitivity, particularly of *M. cornuarietis*, continued to be raised.

Further work was commissioned by the UK rapporteur in an attempt to answer remaining questions in the 2008 update. However, all the preliminary studies that were undertaken had confounding factors (including the use of some wild-caught animals, elevated BPA degradation rates in some cases, and low levels of BPA found in controls). While there were results that suggested BPA has effects on reproduction, there were no significant results using conventional statistical approaches. The consensus EU opinion on the way forward is therefore that there is a need to develop a standardised test for possible use with <u>all</u> chemicals, using one or more freshwater gastropods, and that the Organisation for Economic Co-operation and Development (OECD) endocrine disruption test validation group is the most likely vehicle to achieve this.

Germany and the United Kingdom are therefore currently drafting a Detailed Review Paper (DRP) for the OECD on possible mollusc-based tests that may be sensitive to endocrine disrupting chemicals (EDCs)[11]. Although issues with BPA are clearly one of the drivers for this effort, the lack of a standardised mollusc ecotoxicity test is seen as a more general gap in the tools available for testing substances. There are more than 130,000 species of mollusc (second in abundance only to arthropods), they are economically and ecologically important, occur in freshwater, saltwater and on land,

[10]United States Environmental Protection Agency. 1993. Wildlife exposure factors handbook. Volume 1. National Center for Environmental Assessment, U.S. Environmental Protection Agency, Washington, D.C. (EPA/600/R-93/187). Available at http://www.epa.gov/ncea/pdfs/toc2-37.pdf.

[11] Matthiessen P. 2008. An assessment of endocrine disruption in mollusks and the potential for developing internationally standardized mollusk life cycle test guidelines. Integrated Environmental Assessment and Management 4:274-284.

some aspects of their endocrinology are similar to vertebrates (e.g. possession of sex steroids), some are easy to culture and test, some respond to steroid-mimicking EDCs and are particularly sensitive to other important EDCs such as organotins, and there is clear evidence that EDCs such as organotins at very low concentrations have seriously damaged some mollusc populations. Therefore it is perhaps surprising that a mollusc OECD guideline has not been developed to date. However, modes of action for EDCs in molluscs are only speculative, mainly because molluscan endocrinology is poorly understood. Therefore diagnostic screening tests are not yet practical and testing is currently likely to be restricted to apical endpoints (e.g. reproductive success) in partial and full lifecycle tests.

After examining 21 different candidate mollusc species, the DRP recommends further consideration of tests with the New Zealand mudsnail *Potamopyrgus antipodarum*, the great pond snail *Lymnaea stagnalis*, and the Pacific oyster *Crassostrea gigas*. The draft DRP will be circulated to OECD member states for comment this year, and hopefully published in 2010. Work will then be required to optimise the protocols, and to validate those which show greatest promise, before one or more can become OECD guidance documents. This means that it may take between five to ten years before a validated OECD guideline methods for mollusc ecotoxicity tests is available.

Berlin workshop questions and answers

1. *Is the EU environmental hazard assessment of BPA up to date? If not, what do new studies show that might alter its conclusions?*

The consensus of the experts at the meeting was that the EU environmental hazard assessment for BPA in the 2008 update is sufficiently up to date.

There was discussion about how to use available data on *M. cornuarietis* effectively. It was generally agreed that further laboratory work on aquatic snails, including further repeats of studies with *M. cornuarietis*, would probably not be useful until a standardised method is available via the OECD, as described above. Instead, the existing *M. cornuarietis* data could perhaps be analysed more effectively (e.g. in a meta-analysis) to reach a firmer conclusion on this species, if possible. It is not at all clear why the results differ so substantially in different tests with this species. Information on concentrations of BPA in snail tissues might be useful in helping to explain this, but are unlikely to be available from all of the different studies.

There is clearly a general issue for regulatory authorities about how to build appropriate incentives for industry to perform tests into their decision-making about chemicals. In the case of BPA a very large amount of money was spent on repeating tests with *M. cornuarietis*, the results of which were then not accepted by regulatory authorities.

The workshop group considered whether a flow-through mesocosm study with snails might be useful. However, the consensus was that maintaining appropriate doses would be very difficult in the presence of macrophytes, and with the likelihood of high BPA degradation rates in such systems. Another approach that might yield more useful results would be a desk-based analysis of available monitoring data in an

ecoepidemiological approach to see if effects on prosobranch snails occur in the field and can be related to concentrations of BPA.

2. *Are there any relevant lessons from mammalian toxicity for the EU environmental hazard assessment?*

It may be possible to use mammalian toxicity data for further secondary poisoning assessment (e.g. in a way that is similar to the Canadian assessment). However, the EU risk assessment for BPA was performed in a standard way that has been considered acceptable for other substances, and all secondary poisoning risk characterisation ratios (i.e. risk quotients) in the EU risk assessment for BPA were below 1. In addition to this, there has been criticism of the approach taken and possible errors in the Canadian assessment of secondary poisoning (Norbert Caspers, pers. comm.).

Some tissue specimen databanks are available, such as those held by the Fraunhofer Institute, which might be used to support additional estimates of BPA uptake by mammals (e.g. via *Dreissena*, seagull eggs, brown algae, bream, and eelpout). Binding to proteins and other factors affecting bioavailability may also need to be considered in the analysis of any feeding studies.

3. *Are there any important gaps in the EU environmental hazard assessment?*

No important gaps were identified, but members of the workshop group did question why brown trout data critical to the Canadian assessment were not used in the EU assessment. Representatives from EU regulatory agencies involved in this discussion explained that EU competent authorities felt that there were methodological problems associated with this study, particularly in the measurement of exposure concentrations, which is why it was not used. However, several of the experts believed that such studies on sperm viability, along with other fish studies on, for example, secondary sexual characteristics in fathead minnow and swordtail tail length, should be re-evaluated using a reliable weight of evidence.

4. *Are reliable field data available on the effects of BPA?*

None of those present at the workshop was aware of any relevant field data for BPA. However, there is no evidence of changes in apparently sensitive snail populations in natural systems exposed to BPA, which contrasts with the situation for dogwhelks and organotins and provides some reassurance from the field.

5. *How reliable are in vitro/in vivo hazard data and what do they tell us about the endocrine activity of BPA?*

There are enough reliable data to show that BPA is clearly an endocrine disrupting chemical for several different taxa. However, the ecotoxicity in vivo data are not conclusive about BPA's potency.

6. Is there the potential for additive effects with other EDCs in the environment?

The group agreed that there is the potential for additive effects, as is the case for all endocrine active substances with the same mode of action, which occur in the environment.

7. Are all relevant environmental compartments covered by the EU risk assessment?

The group agreed that the aquatic compartment is the most important when assessing the risks of BPA. However, the potential for BPA accumulation in anaerobic sediments and wastewater sludges deserves further assessment because of the negligible degradation of BPA under such conditions.

8. Is the availability of exposure data adequate?

BPA producers have collected data on exposure concentrations, which are mostly available for surface water. Some are also available for biota, sediments, and soils. The group agreed that there should be further investigation of exposure via sediments.

Concentrations of BPA reported from Canada appear to be similar to Europe, with some apparent differences possibly due to different limits of detection.

It was agreed that a median wastewater treatment plant removal efficiency for BPA of 66% should be assumed in risk assessment. Some inefficiencies might be due to non-optimal microbes, and it should be possible to achieve up to 99% removal efficiency.

9. Is there the potential for sources/releases of BPA from derivative compounds?

Not all possible substances that might degrade to BPA have been considered in risk assessments of BPA. However, the EU assessment did consider one of the most important substances, tetrabromobisphenol-A.

Summary

The environmental experts at the Berlin workshop on BPA concluded that most environmental compartments have been adequately dealt with in the EU's BPA risk assessment, with the possible exception of sediments. The potential effects of BPA on different trophic levels and population-relevant endpoints have also been assessed appropriately and to the extent possible given available test methods.

Under REACH, a chemical is considered to be a substance of very high concern (SVHC) if it is:

- Carcinogenic, Mutagenic or toxic to Reproduction (CMR), meeting the criteria for classification in category 1 or 2 in accordance with Directive 67/548/EEC.
- Persistent, Bioaccumulative and Toxic (PBT) or very Persistent and very Bioaccumulative (vPvB) according to the criteria in Annex XIII of the REACH Regulation, and/or

- Identified, on a case-by-case basis, from scientific evidence as causing probable serious effects to human health or the environment of an equivalent level of concern as those above (e.g. endocrine disrupters)

BPA is widely and increasingly used, and is released into the environment. It is toxic at low concentrations, persistent in anaerobic sediments (and can perhaps be considered "pseudo-persistent" in some surface waters because it is continuously released from wastewater treatment plants). However, BPA is not bioaccumulative, so cannot be classified as either PBT or vPvB, nor is it a category 1 or 2 substance under Directive 67/548/EEC. This means that it could only be classified as a SVHC on the basis of an "equivalent level of concern" to substances that are PBT, vPvB or Directive 67/548/EEC category 1 or 2.

The group consensus was that although there are clearly grounds for concern about the possible environmental effects of BPA, these are insufficient to classify it as of very high concern under REACH.