EUROPEAN COMMISSION
HEALTH & CONSUMER PROTECTION DIRECTORATE-GENERAL

Directorate C - Public Health and Risk Assessment
C7 - Risk assessment

Brussels, C7/GF/csteeop/SCCPs/031003 D(03)

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

"THE SCIENTIFIC BASIS OF THE NATIONAL PROVISIONS ON SHORT CHAIN CHLORINATED PARAFFINS (SCCPS) BEING MORE RESTRICTIVE THAN THOSE LAID DOWN IN DIRECTIVE 2002/45/EC THAT THE NETHERLANDS INTENDS TO MAINTAIN IN ACCORDANCE WITH ARTICLE 95(4) OF THE EC TREATY"

Adopted by the CSTEE by written procedure on 3 October 2003

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

"THE SCIENTIFIC BASIS OF THE NATIONAL PROVISIONS ON SHORT CHAIN CHLORINATED PARAFFINS (SCCPS) BEING MORE RESTRICTIVE THAN THOSE LAID DOWN IN DIRECTIVE 2002/45/EC THAT THE NETHERLANDS INTENDS TO MAINTAIN IN ACCORDANCE WITH ARTICLE 95(4) OF THE EC TREATY"

Adopted by the CSTEE by written procedure on 3 October 2003

SUMMARY

In January 2003 the Dutch authorities requested authorisation to maintain national provisions on the use of SCCPs that are more restrictive than existing legislation. At the same time the UK has developed a draft updated RAR on SCCPs pointing to the likely PBT properties of SCCPs.

In view of these uncertainties the Commission requested the CSTEE to review the updated RAR with respect to 4 main questions relating in turn to: the appropriateness of the PBT assessment relative to the criteria in the TGD; the more classical assessment of new information on use levels using PEC to PNEC ratios; the implications with respect to current uses; and the implications with respect to the contamination of substances and preparations by SCCPs to levels up to 1%.

1. There are uncertainties associated with the classification of SCCPs as PBTs according to strict TGD criteria. However, on the basis of weight of evidence, and taking particular note of evidence on the occurrence of SCCPs in environmental compartments and top predators in remote places, we believe that the PBT classification is appropriate and that this conclusion is unlikely to be changed by more work. Throughout, though, it is important to note that SCCPs represent a broad class of substances and that not all will necessarily conform to the generalisations.

2. Classical risk characterisation carried out by PEC versus PNEC comparisons on further information after the current controls were adopted indicates that there are now concerns for the use of backcoatings in textiles (all compartments), for rubber processing at combined compounding and conversion sites (soil) and also to the regional industrial/urban environment and from wastes remaining in the environment. We agree with these assessments but note that they are based on worst case assumptions on releases and hence exposures. We note that a strict interpretation of the TGD with respect to effects on soil and sediment ecosystems would apply an extra uncertainty factor to account for uptake via food. Unlike the RAR we are of the view that such an adjustment is appropriate on the basis of available evidence on uptake and note that this would extend further the uses of concern. However, we also note that this is based on PNECs derived indirectly by equilibrium partitioning methodology and we have questioned the scientific legitimacy of this in the previous CSTEE opinion on SCCPs (1998). Similarly, we note that the ratios of PECs to PNECs for secondary poisoning give cause for concern for textile uses, taking account of fish-based, mussel-based and earthworm-based food chains. However we have serious reservations about the way the PECs were estimated in arriving at these conclusions.

3. We deal with the question of uses of SCCPs giving rise to risk in two parts; the first based on the PEC/PNEC analyses and the second based on PBT analyses.

(a) The assessments described under #2 certainly extend the areas of concern with respect to the uses of SCCPs over and above those that are already subject to controls from the initial risk characterisation. One response to this could be an immediate consideration of the need for risk reduction measures (conclusion iii). However, the uncertainties in PNECs and PECS are such that we are of the view that the scientifically more defensible response is that there is a need for further information and testing (conclusion i) and that the necessary information could be obtained relatively quickly.

(b) From #1 it is clear that we are of the view that SCCPs align with the weight of evidence interpretation of the PBT criteria as specified in the TGD. However, following a previous opinion on the marine TGD (CSTEE, 2002) we do not believe that hazard based criteria should be the sole basis for taking management action. Rather we are of the view that a PBT classification on the basis of the criteria specified in the TGD should prompt a more detailed analysis, minimally of sources and routes of entry into the marine environment, so that rational decisions can be made about management options.

4. It is difficult to make an assessment of the risks arising from SCCPs as constituents and impurities of other substances and preparations without information on the use volumes of the latter, which we did not have. However, at levels of up to 1% contamination we estimate, from simple approximations that most uses for which we have emission data would have negligible effects. However, we estimated that there may be causes for concerns relating to the environmental impacts of SCCP contaminants in MCCPs used in metal working and possibly from contamination of MCCPs used as flame retardants in plastics. These require more detailed and careful assessment.

INTRODUCTION AND TERMS OF REFERENCE

On 21 January 2003 the Netherlands submitted to the Commission a request for authorisation to maintain its national provisions on the use of SCCPs being more restrictive than those laid down in Directive 2002/45/EC.

The Directive 2002/45/EC bans the use of SCCPs as substances and as constituents of other substances and preparations in those applications in concentrations higher than 1%. This limit value, not included in the original Commission's proposal, was introduced to exclude MCCPs from the scope of the Community use restrictions.

In support of its request, the Netherlands submitted a study by a Dutch toxicologist consultant. In contrast with what the Netherlands claims, the Commission has expressed the view that this study does not highlight a risk for the Dutch aquatic environment or for the Dutch population.

Moreover, the Commission is uncertain whether results of the UK draft updated risk assessment on SCCPs indicate that the relevant available data and information are sufficient to conclude that the environmental risks highlighted therein actually exist.

On the other hand, concerns expressed by the UK in relation to the likely PBT properties of SCCPs seem to suggest that these data and information may justify the recourse to risk reduction measures based on a precautionary approach.

In view of the uncertainties in the conclusions, the CSTEE has been requested to review the updated risk assessment report produced by the United Kingdom to clarify the issues raised by the results of the report.

Terms of reference

(1) To what extent does the CSTEE agree with the conclusion of the risk assessment as to the issue of whether SCCPs fulfil the criteria of the Technical Guidance Document for PBT substances?

(2) To what extent does the CSTEE agree with the conclusion of the risk assessment as to the issue of whether one or more of the uses of SCCPs, which are currently not subject to restrictions under Directive 2002/45, could pose a risk to the environment? Does the CSTEE agree with the quantification of those identified risks[1]?

(3) In the light of questions 1 and 2, which would be the current uses of SCCPs that could give rise to risks?

(4) What is the opinion of the CSTEE with regards to the possible risks from the use of SCCPs as constituents or impurities of other substances and preparations, including MCCPs, in concentrations in the range between 0,3 and 1% in the following applications:
- in metal working;
- for fat liquoring of leather;
- as plasticisers in paints, coatings or sealant;
- as flame-retardant in rubber, plastics or textiles?

Material consulted in formulating an opinion was largely from the draft Updated Risk Assessment of Alkanes, C10-C13 Chloro (report ref. R010_0307 env) produced by the UK as Rapporteur. We also studied the "Ecotoxicological advice on chlorinated paraffins" given to the Dutch Government by Kalf and van de Plassche (1996). We made some reference to the OSPAR Priority Substance Series on Short Chain Chlorinated Paraffins (OSPAR COMMISSION, 2001) and the UNECE ad hoc Expert Group Substance Dossier on Short Chain Chlorinated Paraffins (Final Draft II, 2003).

Below we address each of the Questions in turn.

QUESTION 1

To what extent does the CSTEE agree with the conclusion of the risk assessment as to the issue of whether SCCPs fulfil the criteria of the Technical Guidance Document for PBT substances?

Below we deal with each of the three criteria in turn and then summarise our general conclusions.

P-criteria

No simulation tests have yet been carried out to determine half-lives of SCCPs in the marine environment. However, one screening biodegradation study convincingly established that SCCPs are not readily biodegradable, and in conditions that seemed to optimise the possibility of biodegradation there was limited biodegradation so that it seems unlikely that these substances are inherently biodegradable. One point of caution, noted by the Rapporteurs, is that this study was carried out well above water solubility, and whereas lipophilic substances absorbed to biomass could still be available, degradation below the water solubility cannot be ruled out. With this reservation, the screening assignment according to the TGD would certainly be that the substances are potentially P and possibly vP.

[1] See in particular tables 3.19 to 3.22 of the draft updated risk assessment report.

It is also important to note that evidence is presented in both the RAR and recently finalised UNECE assessment (see above) that SCCPs are occurring in remote areas. We are of the view that this is particularly important evidence that gives further support to the P/vP classification.

In our view, therefore, the weight of evidence suggests that SCCPs in general conform to the P/vP classification.

B-criteria

Some of the measured bioconcentration factors for fish, and the marine mussel, were above the critical thresholds for B (2000) and vB (5000) specified in the TGD. However, there are some ambiguities in the interpretation of these data relative to the guidance. The TGD thresholds are specified as single numbers and it is unclear if it is intended that all or one of the recorded data should breach the threshold for the classification to be applied. We presume that, in the first instance, a worst case interpretation should be used but note that not all data for the fish were above the thresholds (range 200 to 7800). Also the TGD allows use of BCFs from any aquatic organisms and those reported for SCCPs from marine mussels were particularly high (greater than 40000) but we were unable to corroborate this from the original reports. Also, it is known that some invertebrates, such as molluscs, can have BCFs orders of magnitude above those of fishes because of differences in uptake and metabolism.

As a general point we therefore believe that if non-fish data are used the number of B and vB chemicals will turn out to be very large and whether or not a chemical is included will depend on the availability of non-fish species. We also note that the QSARs for estimating BCFs in the TGD refer to fish BCFs There would seem to be a need for the regulatory community to clarify the B criteria so that they can be made consistent across chemicals.

From a scientific perspective we would want to note that though the B criteria in the TGD are based on BCFs, the rationale for the B criterion is related to potential for bioaccumulation. The available studies on SCCPs cover both bioconcentration from water, and toxicokinetic studies on bioaccumulation from food, as well as monitoring data; therefore, it should be possible to come to a sound conclusion on the potential of SCCPs to bioaccumulate in aquatic organisms, and the key requirement: to establish if this bioaccumulation potential increases the environmental hazard of SCCPs for aquatic ecosystems. On this there are two important and contradictory elements in the RAR. The data from Muir *et al* (2000) indicate bioaccumulation factors in lake trout from field studies one order of magnitude higher than the laboratory BCF (34000 to 114000). These results suggest that bioaccumulation plays a key role in the risk assessment of SCCPs. On the other hand, the toxicokinetic studies present relatively short half-lives of SCCPs in biota (days-weeks) suggesting a low relevance for the contribution of bioaccumulation to long-term exposure and low biomagnification potential. However, toxicokinetic modelling (following Carbonell *et al*, 2000; see Appendix) indicates that the contributions from food intake to the body burden are likely to be higher than the contribution from ambient environment with half lives of about 10days (equivalent to BAFs from food of around 2 as reported) and higher. So the exposure linked to bioaccumulation is likely to be relevant, providing further support for the B classification.

The findings of residues of SCCPs in marine mammals frequenting remote waters, e.g. beluga in the Arctic versus the St Laurence Estuary and pinnipeds from Arctic waters, give further support to the B classification of SCCPs.

In our view, therefore, the weight of evidence suggests that SCCPs in general conform to the B classification.

T-criteria

The worst case toxicity NOECs are below the threshold specified within the TGD. The CSTEE considered these to be sound data and therefore accepts that the SCCPs meet the TGD T criteria. However, from a scientific perspective we contend that the application of triggers based on toxicity from waterborne exposures and classification for CMR properties are not satisfactory for establishing the toxicity of bioaccumulable chemicals. Our suggestion is that the information on oral toxicity (fish and mammals) and the expected bioaccumulation potential, once clarified (comparing modelled body burdens from waterborne and food exposures), should be combined to establish an opinion on the relevance of toxicity from non-water exposures versus water exposures.

Conclusions

There are some uncertainties about whether the data on SCCPs fulfil the TGD criteria for PBTs. However, we believe that the weight of evidence supports the P (possibly vP), B and T criteria. Our judgement is that little would be gained from more work in terms of refining the classification according to TGD criteria. An important caveat is that several of the studies in the RAR were performed on synthetic substances that may be somewhat different from the technical products being assessed. Moreover, it is very important to appreciate that SCCPs are complex mixtures so their composition may be different in the environment from the "barrel".

QUESTION 2

To what extent does the CSTEE agree with the conclusion of the risk assessment as to the issue of whether one or more of the uses of SCCPs, which are currently not subject to restrictions under Directive 2002/45, could pose a risk to the environment? Does the CSTEE agree with the quantification of those identified risks?

In this section we refer to the classical risk characterisations involving comparisons of PECs and PNECs as risk quotients and abbreviate as RQs.

Most of the RQs for all compartments are below 1. However, for sediments and soils this depends on whether an extra factor of 10, suggested in the TGD, should be applied to take into account direct ingestion of SCCPs. Contrary to the RAR we believe that the factor should be applied according to the TGD and this is reinforced by the data of Fisk *et al* (1998) that suggest higher uptake rates for SCCPs than for MCCPs for comparable chlorination levels. This would make all RQs for the soil and sediment compartments greater than one. However, for these chemicals the derivation of a PNEC from equilibrium partitioning is not reliable as we stated in the CSTEE opinion on SCCPS of 1998**.** On the basis of current information it is therefore unclear from a scientific perspective if the risks for soils and sediments are likely to be of more or less concern than expressed in the RAR. Consequently, we would argue that management decisions would be more reliably based on experimentally derived PNECs for soil and sediment dwelling organisms and are of the view that these data could be collected relatively rapidly.

For all compartments releases arising from backcoating in textiles RQ>1. The same is the case for releases arising from rubber combined compounding and conversion sites. We agree with these assessments but would want to note that they are based on worst case assumptions with respect to releases and exposures.

The report also states (p80) that the major source of contamination of agricultural soil will be from sewage sludge. This is based on data from the UK. We also agree with the view (p80) that soil degradation may be underestimated because it is based on very conservative default values.

For marine systems all uses, except sealants and formulation of paints, give RQs>1. We agree with this assessment but again we note that it is based on worst case assumptions.

For secondary poisoning in marine food chains we have given some comments under Question 1. Moreover we have serious concerns about the estimation of PECs for biota since they are based on BCF fish plus BMF and this is not acceptable on scientific grounds. The assessment in the RAR is a combination of worst case assumptions (e.g. the highest BCF fish, when the range covers more than 2 orders of magnitude) and non-worst case assumptions (e.g. the BMF based on direct experimental studies without any toxicokinetic calculations). We believe that there are sufficient data to carry out the appropriate toxicokinetic calculations for fish but more data would be required for similar assessments in algae and invertebrates exposed via food. The exposure route through food, though not considered in the RAR, is probably the most likely explanation for the differences observed between BCFs and field BAFs in fish, and between BCFs in fish and mussels. A PNEC for aquatic invertebrates exposed via food is also required. A PNEC for secondary poisoning in fish ought to be compared with the appropriate PECs for aquatic invertebrates and fish.

Our conclusion, therefore, is that the risk assessment carried out using the classical PEC versus PNEC comparisons suggests that uses not currently subject to controls may give cause for concern in terms of environmental effects. However, this should be tempered by the observation that this assessment is based on a number of worst case assumptions that are not necessarily realistic.

QUESTION 3

In the light of questions 1 and 2, which would be the current uses of SCCPs that could give rise to risks?

The current controls under the marketing and use directive focus on metalworking and the fat liquoring of leather. The new analyses, based on more data on uses, have extended the areas of concern to the risks to the aquatic environment and sediment, from back coating of textiles and applying to the risks to the terrestrial environment from rubber and textiles and also to the regional industrial/urban environment from “wastes remaining in the environment”. In contrast to the RAR we are also of the view that there are potential concerns from most uses with respect to likely impacts on soils and sediments. One response to this could be to recommend adoption of conclusion iii, with immediate consideration of risk management. However, we believe that such a conclusion would be based on questionable science (relating to PNECs for soils and sediments and assumptions associated with the assessment of secondary poisoning). Accordingly we are of the view that conclusion i, as advocated in the RAR, is scientifically more defensible and we believe that the necessary experimental work could be effected relatively quickly. We would also want to note that as far as the industrial activities are concerned, it ought to be possible to introduce more rigorous management procedures to considerably reduce releases and hence exposures from present levels.

On the basis of weight of evidence, we believe that SCCPs fulfil the PBT classification as specified in the TGD. However, we have expressed concern about hazard-based criteria being the sole basis for risk management (CSTEE, 2002). Rather we believe, as specified in the TGD, that PBT criteria should be a prompt for more detailed analysis of risk and, minimally (as specified in the TGD), the sources, routes and pathways into the marine environment. It is on this basis that rational decisions can be taken about the need for and form of risk management. As with the Commission Communication on the precautionary principle (COM/2000/1), we would favour a structured approach to the application of the precautionary principle.

It is also important to note that the RAR suggests that for SCCPs there is a considerable amount of information available on bioaccumulation and biomagnification so that we believe that it should be possible to use this to construct medium and long-term risk assessments relatively quickly and inexpensively.

QUESTION 4

What is the opinion of the CSTEE with regards to the possible risks from the use of SCCPs as constituents or impurities of other substances and preparations, including MCCPs, in concentrations in the range between 0,3 and 1% in the following applications:

- *in metal working;*
- *for fat liquoring of leather;*
- *as plasticisers in paints, coatings or sealant;*
- *as flame-retardant in rubber, plastics or textiles?*

To answer this properly it would be necessary to know something about volume of use of the other substances and preparations in the various applications so that predicted environmental concentration of SCCPs emanating from them could be calculated and compared with the PNECs. The CSTEE believes that the only substances or preparations that may contain SCCPs are MCCPs, unless the SCCPs have been added intentionally. On the basis of information from use of MCCPs in the EU in 1997 (Risk Assessment of alkanes, C_{14-17}, chloro, Environment Draft of August 2002) the calculated quantities of SCCPs present in MCCPs used in 1997 are given in the following table:

Application	**Quantity MCCPs used 1997[1] (tonnes MCCPs/y)**	**0.3% SCCPs corresponds to (tonnes SCCPs/y)**	**1% SCCPs corresponds to (tonnes SCCPs/y)**
Metal working	5,953	18	59
Fat liquoring of leather	1,048	3	10
Plasticisers in paint, coatings or sealant	3,541	11	35
Flame retardant in rubber, plastics or textile	53,973	162	540
Total	64,515	194	644

[1] Risk Assessment of alkanes, C_{14-17} , chloro, Environment Draft of August 2002

From this table we can see that almost 10 times more SCCPs may follow MCCPs into plastics than into the other uses listed. However, we do not know the emissions of SCCPs from plastic as that has not been assessed. Moreover, it is not possible for the CSTEE to compare these calculated use volumes with the updated RAR as this is based on confidential use quantities. In the first RAR (European Union Risk Assessment Report, Alkanes, C_{10-13}, chloro, 2000) use volume in 1994 are given, but the applications are not identical to those given in this question. The assessors identified the highest risk quotients for the terrestrial compartment and these are summarised in the following table.

Application	Quantity SCCPs used 1994 (tonnes/y)	PEC/PNEC$_{local}$ terrestrial compartment
Metal working	9,380	Up to 290
Rubber	1,310	<0.92
Paints	1,150	Negligible
Sealants	695	Negligible
Leather	390	4,813
Textiles	183	Negligible
Others	100	
Total	13,208	

Data from European Union Risk Assessment Report, Alkanes, C_{10-13}, chloro, 2000.

Focussing specifically on metal workings the amount of MCCPs used in this process corresponds to ca. 60 tonnes of SCCP if these were present at 1% levels. These are considerably reduced from the 9380 tonnes before the restrictions on metal workings but this level may still lead to unacceptable risks and should be assessed in more detail.

Finally, it is important to note that there is considerable overlap in the structures of so-called SCCPs and MCCPs and this will make it even harder to effect a legally defensible distinction based on rigorous analytical techniques.

CONCLUSIONS

The weight of evidence supports the classification of SCCPs as PBTs within the context of the TGD. However, we believe that this should not automatically lead to risk management but should prompt the consideration of more detailed assessments of sources of substances and their route into the marine environment so that rational management decisions can be made.

New information on use levels and patterns suggests an extension of controls over existing legislation on the basis of the more classical PEC/PNEC analyses. We are of the view that this could be even broader than the RAR suggests if the additional uncertainty factor for soil and sediment organisms were applied. This could suggest that conclusion iii would be appropriate. However, we believe that the more defensible response would be to seek more soundly based information on effects thresholds and exposures. This would argue for conclusion i.

The implications of banning SCCPs on the use of substances such as MCCPs is difficult to assess without information on volumes of use of substitute. However, very approximate assessments on the basis of 1% contamination suggest that there would be no cause for concern for most uses for which we have information on emissions except possibly the use of MCCPs in metal workings. However there may be possible problems from contaminants in flame retardants in plastics. Contamination from MCCPs used in metal working and as fire retardants need more detailed and careful assessment.

APPENDIX

PRELIMINARY ESTIMATIONS OF THE POTENTIAL FOR BIOACCUMULATION OF SCCPs

The data on bioaccumulation presented in the RARs are contradictory. Some model estimations have been conducted to clarify the role of bioaccumulation (B criteria) in the environmental hazard and risk of SCCPs.

The original papers on bioaccumulation and concentrations measured in biota reported in the risk assessment reports where requested by CSTEE members, as some essential information is not summarised in the RARs (e.g. the BCFs are presented as ranges, with insufficient information on the experimental conditions). Unfortunately, this information has not been submitted to the CSTEE because it was considered "confidential" and/or it was in internal reports. Therefore, the original intention, to conduct a probabilistic estimation of the likelihood for bioaccumulation of SCCPs at different trophic levels was not possible.

If this information had been available, it ought to have been possible to model the potential for bioaccumulation of SCCPs, in generic marine and freshwater scenarios, refining the estimations of PECs for secondary poisoning, and including a sensitivity analysis and a risk estimation for aquatic and terrestrial vertebrates.

As an alternative, using those references published in the open scientific literature, we have carried out some toxicokinetic modelling following Carbonell *et al.* (2000) with data on *Lumbriculus* and fish, after checking that the elimination process follows first-order kinetics.

Results for BCF fish of 7000 and 1000, assuming a BCF in algae of 200 and 1000 (a higher factor should be expected from the Kow, see for example Sijm *et al.*, 1998; Hendriks *et al.* 2001) and depuration half-lives of 10 and 20 days, are presented in Figures 1 to 6.

The contribution of food intake to the body burden is equal to or higher than the contribution from water even for half-lives of 10 days (which in the model represent bioaccumulation factors from food around 2 which are in agreement with those reported).

Several model results suggest body burdens resulting from bioaccumulation from food one order of magnitude higher (or even more) than those resulting from bioconcentration from water. These model estimations are in line with the bioaccumulation factors reported from field studies (where obviously both exposure routes, water and food, are combined) and could also explain the higher BCF reported for mussels (under the assumption, not checked as the original report has not been submitted to the CSTEE, that the experimental design for mussels did not exclude the food exposure route).

Results indicate that the contribution from food intake to the body burden are likely to be higher than the contribution from ambient environment for half lives of about 10 days and higher. So, the exposure linked to bioaccumulation is likely to be relevant, and should be considered when assessing the risk of SCCPs.

The relevance of bioaccumulation processes for SCCPs supports the B classification.

Figures 1, 2 and 3. Model estimations for DT50s in fish of 10 days.

Input data:			[1st consumer]	[2sn consumer]	[3rd consumer]
Kd algae	0,5	alfa	0,8	0,8	0,8
BCF algae	200	F	0,5	0,2	0,15
kd fish	0,069	kd	0,049	0,069	0,069
BCF fish	7000				
Output					
		Estimated BAF food	8,16	2,32	1,74

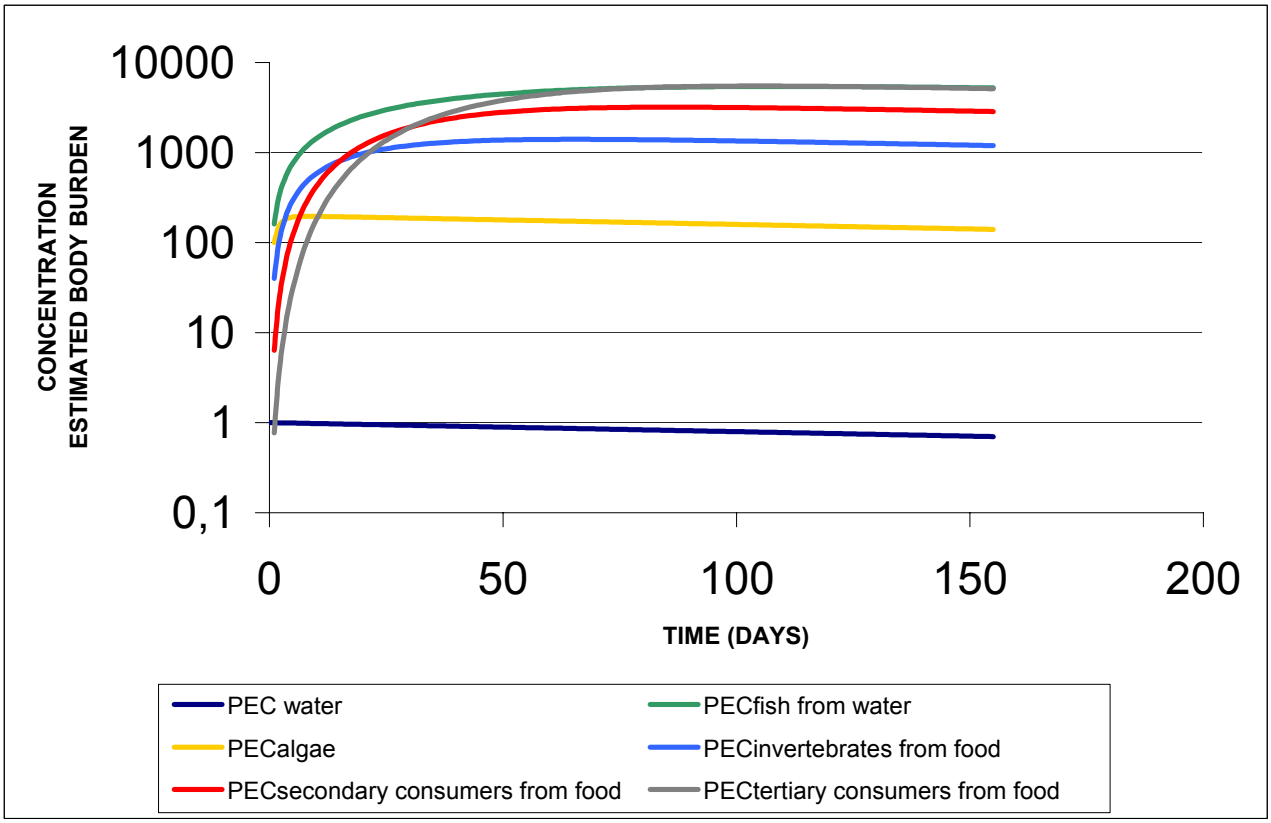

Fig. 1

Input data:			[1st consumer]	[2sn consumer]	[3rd consumer]
Kd algae	0,5	alfa	0,8	0,8	0,8
BCF algae	1000	F	0,5	0,2	0,15
kd fish	0,069	kd	0,049	0,069	0,069
BCF fish	7000				
Output					
		Estimated BAF food	8,16	2,32	1,74

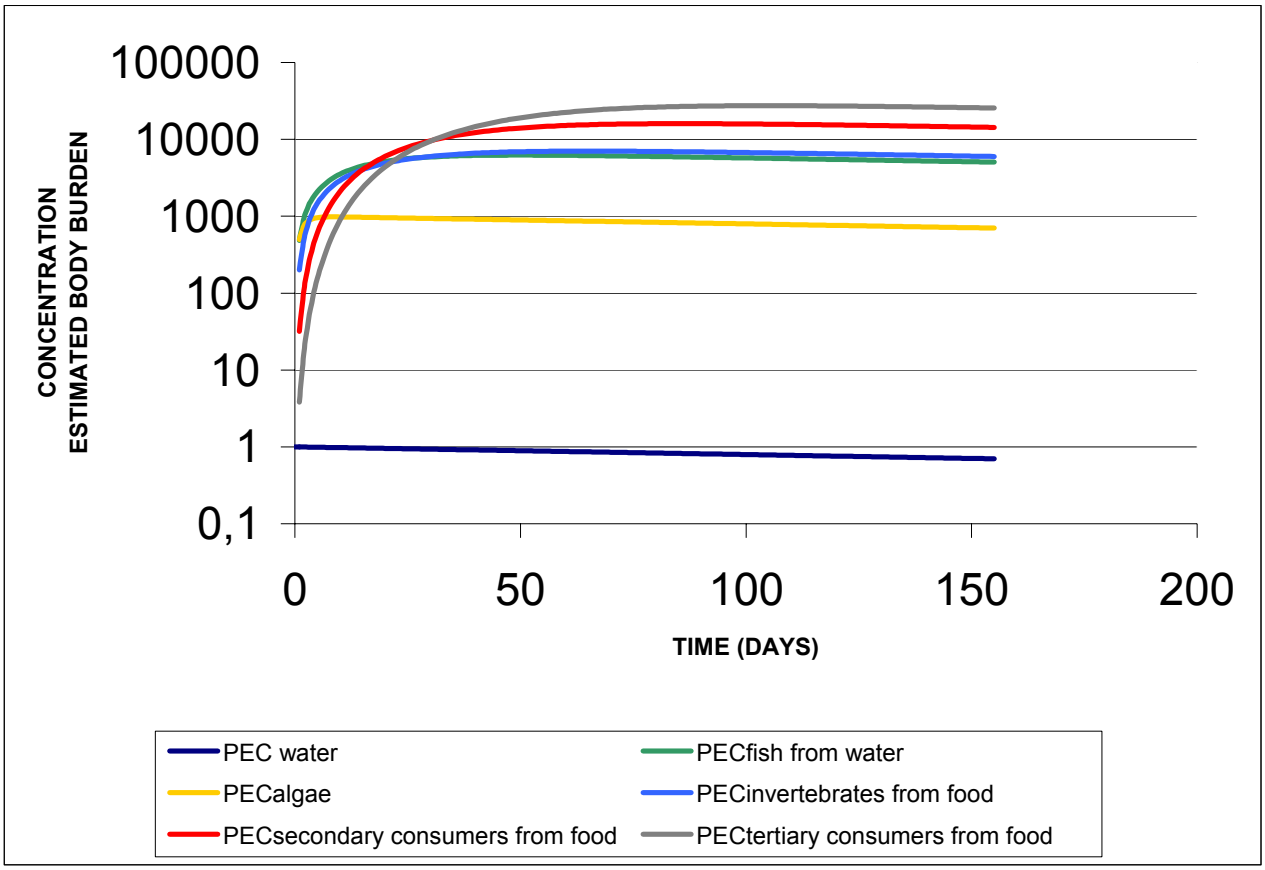

Fig. 2

Input data:			[1st consumer]	[2sn consumer]	[3rd consumer]
Kd algae	0,5	alfa	0,8	0,8	0,8
BCF algae	200	F	0,5	0,2	0,15
kd fish	0,069	kd	0,049	0,069	0,069
BCF fish	1000				
Output					
		Estimated BAF food	8,16	2,32	1,74

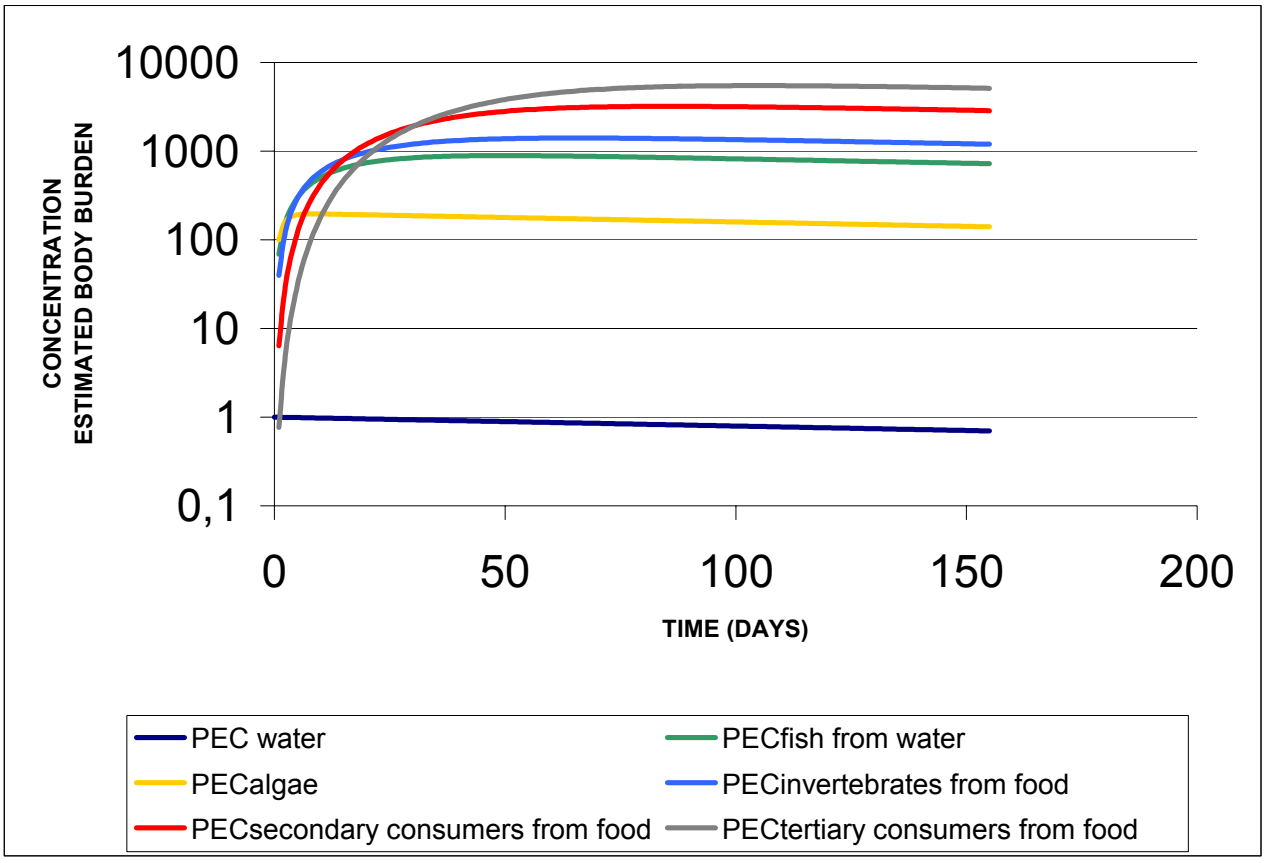

Fig. 3

Figures 4, 5 and 6. Model estimations for DT50s in fish of 20 days.

Input data:			**[1st consumer]**	**[2sn consumer]**	**[3rd consumer]**
Kd algae	0,5	alfa	0,8	0,8	0,8
BCF algae	200	F	0,5	0,2	0,15
kd fish	0,035	kd	0,049	0,035	0,035
BCF fish	7000				
Output					
		Estimated BAF food	8,16	4,57	3,43

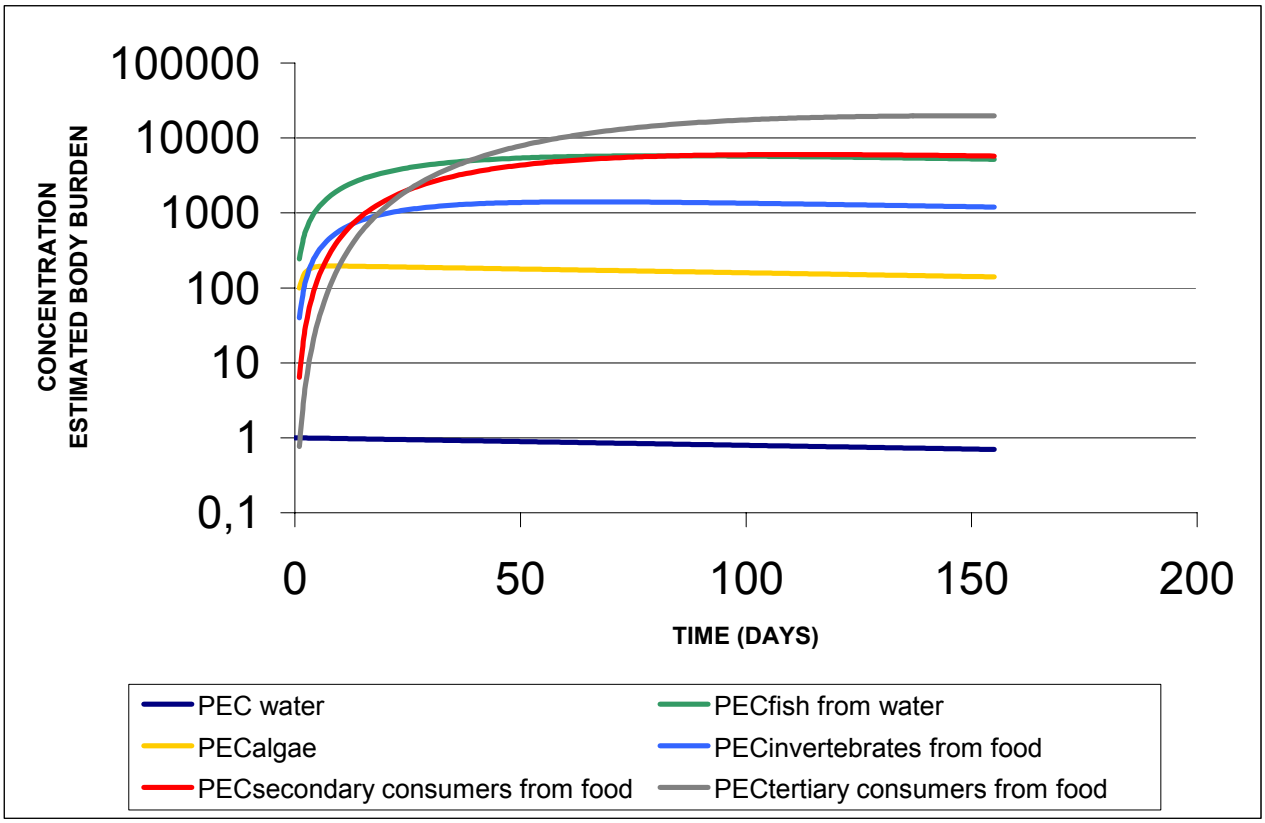

Fig. 4

Input data:			[1st consumer]	[2sn consumer]	[3rd consumer]
Kd algae	0,5	alfa	0,8	0,8	0,8
BCF algae	1000	F	0,5	0,2	0,15
kd fish	0,035	kd	0,049	0,035	0,035
BCF fish	7000				
Output					
		Estimated BAF food	8,16	4,57	3,43

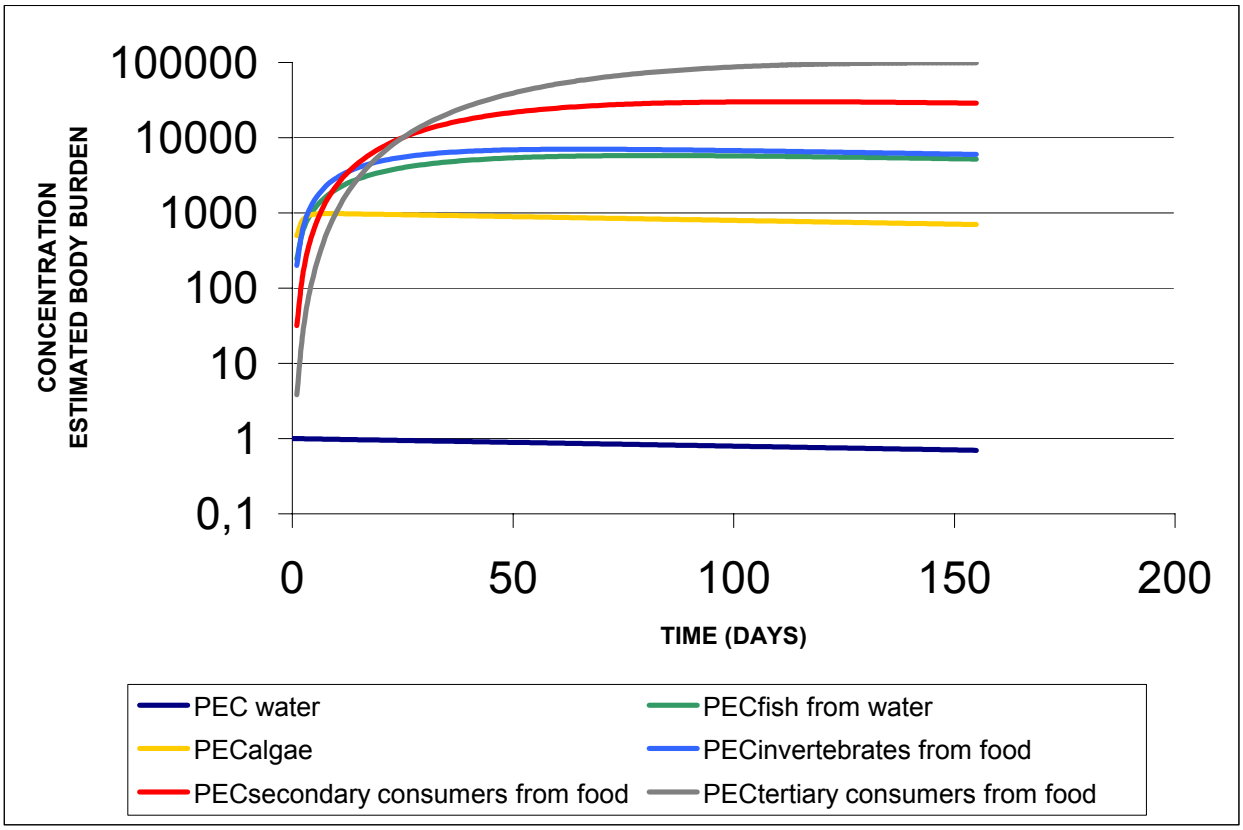

Fig. 5

Input data:			[1st consumer]	[2sn consumer]	[3rd consumer]
Kd algae	0,5	alfa	0,8	0,8	0,8
BCF algae	200	F	0,5	0,2	0,15
kd fish	0,035	kd	0,049	0,035	0,035
BCF fish	1000				
Output					
		Estimated BAF food	8,16	4,57	3,43

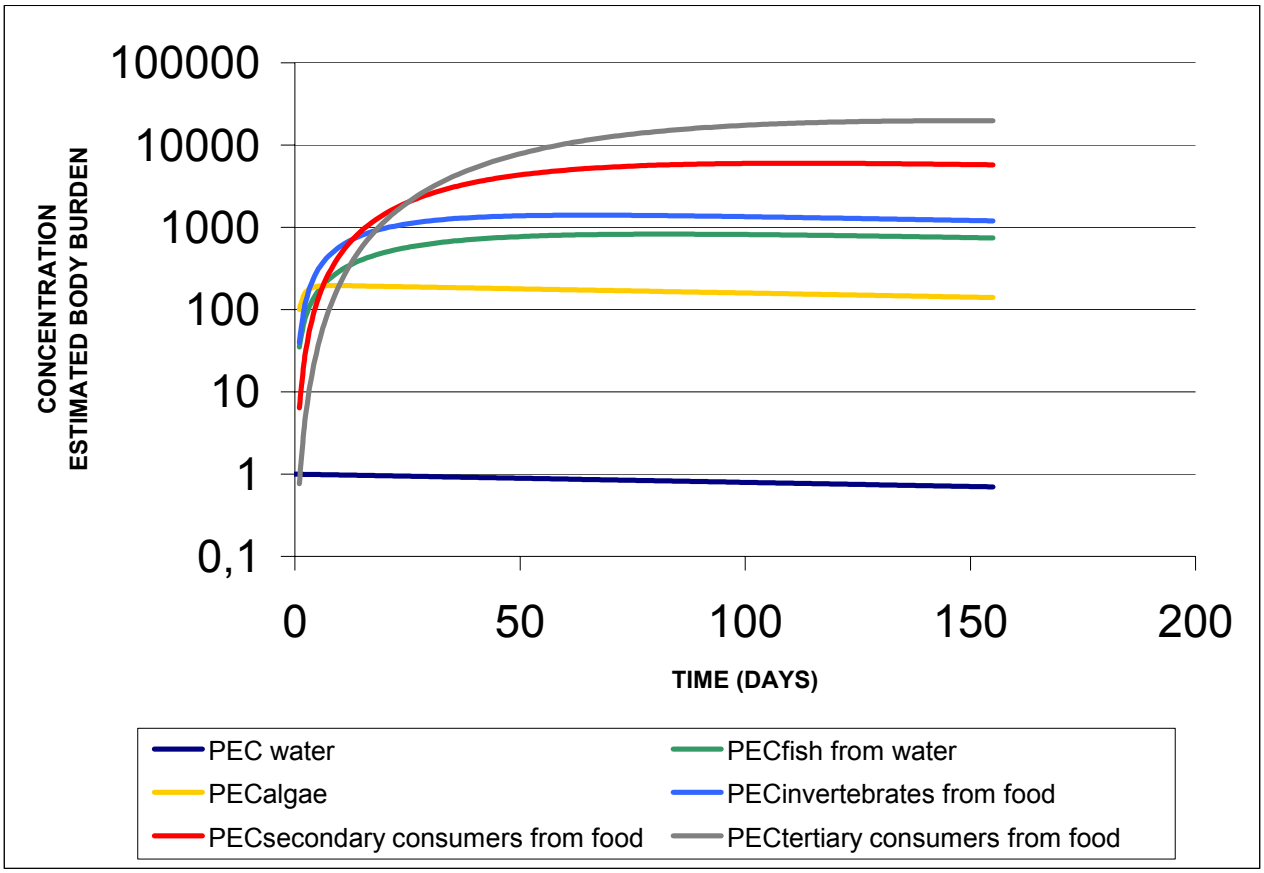

Fig. 6

REFERENCES

Carbonell G, Ramos C, Pablos MV, Ortiz JA, Tarazona JV (2000) A system dynamic model for the assessment of different exposure routes in aquatic ecosystems. The Science of the total environment 247: 107-118.

CSTEE (1998) Opinion on the results of the Risk Assessment of Alkanes, C10-13, chloro {SCCP} carried out in the framework of Council Regulation (EEC)793/93 on the evaluation and control of the risks of existing substances. (Opinion expressed at the 6th CSTEE plenary meeting, Brussels, 27 November 1998). http://europa.eu.int/comm/food/fs/sc/sct/out23_en.html

CSTEE (2002) Opinion on the TGD Draft revision version on Part 3/B - Environmental Risk Assessment - Marine Part. (Opinion expressed by written procedure on 25 January 2002). http://europa.eu.int/comm/food/fs/sc/sct/out152_en.pdf

Jan Hendriks A, van der Linde A, Cornelissen G, T.H.M. Sijm, D (2001) The power of size. 1. Rate constants and equilibrium ratios for accumulation of organic substances related to octanol-water partition ratio and species weight. Environmental Toxicology and Chemistry 20(7): 399-1420.

Sijm, T.H.M. D, Broersen, Kelvin W. de Roode, Daphne F, Mayer P (1998) Bioconcentration kinetics of hydrophobic chemicals in different densities of *Chlorella pyrenoidosa*. Environmental Toxicology and Chemistry 17(9): 1695-1704.

van Haelst AG, Loonen H, van der Wielen FW, Govers HA. (1996) Comparison of bioconcentration factors of tetrachlorobenzyltoluenes in the guppy (*Poecilia reticulata*) and zebra mussel (*Dreissena polymorpha*). Chemosphere. 32(6): 1117-22.