Common Implementation Strategy for the Water Framework Directive

Environmental Quality Standards (EQS)

Substance Data Sheet

Priority Substance No. 8

Chlorfenvinphos

CAS-No. 470-90-6

Final version
Brussels, 15 January 2005

Disclaimer

This data sheet provides background information on the setting of the Environmental Quality Standard in accordance with Article 16 of the Water Framework Directive (2000/60/EC). The information was compiled, evaluated and used as outlined in the Manual [4] and has been discussed in a consultative process with the Expert Advisory Forum on Priority Substances and the Expert Group on Quality Standards. Furthermore, it has been peer-reviewed by the SCTEE[18]. The substance data sheet may, however, not necessarily represent the views of the European Commission.

New upcoming information was considered and included up to the date of finalisation of this data sheet. Information becoming available after finalisation of this document will be evaluated in the review process of priority substances according to Art. 16(4) of the Water Framework Directive. If necessary, the Environmental Quality Standard substance data sheets will then be revised in the light of technical and scientific progress.

1 Identity of substance

Priority Substance No: 8	Chlorfenvinphos
CAS-Number:	470-90-6
Classification WFD Priority List [*]:	PS

* PS: priority substance; PHS: priority hazardous substance; PSR: priority substance under review according to Decision 2455/2001.

2 Proposed quality standards

2.1 Overall quality standards

Ecosystem	**Quality Standard**	**Comment:**
AA-QS All types of surface waters in the scope of the WFD:	0.1 µg/l	The QS refers to the protection of the pelagic community see 8.3 & 8.6
MAC-QS (ECO)	0.3 µg/l	see section 8.1

2.2 Specific quality standards

Protection Objective [#]	**Quality Standard**	**Comment:**
Pelagic community (freshwater & saltwater)	0.1 µg/l	see section 8.1
Benthic community (freshwater & marine sediment)	derivation of QS not required	sorption to sediment presumably low, trigger value for QS derivation not met; see section 8.2
Predators (secondary poisoning)	$QS_{secpois.biota}$: 33 µg/kg food $QS_{secpois.water}$: 0.19 µg/l	see section 8.3
Food uptake by man	$QS_{hh.food}$: 304 µg/kg fishery products $QS_{hh.food.water}$: 1.79 µg/l	see section 8.4
Abstraction of water intended for human consumption (AWIHC)	< 1 µg/l	A1-value for Σpesticides in CD 75/440/EEC; see section 8.5
Water intended for human consumption (WIHC)	0.1 µg/l	Drinking water standard set in CD 98/83/EC

[#] If justified by substance properties or data available, QS for the different protection objectives are given independently for freshwater environments, transitional waters or coastal and territorial waters

3 Classification

R-Phrases and Labelling	Reference
T+; R28 - T; R24 - N; R50-53	[19]

4 Physical and chemical properties

Property	Value	Reference
Vapour pressure	0.5 x 10^{-4} Pa (E-isomer), 3.7 x 10^{-4} Pa (Z-isomer) (25 °C) 1 x 10^{-3} Pa (25 °C) [2]	[8] [5]
Henry's law constant		
Solubility in water	121 mg/L (Z-isomer), 7.3 mg/L (E-isomer) (20 °C) 145 mg/L (23 °C) [2], [4]	[9] [5]
Dissociation constant		

5 Environmental fate and partitioning

Property	Value	Ref.
Hydrolytic stability (DT_{50})	Z-isomer: 262 d (pH 4), 270 d (pH 7), 88 d (pH 9) E-isomer: 275 d (pH 4), 204 d (pH 7), 71 d (pH 9)	[10]
Photostability (DT_{50}) (aqueous, sunlight, state pH)	482 hr (Z-siomer to E-isomer)	[10]
Readily biodegradable (yes/no)	No	[11]
Degradation in Water/sediment -DT_{50} water - DT_{50} whole system	 26.4 – 29.8 d (20 °C) 70 d (10 °C) 7 d (25 °C) 34.5 – 41.6 d (20 °C; river water - sediment) 38 - 40.3 d (20 °C; river water - sediment)	 [12] [5] [5] [12] [5]
Distribution in water / sediment systems (active substance)		
Residues relevant to the aquatic environment		
Partition co-efficient (log P_{OW}) Koc	3.85 (Z-isomer), 4.22 (E-isomer) log Koc: 2.68 (experimental); 1.97 (calculated) 4.22 3.82	[9] [7] [5] [7]
BCF (fish) Pimephales promelas Oncorhynchus mykiss Oncorhynchus mykiss	 37-460 66-103 27 - 103	 [5] [5] [1]

6 Effect data (aquatic environment)

6.1 Single species studies

Table 6.1: Overview on Chlorfenvinphos aquatic toxicity data (single species tests) from different sources (master reference)

Species	Taxon. Grp.	Medium *	Duration	Effect	Endpoint	Value	Unit	Master Ref.	Reference in master ref.
Freshwater:									
Daphnia magna	Crustacea	fw	21 d	Reproduction	NOEC	0.1	µg/l	[5]	PSM-Datenbank
Oncorhynchus mykiss	Pisces	fw	21 d		NOEC	32	µg/l	[5]	PSM-Datenbank
Oncorhynchus mykiss	Fish	fw	21 d	Clinical Effects	NOEC	38	µg/l	[1]	PSD (1994)
Scenedesmus subspicatus	Algae	fw	96 h	Growth	NOEC	246	µg/l	[1]	PSD (1994)
Selenastrum capricornutum	Algae	fw			NOEC	330	µg/l	[6]	RIVM Report 601501002
Daphnia magna	Crustacea	fw	21 d		LOEC	<0.3	µg/l	[1]	PSD (1994)
Daphnia magna	Crustacea	fw	48 h	Mortality	LC50	0.1	µg/l	[1]	Bogacka and Groba (1980)
Daphnia magna	Crustacea	fw			L(E)C50	0.2	µg/l	[6]	RIVM Report 601501002
Daphnia magna	Crustacea	fw	48 h		EC50	0.25	µg/l	[5]	PSM-Datenbank
Ceriodaphnia dubia	Crustacea	fw	48 h	Mortality	LC50	0.4	µg/l	[1]	Ankley et al (1991)
Pteronarcys californica	Insecta	fw	96 h	Mortality	LC50	0.7	µg/l	[1]	Mayer and Ellersieck (1986)
Daphnia magna	Crustacea	fw	48 h		EC50	1.8	µg/l	[1]	Harman (1997)
Lepomis macrochirus	Pisces	fw			L(E)C50	2.8	µg/l	[6]	RIVM Report 601501002
Chironomus tepperi	Insecta	fw	24 h	Mortality	LC50	6	µg/l	[5]	Stevens 1992
Gammarus fasciatus	Crustacea	fw			L(E)C50	9.6	µg/l	[6]	RIVM Report 601501002
Gammarus lacustris	Crustacea	fw	48 h		LC50	13	µg/l	[5]	Samders 1969
Tilapia nilotica	Pisces	fw			L(E)C50	39	µg/l	[6]	RIVM Report 601501002
Oncorhynchus mykiss	Pisces	fw			L(E)C50	510	µg/l	[6]	RIVM Report 601501002
Cyprinus carpio	Pisces	fw			L(E)C50	900	µg/l	[6]	RIVM Report 601501002
Scenedesmus quadricauda	Algae	fw	10 d	Chlorophyll content	EC50	1000	µg/l	[5]	PSM-Datenbank
Selenastrum capricornutum	Algae	fw	96 hd	Growth	EC50	1600	µg/l	[5]	PSM-Datenbank
Ictalurus melas	Pisces	fw			L(E)C50	4000	µg/l	[6]	RIVM Report 601501002
Bufo vulgaris formosus	Amphibia	fw	24 h	Mortality	LC50	4500 - 5300	µg/l	[5]	Nishiuchi 1980
Saltwater:									
Mytilus galloprovincialis	Mollusca	sw	4 d	Mortality	NOEC	7600	µg/l	[5]	Serramo et al. 1995
Fundulus sp.	Pisces	sw			L(E)C50	230	µg/l	[6]	RIVM Report 601501002
Penaeus azeteus	Crustacea	sw	48 h		EC50	250	µg/l	[1]	Butler (1964)
Crassostrea virginica	Mollusca	sw	4 d	Morphology	EC50	600	µg/l	[5]	Butler 1965
Leiostomus xanthurus	Pisces	sw	48 h		EC50	1000	µg/l	[1]	Butler (1964)
Mytilus galloprovincialis	Mollusca	sw	4 d	Mortality	LC50	26300	µg/l	[5]	Serramo et al. 1995

*: fw = freshwater, sw = saltwater

6.2 Multi species studies

BASF AG submitted the report of a confidential study[1] on the evaluation of acute and chronic effects of a formulation of chlorfenvinphos on zooplankton in outdoor aquatic enclosures [15]. The evaluation was based on species richness and abundance during exposure to the test substance in naturalised pond water.

A 240 g/L EC (emulsifiable concentrate) formulation of chlorfenvinphos was applied to a series of outdoor aquatic enclosures (approximately 1 m³ volume) with a sediment layer at the bottom. The test substance was applied in summer (6 August) to the enclosures at treatment rates of (nominal) 0.0, 0.05, 0.5, 5.0, 50 and 100 µg active ingredient per litre. Biological sampling of the enclosures took place over the next 91 days (until temperatures dropped below 0ºC) and the zooplankton sampled were identified and counted. Statistical analysis of the data was undertaken using ANOVA and Friedmans analysis of ranks. Comparisons with control enclosures were made using Dunnetts multiple comparison procedure.

There were treatment-related effects following application of chlorfenvinphos on two groups, *Chaoborus* (Insecta, Diptera) populations at the two highest treatment levels (50 and 100 µg ai/L) and *Cladocera* (Crustacea, daphnids) populations at the three highest treatment levels (5.0, 50 and 100 µg ai/L) Numbers of cladoceran individuals per litre dropped down close to zero within 21 days post application at all three mentioned treatment levels with no recovery seen during the study. No treatment related effects on *Cladocera* populations were observed at 0.05 and 0.5 µg ai/L. The NOEC (initial concentration, nominal) based on the impact on *Cladocera* populations was 0.5 µg ai/l and the LOEC 5.0 µg ai/L.

The toxicity endpoints (NOEC, LOEC) reported in the above study are calculated on the basis of the initial concentrations of chlorfenvinphos. This is in line with the “edge of a field” exposure scenario usually used in the risk assessment for plant protection products (PPPRA). However, this scenario has only very limited relevance for the exposure conditions that might prevail in water bodies draining an agricultural area. The exposure pattern in the water courses of a river basin might be best characterized as prolonged exposure over the entire period in that an active substance is used and also for a while thereafter, however at levels normally lower than the PEC estimates of the PPPRA. The duration of the “post-use” exposure period will be dependent on the properties of the active substance and the prevailing hydrological and climatic conditions. As for any other priority substance, the long-term water quality standard for a PPP under the WFD must therefore refer to an average concentration over a prolonged time interval (i.e. the AA-QS).

This different exposure pattern has implications with respect to the interpretation of results of (Higher-Tier) toxicity studies with plant protection products that do not rapidly dissipate. It is of particular importance that all effects observed (and all NOECs derived, respectively), are related to the time weighted average concentration (C_{TWA}) between application (onset of effects) and onset of recovery in order to render the study results applicable for the derivation of a quality standard in the context of the WFD. Hence, long-term undisturbed function and lack of impact on community structure of aquatic ecosystems at a prevailing average concentration level set by the QS is the protection objective under the WFD. These lines for interpretation of results obtained in Higher-Tier studies of plant protection products are outlined in further detail in the Manual (section 4.3.5) [4]. The NOEC and LOEC values reported in the study submitted by BASF [15] were recalculated accordingly (see Annex 1). The NOEC and LOEC of the study, taking the time weighted average concentrations into account, are:

$LOEC_{TWA}$: 2.8 µg/l **$NOEC_{TWA}$: 0.2 µg/l**

[1] Conducted in accordance with the principles and following codes of Good Laboratory Practice (GLP)

6.3 Mammal and bird oral toxicity data

Table 6.2: Mammal and bird oral toxicity data relevant for the assessment of non compartment specific effects relevant for the food chain (secondary poisoning)

Type of study	Species, test result	Reference
Long-term toxicity to mammals	Adverse effects on reproduction (2 generation study with rats, oral uptake) NOAEL = 0.05 mg/kg bw/d	FAO 1994, in [17]
Long-term toxicity to mammals	Chronic NOEC in rat (2-year) 1 ppm in diet (no toxic effects observed in the parent animals including reproduction parameters nor in the F1 or F2 pups nor on cholinesterase activity in the parent animals; at 10 ppm increased litter mortality and postnatal loss in the parental generation)	[13]
Acute oral toxicity to birds	Common starling (etourneau commun) - LD50 : 3.2 mg/kg bw/d	Shell Chimie, in [17]
Acute oral toxicity to birds	Northern Bobwhite LD_{50} (7 day) 99.8 mg/kg body wt	[14]

6.4 Summary on endocrine disrupting potential

Table 6.3: Information on ED potential of chlorfenvinphos

Comment	Reference
There is insufficient data on chlorfenvinphos available (in the BKH-report)	[2]

7 Effect data (human health)

Table 7.1: Relevant effect data for human health assessment

ADI-Value	Reference
0.0005 mg/kg bw/d	FAO/WHO 1994, in [17]

8 Calculation of quality standards

8.1 Quality standards for water

Freshwater

Aquatic toxicity data (single species tests) collated from different sources are summarized in table 6.1. The results of a zooplankton study conducted in outdoor, aquatic enclosures are discussed and interpreted in section 6.2 and Annex 1.

Freshwater crustaceans are the species that are most sensitive to chlorfenvinphos. Fish and algae appear to be less susceptible. The lowest chronic endpoint reported from a single species test is the 21 d NOEC of 0.1 µg/l for reproduction of *Daphnia magna*. The time weighted NOEC calculated on the basis of a zooplankton study conducted in outdoor enclosures [15] is 0.2 µg/l. In this study, cladocerans (daphnids) were the most sensitive species as well (see section 6.2 and Annex 1 of this data sheet).

It is suggested to derive the $QS_{freshwater}$ on the basis of the $NOEC_{TWA}$ of 0.2 µg/l (time weighted average concentration) of the zooplankton study [15]. The $LOEC_{TWA}$ of this study was 2.8 µg/l, however, this concentration caused already a drop in the cladoceran population close to zero individuals per litre[2] without any sign of recovery seen throughout the duration of the study (i.e. a factual extermination of the population). It is therefore not possible to determine the margin of safety of a $NOEC_{TWA}$ of 0.2 µg/l to the concentration that might only have a slight impact on the cladoceran population. However, the initial short term concentration peak of slightly more than 0.6 µg/l in the first 2-3 days after dosing did not cause any detectable effects. Therefore, the $NOEC_{TWA}$ is believed to provide a sufficient level of protection against adverse effects of chlorphenvinphos on the pelagic community. However, in account of the scope of protection of a quality standard under the WFD, which includes the protection of all types of surface waters, i.e. also those that might significantly differ from the type of water body tested (e.g. different flow regimes or trophic status; see reference [16] for details), it is suggested to apply an additional assessment factor of 2 on the $NOEC_{TWA}$ of 0.2 µg/l.

$QS_{freshwater}$ = NOEC 0.2 µg/l / AF (2) = 0.1 µg Chlorfenvinphos /l

Koc values between approximately 4 and 480 have been estimated for chlorfenvinphos (see section 5 of this data sheet). Hence, the log Kp_{susp}[3] is <1.7 and the trigger criterion to calculate the corresponding concentration to the $QS_{freshwater}$ in SPM is not met (see sections 4.2 and 4.3.1 of the Manual [4]).

Transitional, coastal and territorial waters

Tests with both freshwater species and marine fish, crustacean and mollusc species (which are of comparable sensitivity) have been submitted (see table 6.1). Although there are only a few - mainly

[2] In the report of the zooplankton study [15], numbers of zooplankton counts per litre are not reported. Only diagrams are included in the report showing development of populations with time post application of chlorfenvinphos as line drawings. In the diagram that refers to the LOEC treatment level, the number of cladoceran individuals seems to drop down to zero (i.e. extermination of the population). However, due to the scale of the diagrams it is not possible to conclude with certainty that the cladoceran counts were really zero and not slightly above 0. (The counts in the treatment levels (control and nominal 0.05 and 0.5 µg/l, respectively) below the LOEC-level were variable, but normally in the range of 15-50 individuals per litre.)

[3] Kp_{susp} is the partition coefficient solid-water in suspended matter = Koc * foc (with foc 0.1; see TGD section 2.3.5.3 [3]). For the calculation of the Kp_{susp} (Koc * 0.1) it is suggested to use a Koc of 480 obtained from the experimental log Koc 2.68 used in [7].

short term acute - tests with salt water species reported, the sensitivity of marine fish and molluscs for chlorfenvinphos is comparable with the sensitivity of freshwater fish.

Chlorfenvinphos is an organophosphate insecticide and acaricide exerting its effect by inhibition of cholinesterase activity in the nervous system of the target species. Hence, it is suggested that marine taxa in general, are unlikely to be significantly more sensitive to this plant protection product than taxa living in freshwater. Freshwater crustaceans are the most sensitive organisms and an additional marine assessment factor need not be used. It is therefore suggested to set the same quality standard for transitional, coastal and territorial waters as proposed for the protection of the pelagic community in freshwater.

$QS_{saltwater}$ = $QS_{freshwater}$ = 0.1 µg Chlorfenvinphos / l

Quality standard accounting for transient concentration peaks (MAC-QS)

Acute toxicity data are available for fish, crustaceans, algae, insects, amphibia, and molluscs. An EC50 of 0.1 µg/l obtained with *Daphnia magna* is the lowest acute toxicity value reported from a single species test (see table 6.1). However, in a zooplankton study [15] conducted in outdoor enclosures (see section 6.2), no effects on cladocerans (daphnids, the most sensitive species in the study) were observed after a single application of 0.5 µg/l nominal concentration of chlorfenvinphos. The measured concentrations were 0.67 µg/l at day 0 immediately after application and 0.59 µg/l 2 days post treatment (see table A1-2 in annex 1). The average concentration over 2 days (≈ duration of an acute daphnia single species test) was hence 0.63 µg/l. It is suggested to derive the MAC-QS on the basis of this concentration value. In line with the considerations laid down in the section on the derivation of the annual average $QS_{freshwater}$, it is suggested to divide the value of 0.63 µg/l by an assessment factor of 2 in order to derive the MAC-QS.

MAC-QS = 0.63 µg/l / AF (2) = 0.3 µg Chlorfenvinphos /l

8.2 Quality standard for sediment

The log Kp_{susp} of chlorfenvinphos is <1.7 (see footnote 1) and therefore the trigger criterion to calculate a sediment quality standard is not met.

8.3 Secondary poisoning of top predators

Chlorfenvinphos is classified as very toxic if swallowed and has a worst case BCF > 100 (see section 5 of this data sheet). Thus the trigger criteria to derive a quality standard referring to the protection of top predators from secondary poisoning are met (see table 1a of the Manual [4]).

According to the TGD $NOECs_{food}$ from feeding studies with mammals or birds are acceptable to assess secondary poisoning (see section 4.3.2.5 of the Manual [4]).

For chlorfenvinphos data from long-term oral toxicity studies with rats are available (see table 6.2).

1. The NOAEL of 0.05 mg/kg bw d from feeding studies with rats can be transformed to a $NOEC_{food}$ by multiplying it with a conversion factor of 20 (for rat, see table 22 of [3]).

   $NOEC_{food}$ = NOAEL (0.05 mg) * CONV (20) = 1 mg/kg biota tissue (wet wt)

2. This $NOEC_{food}$ is the same than the NOEC obtained in a confidential study conducted by RCC [13] ($NOEC_{food}$ of 1 ppm ≅ 1 mg/kg food).

The $NOEC_{food}$ of 1 mg/kg food can be transformed to a PNEC by division with an assessment factor of 30 (see TGD [3]). The $PNEC_{food}$ is equivalent to the "save" concentration in the prey of predators and thus is the quality standard for biota ($QS_{secpois.biota}$).

$QS_{secpois.biota}$ = 1 mg/kg food / AF (30) = 33 µg Chlorfenvinphos / kg prey (wet wt)

A BCF_{fish} of 170[4] is used to calculate the concentration in water that corresponds to the $QS_{secpois.biota}$. No information is available on observations regarding the biomagnification potential of chlorfenvinphos.

However, as the relevant BCF is <2000, the use of a default BMF as proposed in the TGD for substances with a BCF >2000 is not required (see sections 4.3.2.5 of the Manual). Consequently, the $QS_{secpois.water}$ is calculated as follows:

$QS_{secpois.water}$ = $QS_{secpois.biota}$ (33 [µg/kg]) / BCF (170 [kg/l]) = 0.19 µg Chlorfenvinphos /l

Thus, the protection of of the pelagic community does require a lower quality standard than the protection of predators from secondary poisoning (i.e. predators are protected by the QS for freshwater or saltwater).

8.4 Quality standard referring to food uptake by humans

Chlorfenvinphos is classified as very toxic if swallowed and has a worst case BCF > 100 (see section 5 of this data sheet). Thus the trigger criteria to derive a quality standard referring to the protection of humans from adverse effects on health due to the ingestion of food from aquatic environments are met (see table 1b of the Manual [4]).

An acceptable daily intake for chlorfenvinphos was estimated by FAO/WHO 1994 (ADI = 0.5 µg / kg bw d^{-1}).

In the final report [4] it is suggested that the ADI may not be exhausted for more than 10% by consumption of food originating from aquatic sources. For a person weighing 70 kg this results in an acceptable daily intake of 35 µg chlorfenvinphos per day.

The average fish consumption of an EU citizen is 115 g d-1 (TGD [3]). Thus, 115 g edible fish tissue (or fishery products) must not contain more than 35 µg chlorfenvinphos.

$$QS_{hh.food} = \frac{35\ \mu g\ chlorfenvinphos}{115 g\ seafood\ consumption} * 1000\ g = \textbf{304 µg Chlorfenvinphos / kg}\ \text{fishery products}$$

In the TGD approach for the assessment of secondary poisoning (see 4.3.2.6 of the Manual [4]) it is foreseen to consider bioconcentration and biomagnification as relevant factors affecting body burdens and the PEC, respectively. If no information on BMF values is available, it is proposed in the TGD to use default BMFs for substances with a BCF_{fish} >2000. However, as the BCFfish of chlorfenvinphos is lower than the trigger value, biomagnification needs not to be considered and the water concentration corresponding to the $QS_{hh.food}$ can be calculated as follows:

[4] The BCF_{fish} of 170 l/kg is the geometric mean of the higher end of the BCF ranges reported for 2 different fish species in section 5 of this data sheet.

$$\mathbf{QS_{hh.food.water}} = \frac{QS_{hh.food}\ (304\ [\mu g/kg])}{BCF\ (170\ [l/kg])} = \mathbf{1.79\ \mu g\ Chlorfenvinphos\ /\ l}$$

Thus, the quality standard required to protect human health from adverse effects due to ingestion of fishery products is not as low as the respective standards required for the protection of top-predators from secondary poisoning or for the protection of the freshwater and saltwater pelagic communities.

8.5 Quality standard for drinking water abstraction

The imperative A1 value referring to drinking water abstraction by simple treatment is 1 µg/l for the total amount of pesticides (Council Directive 75/440/EEC). The drinking water standard (DWS) set in CD 98/83/EC is 0.1 µg/l for individual pesticides.

The DWS is a limit value never to be exceeded at the tap. The MAC-QS (ECO) derived for the protection of the freshwater community (0.3 µg/l) may therefore not suffice to allow for compliance with the DWS if only simple purification techniques (category A1 of CD 75/440/EEC, i.e. filtration and disinfection) are used for the abstraction of drinking water from surface water bodies according to Art. 7 of the WFD.

An assessment by experts in drinking water technology with regard to the question which fraction of the amount of chlorfenvinphos present in raw water can be removed by usual simple treatment procedures might be helpful. If the respective fraction were known, this figure could be used together with the drinking water standard to set the maximum acceptable concentration in surface water bodies designated for the **a**bstraction of **w**ater **i**ntended for **h**uman **c**onsumption (AWIHC).

MAC-QS (AWIHC) = DWS (0.1 µg/l) / fraction not removable by simple treatment

8.6 Overall quality standard

The quality standard derived for the protection of the pelagic community is the lowest specific quality standard calculated and therefore suggested as overall annual average quality standard (AA-QS). If the drinking water standard is exceeded in areas designated for the abstraction of water intended for human consumption in accordance with Art. 7 of the WFD, specific measures need to be taken in order to guarantee compliance with the drinking water standard at the tap.

9. References

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[4] Manual of the Methodological Framework Used to Derive Environmental Quality Standards for Priority Substances of the Water Framework Directive. Peter Lepper, Fraunhofer-Institute Molecular Biology and Applied Ecology, 15 November 2004. Available at the internet-site of the European Commission: http://europa.eu.int/comm/environment/water/water-dangersub/pri_substances.htm

[5] Frimmel, FH et al., 2001: Ableitung von Qualitätszielen für Kandidatenstoffe der prioritären Liste für die EU-Wasserrahmenrichtlinie. Projektbericht zum Forschungsvorhaben. Substance data sheet for chlorfenvinphos

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[13] Dotti, A. et al.; 1993: Two generation reproduction study with chlorfenvinphos in the rat. Report part 1. RCC Report 271833, unpublished, property of BASF AG. (Summary of the study available to FHI, provided by BASF AG)

[14] Troup, R. and Ahmed, M. 1997. Acute Toxicity Screening Study with Chlorfenvinphos in Northern Bobwhite (Colinus virginianus). Genesis Laboratories, Wellington, CO, USA, unpublished Report No. N97006. (Study not available to FHI. Data and reference provided by BASF AG)

[15] Child, P, G Mitchell, L Wyness, D Wilson, E Farrelly; 1998: Evaluation of Acute and Chronic Effects of a 240g/L EC Formulation (CF02395) of AC 58085 (chlorfenvinphos) on Zooplankton in Outdoor, Aquatic Enclosures. Covance Laboratories, Harrogate, North Yorkshire, UK. © American Cyanamid Company, Report Number ECO 96-336. Unpublished.

[16] Compatibility of “Acceptable Concentrations” Derived in the Higher-Tier Aquatic Risk Assessment for Plant Protection Products with the Objectives of Surface Water Quality Standards in the Context of the Water Framework Directive. Paper disseminated at: (i) The workshop of the Expert Group on Quality Standards, 12-16 May 2003, Brussels, (ii) The 5th Expert Advisory Forum on Priority Substances, 26-27 May 2003, Brussels.

[17] Agritox database: http://www.inra.fr/Internet/Produits/agritox/

[18] Opinion of the Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE) on "The Setting of Environmental Quality Standards for the Priority Substances included in Annex X of Directive 2000/60/EC in Accordance with Article 16 thereof", adopted by the CSTEE during the 43rd plenary meeting of 28 May 2004, European Commission Health & Consumer Protection Directorate General, Brussels. http://europa.eu.int/comm/health/ph_risk/committees/sct/documents/out230_en.pdf

[19] ESIS: European Chemicals Bureau – ESIS (European Substances Information System), January 2005. http://ecb.jrc.it/existing-chemicals/ ⇒ tick ESIS button, then enter CAS or EINECS number of substance.

ANNEX 1:

Calculation of Time Weighted Average Concentrations for the LOEC and the NOEC of the Study: "Evaluation of Acute and Chronic Effects of a 240 g/L EC Formulation of Chlorfenvinphos in Outdoor, Aquatic Enclosures" [15]

The time weighted average concentration is calculated as follows:

In the study [15] the measured concentrations in the different treatment levels are reported. Time weighted average concentrations were calculated for the arithmetic means of the concentrations measured in the replicates of the treatment levels that resulted in the NOEC and the LOEC, respectively. To this end, the mean concentration in a time interval between two consecutive measurements (i.e. interval day 0–1; day 1–2, day 2-7 etc.) were calculated (column 4 in the tables). These mean concentrations in a time interval were than weighted with the duration of the time interval (column 3; i.e. mean concentration in a time interval multiplied by the duration of the time interval, result in column 5). The weighted means of column 5 were than added up and divided by the study duration[5] (91 days). The result is the time weighted average concentration C_{TWA}.

Table A1-1: Measured mean concentrations and resulting CTWA - nominal treatment level 5 µg/L (LOEC)

1 Study Day	2 Mean Measured Concentration [µg/l]	3 Duration of Time Interval (days)	4 Mean Concentration in Time Interval [µg/l]	5 Mean Concentration in Time Interval weighted with Duration of Time Interval
0	4.33			
1	4.10	1	4.27	4.27
2	4.20	1	4.75	4.75
7	5.39	5	4.80	23.98
14	5.27	7	5.33	37.31
21	3.80	7	4.54	31.75
28	2.52	7	3.16	22.12
35	1.57	7	2.05	14.32
42	1.94	7	1.76	12.29
49	1.21	7	1.58	11.03
56	2.10	7	1.66	11.59
63	3.72	7	2.91	20.37
70	1.58	7	2.65	18.55
77	1.66	7	1.62	11.34
84	2.13	7	1.90	13.27
91	2.10	7	2.12	14.81
			SUM:	251.7
			C_{TWA}:	**2.8 µg/L**

[5] As no recovery of the cladocera population even in the LOEC-treatment level was observed throughout the duration of the study, the C_{TWA} over the whole observation period was calculated. Normally, the C_{TWA} should be calculated for the time interval between the application of the test substance and the clear onset of recovery of the most sensitive affected population.

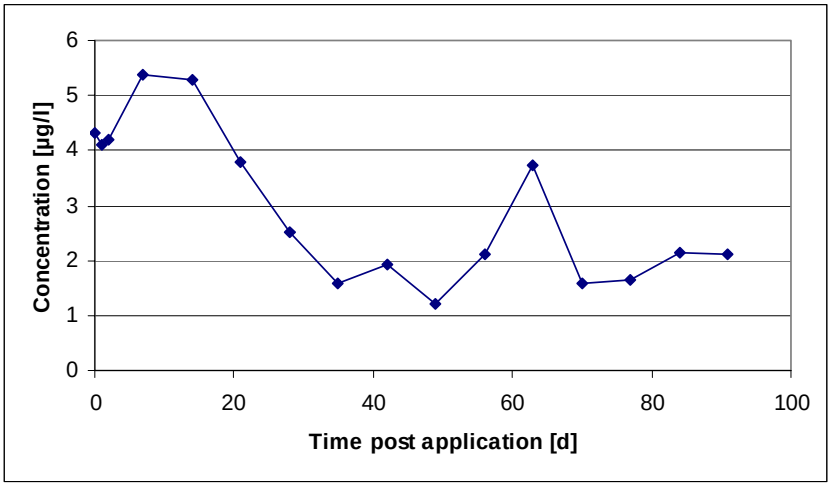

Figure A1-1: Concentration versus time post application in the 5 µg/L (nominal) treatment level that resulted in the LOEC

Table A1-2: Measured mean concentrations and resulting CTWA - nominal treatment level 0.5 µg/L (NOEC)

1 Study Day	2 Mean Measured Concentration [µg/l]	3 Duration of Time Interval (days)	4 Mean Concentration in Time Interval [µg/l]	5 Mean Concentration in Time Interval weighted with Duration of Time Interval
0	0.67			
2	0.59	2	0.63	1.26
7	0.39	5	0.49	2.45
14	0.35	7	0.37	2.59
21	0.27	7	0.31	2.17
28	0.2	7	0.24	1.65
35	0.21	7	0.21	1.44
42	0.23	7	0.22	1.54
49	0.16	7	0.20	1.37
56	0.12	7	0.14	0.98
63	0.07	7	0.10	0.67
70	0.09	7	0.08	0.56
77	0.11	7	0.10	0.70
84	0.1	7	0.11	0.74
91	0.08	7	0.09	0.63
			SUM:	18.73
			C_{TWA}:	**0.2 µg/L**

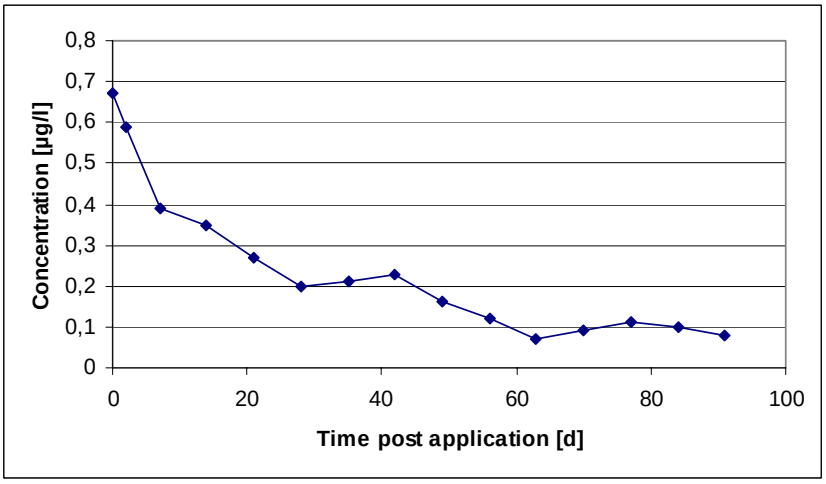

Figure A1-2: Concentration versus time post application in the 0.5 µg/L (nominal) treatment level that resulted in the NOEC