Evaluation Manual for the Authorisation of plant protection products and biocides

EU part

Biocides

Chapter 6 Ecotoxicology; terrestrial organisms birds and mammals

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Board
for the Authorisation
of plant protection products and biocides

Chapter 6 Ecotoxicology; terrestrial organisms
Category: biocides

II BIRDS AND MAMMALS

GENERAL INTRODUCTION

This chapter describes the data requirements for estimation of the risk to birds and mammals of a biocide and the active substance, and which evaluation methodologies are applied for the EU framework (§1 - §1.5).

1. EU FRAMEWORK

The procedure for inclusion of active substances in Annex I to Biocides Directive 98/8/EC [1] is described under EU framework (§1 - §1.5) where only the procedure laid down in the EU is described. The NL procedure for evaluation of a substance, described in the NL part §2 - §2.5 of this chapter, is reverted to where no EU procedure has been laid down.

1.1. Introduction

This chapter serves to estimate the risks to birds and mammals.

This chapter has a relationship with Chapter 4, Human toxicology of the HTB Biocides as regards data concerning mammals; Chapter 5, Behaviour and fate in the environment; behaviour in surface water, sediment and sewage treatment plants (STPs) as regards data concerning the concentration in water, and Chapter 6, Ecotoxicology, aquatic of the HTB Biocides as regards data concerning bioconcentration (BCF).

Described are guidelines for assessment of the risk to birds mammals in the Technical Guidance Document on Risk Assessment [3] and the TNsG on Data Requirements [2], including addenda and additional guidance agreed at Technical Meetings, endorsed at Competent Authority meetings.

Determination of the relevance of the emission routes and quantification of emissions are based on emission scenarios drawn up for various product types in emission scenario documents (see the ex-ECB web site [**Fout! Bladwijzer niet gedefinieerd.**]). Objective of these emission scenarios is the harmonisation of the annex I inclusion and authorisation process for biocidal products. They are briefly described in Appendix A to the environmental section. product type 14, Rodenticides [4] is in particular relevant.

A decision tree with corresponding explanatory notes is included in the NL part in Appendix 1, which is fully in line with the decision process in the EU. This decision tree summarises the evaluation system used for birds and mammals.

Data requirements, evaluation methodologies, criteria and trigger values that deviate from, or further elaborate, the provisions under EU framework (§1), are described in the NL part (§2 - §2.5). The National further provisions can also be used for inclusion of an active substance in Annex I to 98/8/EC.

1.2. Data requirements

The data requirements laid down in the TNsG on data requirements [2] corresponding with the Biocides Directive (98/8/EC) are listed below; the data requirements for the active substance and the product for evaluation of the risk to birds and mammals. This is the verbatim text of the Directive (grey frames). Numbering of the studies corresponds with the numbering of the TNsG on data requirements. Numbering in square brackets follows the numbering of the Biocides Directive. Where relevant, the result of the study has been added.

The data requirements are divided into standard data requirements (core data) that apply for each product type. There are no standard data requirements for birds and mammals and non-target arthropods. In addition, product-type-specific data should be submitted for different product types. The different product types are elaborated in the relevant chapters. Additional data must be submitted in case a higher tier evaluation must be carried out.

It should be noted that legislation is not clear as regards the definition of relevant metabolites. It is neither clear when these data on relevant metabolites must be submitted and how these should be evaluated. This lacuna is for the NL framework elaborated in the NL part §2.2 and Appendix C. The procedure in the NL part §2.2 is followed as long as this has not been elaborated in EU framework.

Data requirements for the active substance

Standard data requirements
There are no standard data requirements for birds.
For mammals, data are submitted for the aspect human toxicology.

Product-type-specific and additional data
Product-type-specific and additional data are required for a number of product types.

These studies as described in the TNsG on data requirements [2] are summarised below.

7.5.3 Effects on birds

7.5.3.1 For some product types, direct exposure for birds is possible and some tests with birds would be required (cf. Part C of Chapter 2). Furthermore, the risk assessment for fish eating birds, using mammalian data for a first approach, might indicate concern, which would trigger tests with birds.

7.5.3.1.1 Acute oral toxicity [Ann. IIIA, XIII.1.1.]
- The acute oral toxicity of the active substance must be determined according to SETAC procedures (SETAC 1995). The highest dose used in tests need not exceed 2 000 mg/kg body weight.

Result:
→ LD_{50} birds

7.5.3.1.2 Short-term toxicity [Ann. IIIA, XIII.1.2.]
- An eight-day dietary study in at least one species (other than chickens) according to OECD guideline 205.
- If the test for effects on reproduction (A7.5.3.1.3) is available this test is not necessary.

Result:
→ LC_{50} birds

7.5.3.1.3 Effects on reproduction [Ann. IIIA, XIII.1.3.]
- An avian reproduction study according to, for example, OECD guideline 206.

Result:
→ NOEC birds expressed as mg a.s./kg food AND mg/kg body weight

For mammals, data are submitted for the aspect human toxicology.

Result:
→ LD_{50} mammals
→ LC_{50} mammals
→ NOAEL mammals expressed as mg a.s./kg food AND mg/kg body weight

Higher tier studies
Submission of a higher tier study may be required in the context of a further (adequate) risk assessment. This needs to be provided if the PEC exceeds the criterion.
The EU framework biocides does not indicate which higher tier studies may be submitted and how these must be carried out. This lacuna has for the national framework been elaborated in the NL part §2.2. The procedure of in the NL part §2.2 is followed as long as this has not been elaborated in EU framework.

Data requirements for the product
The TNsG on data requirements [2] reads as follows as regards the submission of product data:

Information on the ecotoxicology of the active substance in the product, where this cannot be extrapolated from the information on the active substance itself [Ann. IIB, VII.7.2.]
- Required, for example, if the composition (formulation) of or the application technique for the product is suspected to influence the degradation and transformation, mobility and adsorption properties or effects on aquatic or terrestrial organisms in a way that may considerably alter the conclusions of the risk characterisation. For instance, assessment by an expert on the effect of formulation on the ecotoxicology of the active substance should be submitted (see Chapter 1.2, point 4)[1]. Guidelines of the Council

[1] Point 4: The data requirements have been specified in as much detail as possible. However, in certain cases expert judgement by the applicant and by the competent authority may be necessary in order to assess, for instance, whether an additional study is needed or on which organism or under which conditions a test should be performed. The applicant should propose the initial expert judgement, which is then examined by the competent authority and the European Commission. In making the decision as to whether additional testing is justified, the benefit for risk assessment, the compatibility with accepted risk assessment rationales, and the feasibility of the required test may have to be considered. When providing an expert judgement one must, when relevant, take into account both the proposed normal use and a possible realistic worst case situation. Expert judgement decisions should be justified scientifically and be transparent. In certain cases the final decision on data requirements is made by the Standing Committee on Biocides. Where (at the time of writing of this guidance) there are endpoints of concern, but no clearly defined or standardised methods exist, care must be taken and the applicant must check-up where relevant methods take place. New test methods are continuously being developed and the applicant should be currently updated. Special care to check for test methods should be done for substances suspected to be endocrine disrupters, as several international programmes at the moment attempt to develop tests.

Directive 88/379/EEC (as amended) on assessing the effect of a single substance in causing hazard in a preparation may be partly applicable here.
- In addition, a qualitative or, preferably, a quantitative estimate on the possibility of formation of by-products of the active substance during normal use should be submitted on the basis of available data on the active substance and the intended use of the biocidal product.
- Ecotoxicology testing with a product might be required in those cases where a direct release of a product to a compartment is possible (see Part C of Chapter 2).

Besides studies that must also be provided for the active substance (7.5.3.1.1, 7.5.3.1.2 and 7.5.3.1.3), in some situations the following data must be provided as additional data. Product data are required if the submitted data on the active substance provide insufficient information or if there are indications of risks to be ascribed to specific properties of the product.

7.6 Effects on birds

7.6.1 Acute oral toxicity, if not already done according to Annex IIB, section VII be at risk

7.8.7 If the biocidal product is in the form of bait or granules

7.8.7.1 Supervised trials to assess risks to non-target organisms under field conditions.

7.8.7.2 Studies on acceptance by ingestion of the biocidal product by any non-target organisms thought to be at risk.
- Required if the biocidal product is in form of baits, granules, or treated seeds.
- In order to assess risks to predators, residue data in target organisms concerning the active substance and including toxicologically relevant metabolites would be needed. (cf. Chapter 2, part B, section 5.11)

For mammals, data on reproduction toxicity are provided for the aspect human toxicology. These can be found in Chapter 1.2.1 of Human Toxicology.

1.3. Risk assessment

The risk assessment and comparison for acute toxicity for birds and mammals has been elaborated in the following documents:
Technical Guidance Document [3] (TGD):
- Part 2, Chapter 3.8: Assessment of secondary poisoning.
- Part 2, Chapter 4.3.3: Assessment of secondary poisoning.

CA-Nov06-Doc.4.3 [4]:
Addendum relevant to Biocides to the TGD on Risk Assessment $PNEC_{oral}$ derivation for the primary and secondary poisoning assessment of anti-coagulant rodenticides (and other product types).

TNsG on data requirements [2]:
- Part C of Chapter 2: Important compartments are indicated per product type.
- p.121: Effects on birds.
- p.126: Further ecotoxicological studies.
- 3.11 Particle size distribution – as part of the primary poisoning assessment of biocidal

products applied as granules.

Emission Scenario Document for Product type 14, Rodenticides [5].
- The emissions for primary and secondary poisoning are explained here.

Introduction
The assessment of birds and mammals consists of two approaches:
Qualitative assessment and quantitative risk assessment. Reason for these separate approaches is that at present the TGD does not give guidance on how to derive a PNEC for short term exposure.

The qualitative assessment only gives a first indication of the acute toxicity of the substance and is not intended to be used for the risk assessment. Furthermore this approach is NOT meant for comparative assessment either. Except for the conclusion that a substance is acutely toxic (yes or no), no further conclusions can be drawn from this approach. The guidance was developed for harmonisation sake. This qualitative assessment is carried out for both primary poisoning and secondary poisoning.

The quantitative risk assessment for birds and mammals follows two routes:
- exposure via primary poisoning (direct intake of the product);
- exposure via secondary poisoning (consumption of food items contaminated with the product).

Assessments follow a tiered approach. The first tier is based on a general realistic worst case evaluation of behaviour and toxicity of the substance in the environment.
If the trigger values in the first tier of the evaluation are not met, the applicant is given the opportunity to submit additional data on the basis of which a refined evaluation is carried out (higher tier).

Qualitative assessment:
Primary poisoning via the intake of the biocidal product
The acute toxicity to birds and mammals of a substance is estimated comparing the estimated concentration in the environment, the PEC (Predicted Environmental Concentration) with the acute LD50 for the short term situation [mg/kg bw]. Not ratio is determined. Two Tiers are considered:
- Tier 1 where the PECoral is the concentration of the active substance in the food (bait) [mg/kg food]
- As a Tier 2 for 1 days exposure with and without excretion, where the PEC_{oral} is the expected concentration of the active substance in the non-target animal *after 1 day* exposure (single meal) [mg/kg bw]. A default excretion factor of 0.3 (for birds and mammals) should be used in case no data is available. For a first step worst case, the parameter AV*, PT and PD are all 1. For a more realistic worst case AV* = 0.9, PT = 0.8 and PD = 1.

Conclusion: if PEC > LD50 then the substance is acutely toxic.

Secondary poisoning via the contaminated target species
In a first tier is a qualitative approach for the acute situation to compare the possible single uptake (with Frodent = 1) with a LD50 of the active substance (mg/kg bw).

* AV has to be set to 0.5 for birds if the product is a paste in an envelope

- Tier 1, where the PEC_{oral} is the concentration in the rodent immediately after a last meal on day 5 [mg/kg food]. For a short-term exposure PD is 1 (rodents have fed entirely on rodenticide) and Frodent = 1 (non-target animals consume 100 % of their daily intake on poisoned rodents). For comparison calculations with PD = 0.5 and PD = 0.2 could also be included.

Conclusion: if PEC > LD50 then the substance is acutely toxic.

Quantitative risk assessment:

General assessment methodology Risk to birds and mammals

The risk to birds and mammals is estimated by dividing the estimated concentration in the environment, the PEC (Predicted Environmental Concentration) by the criterion, the PNEC (Predicted No Effect Concentration) for the long-term situation. The PEC is calculated by using the Emission Scenario Documents [6] and additional guidance [4]. Furthermore, a criterion is laid down on the basis of the data submitted on the toxicity to birds and mammals (LC_{50}, LD_{50}, NOEC) by application of an assessment factor (PNEC).

This chapter elaborates the PEC as well as the PNEC calculations.

The decision tree “Risk to birds and mammals” in the NL part Appendix 1 relates the PEC to the toxicity data on the different birds and mammals.

A number of aspects have not yet been elaborated in EU framework; §2.3 elaborates these lacunas for the NL framework (how to deal with metabolites, etc.). As long as these lacunas have not been elaborated in EU framework, In the NL part §2.3 and appendix C is followed. When in EU framework these currently not yet elaborated aspects will have been worked out, these will be followed.

Exposure via primary poisoning;

Introduction

The risk for primary poisoning of a non-target organism feeding on the biocidal product as a food item, is calculated as the ratio between the concentration in their food (PECoral) and the no-effect-concentration for oral intake (PNECoral). Two Tiers are considered:

- Tier 1 where the PECoral is the concentration of the active substance in the food (bait) [mg/kg food]
- Tier 2 for 5 days exposure, considering excretion, where the PEC oral is the expected concentration of the active substance in the non-target animal *after 5 days* exposure [mg/kg bw]. A default excretion factor of 0.3 (for birds and mammals) should be used in case no data are available. As a worst case, the parameter AV*, PT and PD are all 1.

In the first tier it is assumed that the animal in question consumes nothing but the biocide (until an upper limit of 600 g) in one daily meal and therefore this is used as a default value.

As a second tier evaluation, the following more detailed exposure assessment can be done. Basically the estimated daily uptake of a compound (ETE) is given by the following equation:

$ETE = (FIR / BW) * C * AV * PT * PD$ ($mg.kg^{-1}$ bw/d)

Variable/parameter	Symbol	Unit	Default
Input:			
Food intake rate of indicator species (freshweight)	FIR	$g.d^{-1}$	
Body weight	BW	g	
Concentration of active compound in fresh diet (bait)	C*	$mg.kg^{-1}$	
Avoidance factor (1 = no avoidance, 0 = complete avoidance)	AV	-	1
Fraction of diet obtained in treated area value between 0 and 1)	PT	-	1
Fraction of food type in diet (number between 0 and 1; one type or more types)	PD	-	1
Output:			
Estimated daily uptake of a compound	ETE	$mg.kg.^{-1}d^{-1}$	

In the calculations of uptake of active substance of a rodenticide, in this first step worst case scenario AV, PT and PD are all set to 1. If no other information is available this will also be considered as a realistic worst case. A realistic worst case values AV = 0.9, PT = 0.8 and PD = 1 might be used instead as a second step, based on e.g. recommendations of the EPPO Rodent Control Panel on acceptable avoidance factors for rodenticides.

Food intake can be very variable, depending on the metabolic rates of the species, the nature of their food, weather conditions, time of year, etc. If no information is available on the mean daily food intake, the following regression equations (from Nagy 1987 cited in EPPO 1993) can be used to predict dry weight intake for an animal of a particular body weight:

for all birds: log FIR = 0.651 log BW - 0.188
for songbirds: log FIR = 0.85 log BW - 0.4
for other birds: log FIR = 0.751 log BW - 0.521
for mammals: log FIR = 0.822 log BW - 0.629
(where FIR = daily food intake expressed as dry weight, BW = body weight)

The expected concentration of active substance in the animal after metabolism and other elimination is calculated as follows:

EC = ETE * (1 - EI)

Variable/parameter	Symbol	Unit	Defaul
Input:			
Estimated daily uptake of a compound	ETE	$mg.kg^{-1}d^{-1}$	
Fraction of daily uptake eliminated (number between 0 and 1)	EI	-	
Output:			
Expected concentration of active substance in the animal	EC	$mg.kg^{-1}$	

The general formula for calculation of EC_n for animals that eats the same daily amounts is then:

$$EC_n = \sum_{n=1}^{n-1} ETE * (1-EL)^n$$

The predicted environmental concentration of an active substance in food of a rodent-eating predator is calculated as follows:

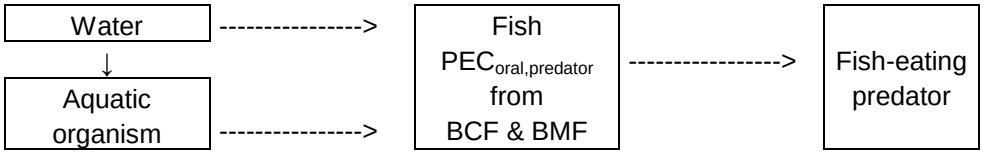
$PEC_{oral,\ predator} = (EC_N + ETE) * F_{rodent}$

Variable/parameter	Symbol	Unit	Default
Input:			
Expected concentration of active substance in the rodent on day "n" before the last meal	EC_N	$mg.kg^{-1}$	
Number of days the rodent is eating rodenticide until caught by the predator	N	-	5
Estimated uptake of active substance by rodent on day "n" (i.e. intake of rodenticide in the last meal, no elimination)	ETE	$mg.kg^{-1}$	
Fraction of poisoned rodents in predator's diet	F_{rodent}	-	
- short-term exposure			1
- long-term exposure			0,5
Output:			
Predicted environmental concentration of an active substance in food of a predator per day	$PEC_{oral,predator}$	$mg.kg^{-1}$	

Assessment of secondary poisoning via feeding on contaminated target-species
For the risk assessment the long-term PEC/PNEC values of the respective substances should be compared. As a worst case, PEC/PNEC ratios of the smallest bird and the smallest mammal should be compared for secondary poisoning.

- Tier 1 for a long-term exposure. The PEC oral is the concentration in the rodent immediately after a last meal on day 5 [mg/kg food]; PD = 1 and Frodent = 0.5 (non-target animals consume 50 % of their daily intake on poisoned rodents). For comparison calculations with PD = 0.5 and PD = 0.2 could also be included.
- Tier 2 for a long-term exposure. The PEC oral is the concentration in non-target animals after a single day of exposure [mg/kg bw]; PD = 1 and Frodent = 0.5.

Assessment of secondary poisoning via the aquatic food chain
Effects assessments for bioaccumulation and secondary poisoning
A schematic view of the assessment scheme for the exposure route water → aquatic organisms → fish → fish-eating mammal or fish-eating bird is given in the Figure below.



The risk to the fish-eating predators (mammals and/or birds) is calculated as the ratio between the concentration in their food ($PEC_{oralpredator}$) and the no-effect-concentration for oral intake ($PNEC_{oral}$). The concentration in fish is a result of uptake from the aqueous phase and intake of contaminated food (aquatic organisms). Thus, $PEC_{oralpredator}$ is calculated from the bioconcentration factor (BCF) and a biomagnification factor (BMF).

The BMF is defined as the relative concentration in a predatory animal compared to the concentration in its prey (BMF = Cpredator/Cprey). The concentrations used to derive and

report BMF values should, where possible, be lipid normalised.

Calculation of BCF from log Kow

log Kow of 2-6: $\log BCF_{fish} = 0.85 * \log Kow - 0.70$

log Kow >6: $\log BCF_{fish} = - 0.20 * \log Kow^2 + 2.74 * \log Kow - 4.72$

Explanation of symbols		
Kow	octanol-water partition coefficient	[-]
BCFfish	bioconcentration factor for fish on wet weight basis	[$l.kg_{wet\ fish}$]

Calculation of a predicted environmental concentration in food (PEC)

$PEC_{oral,\ predator} = PEC_{water} * BCF_{fish} * BMF$

In case there is emission to marine waters next to the assessment of predators also an assessment of top-predators is required:

$PEC_{oral,\ toppredator} = PEC_{water} * BCF_{fish} * BMF_1 * BMF_2$ (Seal)

Explanation of symbols		
$PEC_{oralpredator}$	Predicted Environmental Concentration in food	[$mg.kg^{-1}$]
$PEC_{oral\ toppredator}$	Predicted Environmental Concentration in food of top predator	[$mg.kg^{-1}$]
PEC_{water}	Predicted Environmental Concentration in water	[$mg.l^{-1}$]
BCF_{fish}	bioconcentration factor for fish on wet weight basis	[$l.kg_{wet\ fish}^{-1}$]
$BMF = BMF_1$	biomagnification factor in fish	[-]
BMF_2	biomagnification in the predator	[-]

PEC(water) = 50% local water, 50% regional water
PEC(water, toppredator) = 10% local, 90% regional

Default BMF values for organic substances with different log Kow or BCF in fish			
log Kow	**BCF (fish)**	**BMF_1**	**BMF_2**
<4.5	< 2,000	1	1
4.5 - < 5	2,000-5,000	2	2
5 – 8	> 5,000	10	10
>8 – 9	2,000-5,000	3	3
>9	< 2,000	1	1

Calculation of the predicted no-effect concentration (PNECoral)

$NOEC_{bird} = NOAEL_{bird} * CONV_{bird}$

$NOEC_{mammal,\ food\ chr} = NOAEL_{mammal,\ oral\ chr} * CONV_{mammal}$

Explanation of symbols		
$NOEC_{bird}$	NOEC for birds	($kg.kg_{food}^{-1}$)
$NOEC_{mammal,\ food\ chr}$	NOEC for mammals	($kg.kg_{food}^{-1}$)
$NOAEL_{bird}$	NOAEL for birds	($kg.kg\ bw.d^{-1}$)
$NOAEL_{mammal,\ oral\ chr}$	NOAEL for mammals	($kg.kg\ bw.d^{-1}$)
$CONV_{bird}$	conversion factor from NOAEL to NOEC	($kg\ bw.d.kg_{food}^{-1}$)
$CONV_{mammal}$	conversion factor from NOAEL to NOEC	($kg\ bw.d.kg_{food}^{-1}$)

Conversion factors from NOAEL to NOEC for several mammalian and one bird species	
Species	**Conversion factor (bw/dfi)**

Canis domesticus	40
Macaca sp.	20
Microtus spp.	8,3
Must musculus	8,3
Oryctolagus cuniculus	33,3
Rattus norvegicus (> 6 weeks)	20
Rattus norvegicus (≤ 6 weeks)	10
Gallus domesticus	8
bw = body weight (g); dfi: daily food intake (g/day)	

The PNECoral is ultimately derived from the toxicity data (food basis) applying an assessment factor. In formula:

$PNEC_{oral} = TOX_{oral} / AF_{oral}$

Explanation of symbols		
$PNEC_{oral}$	PNEC for secondary poisoning of birds and mammals	[in $kg.kg_{food}^{-1}$]
AF_{oral}	assessment factor applied in extrapolation of PNEC	[-]
TOX_{oral}	either $LC50_{bird}$, $NOEC_{bird}$ or $NOEC_{mammal, food, chr}$	[in $kg.kg_{food}^{-1}$]

Assessment factors for extrapolation of mammalian and bird toxicity data		
TOXoral	**Duration of test**	**AForal**
$LC50_{bird}$	5 days	3,000
$NOEC_{bird}$	chronic	30
$NOEC_{mammal, food,chr}$	28 days 90 days chronic	300 90 30

For more additional information about the assessment of secondary poisoning via the aquatic food chain, see the TGD, Chapter 3.8.3.6.

Assessment of secondary poisoning via the terrestrial food chain
Calculation of a predicted environmental concentration in food (PEC)
the exposure of the predators may be affected by the amount of substance that is in this soil. The PECoralpredator is calculated as:

$PEC_{oral\ predator} = c_{earthworm}$

where $C_{earthworm}$ is the total concentration of the substance in the worm as a result of bioaccumulation in worm tissues and the adsorption of the substance to the soil present in the gut.

$$C_{earthworm} = \frac{BCF_{earthworm} * C_{porewater} * W_{earthworm} + C_{soil} * W_{gut}}{W_{earthworm} + W_{gut}}$$

Explanation of symbols		
$PEC_{oralpredator}$	Predicted Environmental Concentration in food	[$mg.kg_{wet\ earthworm}^{-1}$]
$BCF_{earthworm}$	bioconcentration factor for earthworms on wet weight basis	[$L.kg_{wet\ earthworm}^{-1}$]
$C_{earthworm}$	concentration in earthworm on wet weight basis	[$mg.kg_{wet\ earthworm}^{-1}$]
$C_{porewater}$	concentration in porewater	[$mg.L^{-1}$]

C_{soil}	concentration in soil	[$mg.kg_{wwt}^{-1}$]
$W_{earthworm}$	weight of earthworm tissue	[$kg_{wwt\ tissue}$]
W_{gut}	weight of gut contents	[kg_{wwt}]

$W_{gut} = W_{earthworm} * F_{gut} * CONV_{soil}$

Where:

$CONV_{soil} = RHO_{soil} / (F_{solid} * RHO_{solid})$

Explanation of symbols			
$CONV_{soil}$		conversion factor for soil concentration wet-dry weight soil	[$kg_{wwt}.kg_{dwt}^{-1}$]
F_{solid}	volume fraction of solids in soil	[$m^3.m^{-3}$]	= 0.6
F_{gut}	fraction of gut loading in worm	[$kgdwt.kg_{wwt}^{-1}$]	= 0.1
RHO_{soil}	bulk density of wet soil	[$kg_{wwt}.m^{-3}$]	= 1,700
RHO_{solid}	density of solid phase	[$kg_{dwt}.m^{-3}$]	= 2,500

The concentration in a full worm can be written as:

$$C_{earthworm} = \frac{BCF_{earthworm} * C_{porewater} + C_{soil} * F_{gut} * CONV_{soil}}{1 + F_{gut} * CONV_{soil}}$$

When measured data on bioconcentration in worms is available the BCF factors can be inserted in the above equation. For most substances, however, these data will not be present and BCF will have to be estimated. For organic chemicals, the main route of uptake into earthworms will be via the interstitial water. Bioconcentration can be described as a hydrophobic partitioning between the pore water and the phases inside the organism and can be modelled according to the following equation as described by Jager (1998):

$BCF_{earthworm} = (0.84 + 0.012\ K_{ow}) / RHO_{earthworm}$

Where for $RHO_{earthworm}$ by default a value of 1 ($kg_{ww}*L^{-1}$) can be assumed

1.4. Approval

According to the Directive of the European Parliament and the Council of 16 February 1998 concerning the placing of biocides on the market (98/8/EC) it should be investigated whether biocides have, when approved, no unacceptable effect on the environment and in particular the health humans and animals (consideration 8) if used properly for the envisaged purpose, in the light of the current scientific and technical knowledge.

Article 5, 1, b ii), iii) and iv) stipulates that Member States may only authorise a biocide if the product, when used consistent with the authorisation and taking into account:
- all conditions under which the biocide is normally used,
- the way in which material treated with the product can be used,
- the consequences of use and removal,

ii) has no unacceptable effects on the target organisms, such as unacceptable resistance or cross-resistance or unnecessary suffering and pain for vertebrates,

(iii) has no unacceptable effects itself or as a result of its residues, on human or animal health, directly or indirectly (e.g. through drinking water, food or feed, indoor air or consequences in the place of work) or on surface water and groundwater,

(iv) has no unacceptable effect itself, or as a result of its residues, on the environment having particular regard to the following considerations:
- its fate and distribution in the environment; particularly contamination of surface waters (including estuarian and seawater), groundwater and drinking water,
- its impact on non-target organisms;

1.4.1. Evaluation

The Common Principles (Annex VI to 98/8) present the starting points for evaluation as regards the effects on the environment.
These concern the relevant parts of the introductory principles, the common principles, and the specific principles for the effects on the environment.
The specific principles for the risk to birds and mammals are in the text below printed in a grey frame. This text, including numbering, is the verbatim text of Annex VI to Directive 98/8/EC.

36. The risk assessment shall take account of any adverse effects arising in any of the three environmental compartments — air, soil and water (including sediment) — and of the biota following the use of the biocidal product.
37. The hazard identification shall address the properties and potential adverse effects of the active substance and any substances of concern present in the biocidal product. If this results in the biocidal product being classified according to the requirements of this Directive then dose (concentration) — response (effect) assessment, exposure assessment and risk characterisation shall be required.
38. In those cases where the test appropriate to hazard identification in relation to a particular potential effect of an active substance or a substance of concern present in a biocidal product has been conducted but the results have not led to classification of the biocidal product then risk characterisation in relation to that effect shall not be necessary unless there are other reasonable grounds for concern. Such grounds may derive from the properties and effects of any active substance or substance of concern in the biocidal product, in particular:
    - any indications of bioaccumulation potential,
    - the persistence characteristics,
    - the shape of the toxicity/time curve in ecotoxicity testing,
    - indications of other adverse effects on the basis of toxicity studies (e.g. classification as a mutagen),
    - data on structurally analogous substances,
    - endocrine effects.
39. A dose (concentration) — response (effect) assessment shall be carried out in order to predict the concentration below which adverse effects in the environmental compartment of concern are not expected to occur. This shall be carried out for the active substance and for any substance of concern present in the biocidal product. This concentration is known as the predicted no-effect concentration (PNEC). However, in some cases, it may not be possible to establish a PNEC and a qualitative estimation of the dose (concentration) — response (effect) then has to be made.
40. The PNEC shall be determined from the data on effects on organisms and ecotoxicity studies submitted in accordance with requirements of Article 8 of this Directive. It shall be calculated by applying an assessment factor to the values resulting from tests on organisms, e.g. LD50 (median lethal dose), LC50 (median lethal concentration), EC50 (median effective concentration), IC50 (concentration causing

50% inhibition of a given parameter, e.g. growth), NOEL(C) (no-observed-effect level (concentration)), or LOEL(C) (lowest-observed-effect level (concentration)).

41. An assessment factor is an expression of the degree of uncertainty in extrapolation from test data on a limited number of species to the real environment. Therefore, in general, the more extensive the data and the longer the duration of the tests, the smaller is the degree of uncertainty and the size of the assessment factor.
    The specifications for the assessment factors shall be elaborated in the notes for technical guidance which, to this end, shall be based particularly on the indications given in Commission Directive 93/67/EEC of 20 July 1993 laying down the principles for assessment of risks to man and environment from substances notified in accordance with Council Directive 67/548/EEC(*).
    (*) OJ L 227, 8.9.1993, p. 9.
42. For each environmental compartment an exposure assessment shall be carried out in order to predict the concentration likely to be found of each active substance or substance of concern present in the biocidal product. This concentration is known as the predicted environmental concentration (PEC). However in some cases it may not be possible to establish a PEC and a qualitative estimate of exposure then has to be made.
43. A PEC, or where necessary a qualitative estimate of exposure, need only be determined for the environmental compartments to which emissions, discharges, disposal or distributions including any relevant contribution from material treated with biocidal products are known or are reasonably foreseeable.
44. The PEC, or qualitative estimation of exposure, shall be determined taking account of, in particular, and if appropriate:
    - adequately measured exposure data,
    - the form in which the product is marketed,
    - the type of biocidal product,
    - the application method and application rate,
    - the physico-chemical properties,
    - breakdown/transformation products,
    - likely pathways to environmental compartments and potential for adsorption/desorption and degradation,
    - the frequency and duration of exposure.
45. Where adequately measured, representative exposure data are available, special consideration shall be given to them when conducting the exposure assessment. Where calculation methods are used for the estimation of exposure levels, adequate models shall be applied. The characteristics of these models shall be as listed in paragraph 33. Where appropriate, on a case-by-case basis, relevant monitoring data from substances with analogous use and exposure patterns or analogous properties should also be considered.
46. For any given environmental compartment, the risk characterisation shall, as far as possible, entail comparison of the PEC with the PNEC so that a PEC/PNEC ratio may be derived.
47. If it has not been possible to derive a PEC/PNEC ratio, the risk characterisation shall entail a qualitative evaluation of the likelihood that an effect is occurring under the current conditions of exposure or will occur under the expected conditions of exposure.

1.4.2. Decision making

The Common Principles (Annex VI to 98/8) present the starting points for decision making as regards the effects on the environment.

These concern the relevant parts of the introductory principles, the common principles, and the specific principles for the effects on the environment.
The specific principles for risk to birds and mammals are in the text below printed in a grey frame. This text, including numbering, is the verbatim text of Annex VI to Directive 98/8/EC.

78. The Member State shall not authorise a biocidal product if the risk assessment confirms that the active substance, or any substance of concern, or any degradation, or reaction product presents an unacceptable risk in any of the environmental compartments
    - water (including sediment), soil and air. This shall include the assessment of risks to non-target organisms in these compartments.

87. The Member State shall not authorise a biocidal product where there is a reasonably foreseeable possibility of non-target organisms being exposed to the biocidal product if for any active substance or substance of concern:
    - the PEC/PNEC is above 1 unless it is clearly established in the risk assessment that under field conditions no unacceptable effects occur after use of the biocidal product according to the proposed conditions of use. or
    - the bioconcentration factor (BCF) related to fat tissues in non-target vertebrates is above 1 unless it is clearly established in the risk assessment that under field conditions no unacceptable effects occur, either directly or indirectly, after use of the product according to the proposed conditions of use.

In line with the TGD and described in EU part §1.3, the PEC and PNEC can be calculated in different ways.

The following procedure applies for the biocide and relevant metabolites:

General

If: PEC > LD50
The substance is acutely toxic

If:
PEC ≤ PNEC
the criteria for toxicity birds and mammals are met.

If:
PEC / PNEC > 1

The criteria for toxicity birds and mammals are not met, unless it is demonstrated by means of an adequate risk assessment that there are under field conditions no unacceptable direct or indirect effects on birds and mammals after application of the product consistent with the proposed instructions for use.

For granules
In a number of CARs with biocidal products applied as granules methods were basically taken from the Guidance Document for Risk Assessment for Birds and Mammals under Council Directive 91/414/EC (SANCO, 2000). This document specifically refers to the EPPO risk assessment scheme (EPPO, 2002) when granules have to be assessed. In principle, the EPPO methods will be followed here. However, in some cases the default

values for focal species in the EPPO scheme differ from those in the Guidance Document, and input values from the latter are used here. In line with the assessment of rodenticides (CA-Nov06-Doc.4.3), the assessment of primary poisoning, is based on a qualitative and quantitative assessment.

Basic principles are:
- To calculate amount of active substance per granule on basis of the particle size distribution of granules (Described in 3.11 of the TNsG on data requirements[2]).
- Risk is estimated for a 25 gram bird and mammal.

Further (adequate) risk assessment
If the criterion is not met, the specific use in question is considered as non-permissible unless a further (adequate) risk assessment shows that there are no unacceptable direct or indirect effects on birds and mammals under relevant field conditions.

For a further adequate risk assessment data must be submitted which give cause for adjustment of the calculated PEC or for adjustment of the effect concentration under field conditions; here, a field study is a possibility.

An additional option for an adequate risk assessment is the inclusion of mitigation measures / restrictions. The applicant must, however, provide evidence that the proposed mitigation measures / restrictions are realistic and will result in an acceptable risk.

As to granular type of biocidal products in the refinement of the long-term risk assessment of primary poisoning it should be judged to what extent it is likely that birds and mammals will take up enough granules to experience effects.
Additional information can be obtained from palatability tests mimicking the type of use and information on the chance of accidental uptake of granules and the potential effects. Furthermore measures can be proposed to minimise the exposure of birds and mammals to the granules. The applicant must, however, provide evidence that the proposed mitigation measures / restrictions are realistic and will result in an acceptable risk.

If the adequate risk assessment shows that PEC / PNEC ≤ 1, the use in question can part of the Annex I inclusion.
If the adequate risk assessment shows that PEC / PNEC > 1, the use in question is recommended for non Annex I inclusion.

1.5. Developments

Developments
- None
- EU developments will be followed.

Lacunas
- It is not clear what is to be understood by relevant transformation products. It is neither clear when data on relevant transformation products must be provided and how these must be evaluated.
- The EU framework Biocides does not indicate how a higher tier study must be carried out and assessed. This still needs to be elaborated.

2. REFERENCES

1 Biocides Directive (98/8/EC).
2 Technical notes for guidance in support of Directive 98/8/EC concerning the placing of biocidal products on the market. Guidance on data requirements for active substances and biocidal products. October 2002.
3 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, part II, April 2003.
4 CA-Nov06-Doc.4.3. Addendum relevant to Biocides to the TGD on Risk Assessment PNECoral derivation for the primary and secondary poisoning assessment of anti-coagulant rodenticides.
5 Supplement to the methodology for risk evaluation of biocides Emission scenario document for biocides used as rodenticides. CA-Jun03-Doc.8.2-PT14.
6 Emission Scenario Document for Biocides (esd) > Documents > Emission scenario Documents > ESD per product type: E.g. Emission scenarios for all 23 product types of EU Directive 98/8/EC, report RIVM 601450009/2002. P. van der Poel en J. Bakker & Development of Environmental Emission Scenarios for active substances used in Biocidal Products. Final Report, January 2004. European Commission DG ENV, RIVM Service contract B4-3040/2001/326154/Mar/C3