JRC Scientific and Technical Reports

Emission Scenario Document for Product Type 3

Veterinary hygiene biocidal products

Drafted by Scientific Consulting Company (SCC) GmbH
Revised by the Biocides Technical Meeting
Endorsed by the Biocides Competent Authorities Meeting
Edited by B. Raffael and E. van de Plassche

EUR 25116 EN - 2011

JRC
EUROPEAN COMMISSION

ihcp
Institute for Health and Consumer Protection

The mission of the JRC-IHCP is to protect the interests and health of the consumer in the framework of EU legislation on chemicals, food, and consumer products by providing scientific and technical support including risk-benefit assessment and analysis of traceability.

European Commission
Joint Research Centre
Institute for Health and Consumer Protection

Contact information
Address: DG JRC, IHCP TP 582, I-21020 Ispra, Italy
E-mail: Barbara.raffael@jrc.ec.europa.eu
Tel.: +39.0332.785303
Fax: +39.0332.789453
http://ihcp.jrc.ec.europa.eu/our_activities/health-env/biocides
http://ihcp.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/

JRC 67706

EUR 25116 EN
ISBN 978-92-79-22401-0 (PDF)
ISBN 978-92-79-22400-3 (print)

ISSN 1831-9424 (online)
ISSN 1018-5593 (print)

doi:10.2788/29747

Luxembourg: Publications Office of the European Union, 2011

Printed in Italy

EXECUTIVE SUMMARY

Following the entry into force of the Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market, all active substances in the European market have to be reviewed to ensure that under normal conditions of use they can be used without unacceptable risk for people, animals or the environment. Thus, in the frame of the review process, the risk assessment of each active substance plays a fundamental role and providing technical guidance to the assessments that must be performed ensures a correct and uniform implementation of the Directive for the different Member States.
According to Annex VI of Directive 98/8/EC the risk assessment shall cover the proposed normal use of the biocidal product together with a 'realistic worst case scenario'.

The aim of this Emission Scenario Document (ESD) is to set up methods for the estimation of the emission of disinfectants, used for the disinfection of vehicles used for animal transport, for veterinary hygiene and in hatcheries.

The present ESD is intended to be used by Member States as a basis for assessing applications submitted with a view to include existing active substances used in PT3 in Annex I or IA of Directive 98/8/EC or for assessing applications for product authorisation. It can be a useful tool also for Industry, when assessing requirements for a submission.

This ESD have been developed in the context of project FKZ 360 04 023 of the German Federal Environmental Agency (UBA), who contracted SCC GmbH for a first draft of the document. The first draft was then revised by the Biocides competence group of Chemical assessment and toxicology (CAT) Unit of the Institute for Health and Consumer Protection (IHCP) of the JRC, taking into account the comments of the Member States. The final version, approved by the Biocides Technical Meeting, was endorsed by the Biocides Competent Authority Meeting in May 2011.The Biocides Technical Meeting and the Biocides Competent Authorities Meeting agreed in asking the JRC to publish the present Emission Scenario Document as a Scientific and Technical Report.

CONTEXT

This report has been developed in the context of the German Federal Environmental Agency (UBA) project entitled "Überarbeitung und Fertigstellung des Draft ESD für Desinfektionsmittel PT 2-4" (Revision and finalisation of the draft ESD for disinfectants in PT 2-4).

In 2006, the EU Commission initiated a project together with the former European Chemicals Bureau (ECB) to compile an emission scenario document for assessing active substances used as disinfectants in product types (PTs) 2 to 4 (concerning active substances on the third priority list, which are currently being evaluated) to extend the existing published ESDs. In January 2007, the project ended without the approval of the draft. As a result, the draft was not passed to the Biocides Competent Authority Meeting, so that the ESD was not approved at EU level.

Discussion on unanswered questions failed to reach a conclusion during the EU workshop on environmental assessment of disinfectants in Arona organised by the ECB on 11 March 2008.

Therefore, the UBA contracted SCC GmbH on 17 November 2008 to review the present draft of the ESD taking into account the discussions in the ESD working group, the subsequent feedback from the member states, and the discussions at the technical meetings and the Arona workshop of 11 March 2008. In addition, shortcomings in both form and content needed to be corrected and missing data and scenarios to be added.
The results of the revision have been presented at the TM I 09 (Biocides Technical Meeting I of 2009) and discussed by the Member States; final alterations following comments made by the Member States after TM I 09 were incorporated. Thereafter the Technical Notes for Guidance were endorsed during the 34th CA meeting (Biocides Competent Authority meeting) for release for a 6-month consultation period of stakeholders. At the end of the consultation period, this ESD was revised on the basis of the comments received and the remaining issues were discussed at the first Biocides Technical Meeting of 2011 (chaired by the Biocides competence group of IHCP-JRC). Results of this discussion were incorporated in the final version.
The final version, approved by the Biocides Technical Meeting (chaired by the Biocides competence group of IHCP-JRC), was endorsed by the Biocides Competent Authority Meeting in May 2011.

The revision as detailed in this document includes the following points:

- Removing formal shortcomings by harmonising the terminology with ESDs which have already been approved, also within the document, and improving legibility and clarity;

- Supplying missing notes for determining regulatory values;

- Incorporation of the results of the discussion at both EU workshops on PT 1-6 and PT 18 (Insecticides for stables and manure storage systems) into the document;

- Compiling scenarios for known desiderata in PT 3 (Hatchery) on the basis of previous available preparatory work;

- Identifying gaps in knowledge and requirement for further research.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

Biocidal products of product type 3 are biocidal products used for disinfection in the means of veterinary hygiene. Veterinary hygiene biocidal products are those biocidal products used in areas in which animals are housed, kept or transported.

According to Annex VI of the Biocidal Products Directive the risk assessment shall cover the proposed normal use of the biocidal product together with a 'realistic worst case scenario'. The aim of ESDs is to set up methods for the estimation of the emission of disinfectants to the primary receiving environmental compartments. The calculation of PEC values using environmental interactions, for example movement of emissions to secondary environmental compartments (e.g. from soil to groundwater) is the result of fate and behaviour calculations and models and therefore considered to be outside the scope of this ESD.

The Directive 98/8/EC[1] was adopted by the European Parliament and the Council in 1998. One objective of the Directive is to allow harmonisation of Member States' legislation concerning biocides. The Directive implements an authorisation process for biocidal products containing active substances listed in Annex I and IA. Active substances may be added to the Annexes after undergoing an assessment of risks to the users of the biocides, the general public and the environment. For the required environmental risk assessment, Environmental Emission Scenario Documents (ESDs) provide a tool for the assessment process, and a methodology for estimating the quantities of active substances which may be released to the environment during the various stages of a biocidal product's lifecycle.

As specified in the requirements of the Biocides Directive (98/8/EC), Member States may only authorise the placing on the market of biocidal products whose active ingredients are listed in Annex I (or Annex IA for low risk biocidal products) of the Directive. Substances can only be included in these annexes if thorough assessment of the risks establishes that, under normal conditions of use, they will not have unacceptable effects on public health or the environment. Providing technical guidance to the assessments that must be performed ensures a correct and uniform implementation of the Directive for the different Member States.

1.2 Existing models and other ESD relevant sources of information

The following documents and existing models are the basis for the presented supplement to the ESD for PT 3:

- *"Service contract for the development of environmental emission scenarios for active agents used in certain biocidal products, draft final report to European Commission, Directorate General Environment, January 2007".*

- *ECB Document "Remaining Comments of the Member States and the Industry for the Finalisation of the AEAT Emission Scenario Document for PT 2-3-4".*

[1] Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market

- *“Workshop on Emission Scenario Documents for PT 1, 2, 3, 4, 5, 6" - draft minutes of the workshop on the environmental assessment of PTs 1-6 in Arona, 11 March 2008.*

- *“Workshop on environmental risk assessment for insecticides, acaricides and products to control other arthropods (Product Type 18). Brussels, Belgium, 11th of December 2007."*

- *ESD for PT 18: "OECD Environmental Health and safety Publications. Series on Emission Scenario Documents No. 14 Emission Scenario Document for Insecticides for Stables and Manure Storage Systems. Environment Directorate. Organisation for Economic Co-operation and Development. 2006".*

- *Baumann et al. 2000, (Institute for Environmental Research (INFU), University of Dortmund, UBA Berlin: Gathering and review of Environmental Emission Scenarios for biocides (2000)).*

- *Van der Poel and Bakker 2002, RIVM report 601 450 009. Emission Scenario Document for Biocides: Emission Scenarios for all 23 Product types of EU Directive 98/8/EEC.*

- *Montfoort et al. 2006, The use of disinfectants in livestock farming - Supplement to the evaluation method of non-agricultural pesticides of the Uniform system for Evaluation of substances (USES), RIVM report nr. 679102033.*

1.3 Harmonised presentation

The emission scenarios are presented in text and tables in this report. In the tables, the input and output data and calculations are specified, and units according to (E)USES are used. The input and output data are divided into four groups:

S data Set	Parameter must be present in the input data set for the calculation to be executed (no method has been implemented in the system to estimate this parameter; no default value is set, data either to be supplied by the notifier or available in the literature).
D Default	Parameter has a standard value (most defaults can be changed by the user).
O Output	Parameter is the output from another calculation (most output parameters can be overwritten by the user with alternative data).
P Pick list	Parameter value can be chosen from a “pick list” of values.

Pick lists values and default parameters are to be adapted, when specific data is available, instead of a mandatory use of these values as defaults.

2 Veterinary hygiene biocidal products (PT 3)

Veterinary hygiene biocidal products are used in areas in which animals are housed, kept or transported. PT 3 covers the use of disinfectants to control animal pathogens, prevent animal diseases, increase production and improve the quality of animal products. General cleaning of farm buildings and equipment is not included since it is outside the scope of PT 3.

A clear distinction must be made between biocides and veterinary medicinal products (which are outside scope of the Biocidal Products Directive as per Article 2b); the latter are controlled under a number of Council Directives. The distinction between biocides and veterinary medicinal products is made on the basis of 'claim-driven' definitions. All applications of biocides within this product type area are assumed to be for 'professional' use.

Scenarios for the following sub-groups of PT 3 are presented in this document:

- Disinfection of animal housings (see chapter 2.1)
- Disinfection of vehicles used for animal transport (see chapter 2.2)
- Disinfection for veterinary hygiene: non-medicinal teat dips (see chapter 2.3)
- Disinfection for veterinary hygiene: footwear and animals' feet (see chapter 2.4)
- Disinfection in hatcheries (see chapter 2.5)

A scenario for the disinfection of milking parlours is provided in the ESD for PT 4 (Disinfectants used in food and feed areas).

The ESD for PT 18 (OECD, Series on Emission Scenario Documents No. 14, Emission Scenario Document for Insecticides for Stables and Manure Storage Systems; cited in the following as "ESD for PT 18 No. 14") was used as the basis for the ESD for PT 3 since the application of insecticides in stables (PT 18) and the application of disinfectants in stables (PT 3) are very similar and the emission paths are almost identical. The ESD for PT 18 already provides detailed scenarios and emission descriptions including respective calculation procedures and formula.

In this document, the chapters 5.7.2 to 5.9 of the ESD for PT 18 No. 14 have been included in an adapted form.

The other parts of the ESD for PT 18 No. 14, listed in the following, providing general information have not been included in this ESD:

- Chapters 1 to 5, providing explanations concerning animal categories, housing types, stable areas etc.

- Chapter 6, providing information on calculations of biocide concentration in fresh surface water and in ground water as well as models for calculation the degradation of biocides in the manure/slurry.

- Chapter 7 and the appendices, providing options for refinement of the emission estimations.

In this document, only reference is made to these chapters in the ESD for PT 18 No. 14.

Relevant tables and pick lists from the ESD for PT 18 No. 14 (in adapted form) are provided in Appendix 1 in this document.
In the emission scenarios provided in this document, release pathways to manure/slurry, waste water, air and land (from spreading of manure/slurry) are considered. Deposition of substances to soil following release to air are negligible compared to direct application of biocide-containing manure/slurry to land and is therefore not considered.

Agricultural run-off to surface water after manure/slurry application to land can also lead to environmental exposure of biocides. Reference is made to the ESD for PT 18 No. 14 where a first tier approach to calculate the surface water concentration on the basis of the pore-water concentration following the method of Montfoort (1999) is provided.

In general, across Europe, it is prohibited to discharge waste water containing slurry to the public (municipal) sewer, and hence liquid waste containing manure is either removed to a slurry or waste water collection tank and may be subsequently applied to land or treated in a communal or on-farm waste water treatment plant (EC 2003b). The fraction of the biocide reaching the manure/slurry storage system will depend on the animal species and category considered (i.e. the type of housing and slurry collection system), the way of application and the way of action of the biocide. In a small number of cases it is possible that local authorities might allow livestock farms to discharge diluted waste streams from stables to the public sewer if they are able to treat the extra pollution load (OECD 2006).

In the ESD for PT 18 No. 14, scenarios for deposition of active ingredients onto land have been developed taking into account that in a number of countries land application of manure/slurry is regulated by emission standards for phosphate and/or nitrogen. There are periods during which land application is not allowed. In the ESD for PT 18 No. 14 and accordingly in this document, it is assumed that the legal standards for phosphate and nitrogen loading determine the maximum amounts of biocides in soil due to manure or slurry application.

The ESD for PT 18 No. 14 and the present document allow considering biodegradation of biocides in slurry/manure. Since considerable uncertainty exists concerning methods for the estimation of biodegradation in manure/slurry, the ESD for PT 18 No. 14 does not consider biodegradation in the first-tier assessment (only as second-tier). No standard test-guideline for testing the degradation of biocides in slurry exists at present (a guideline for testing the anaerobic degradation of biocides and veterinary pharmaceuticals in liquid manure is being developed). The same approach as for PT 18 No. 14 should be applied to PT 3. A methodology to include biodegradation in manure and slurry as second-tier approach in the emission estimation is provided in the ESD for PT 18 No. 14.

2.1 Disinfection of animal housings

2.1.1 Description of this use area

Disinfection of animal housing facilities is widely carried out, especially in poultry and pig farming. Two main types of animal husbandry exist, continuous and batch system.

- In **batch systems**, all animals in a given animal house are moved in (e.g. at the beginning of the fattening period) or out (at the end of the fattening period) at more or less the same time. Only stables which are empty of animals are cleaned and disinfected.

- In **continuous systems,** at a given time point, only parts of the herd are moved in or out. When parts of the animals are moved out, the free space in the animal house is cleaned and disinfected. Then, new animal are generally moved in. The presence of animals complicates the disinfection and limits the choice of disinfectants.

The amount of disinfectant applied in the continuous system at a given time is lower than in the batch system, where the whole stable area is disinfected. Therefore, as a worst case, only the batch system is considered in the following.

The disinfection in batch systems is carried out as follows: upon removal of all animals, the stable is thoroughly cleaned. Once the areas have dried, the disinfectants are applied by spraying surfaces with high- or low pressure equipment.
Disinfection with aerosol (droplet size < 10 µm) by nebulizer or vaporizer is only carried out in exceptional cases, since it can only be carried out in sealable small housings (Bodenschatz, 2006).
In intensive poultry husbandry, resistant stages (resistant dormant bodies) of parasites can cause severe problems. Therefore, two successive disinfections may be carried out, often using different substances.

2.1.2 Biocidal active substances typically applied in these areas

According to Strauch (2002), the most common disinfectants used for the disinfection of animal housings are:

- Organic acids (such as formic acid),
- "Per" compounds (such as hydrogen peroxide, peracetic acid),
- Formaldehyde and other aldehydes,
- Quaternary ammonium compounds,
- Phenols,
- Halogenated compounds.

The choice of disinfectant depends on different factors. Some of the most important ones are the temperature at which disinfection is carried out, the time point and the method used.

2.1.3 Environmental release pathways

The main emission paths are into the slurry/manure system and into the air. In the case of some housing types for poultry, emission to waste water can take place.

2.1.4 Emission scenario

The scenario presented below covers the disinfection of an entire stable (batch system). It is based on the scenario for insecticide application by spraying as described in the ESD for PT 18 No. 14. Default values for the different animal categories and the respective data on housing sizes, animal numbers and slurry production are presented in Table 8 and 11 in

Appendix 1 of this document and correspond to the figures given in tables 5.2, 5.3 and 5.5 in the ESD for PT 18 No. 14.
Additional data relevant for PT 3 is presented in Table 9 of Appendix 1, providing default values for the number of disinfection events for the different animal categories.

2.1.4.1 Additional explanations on the emission scenario (from ESD for PT 18 No. 14, adapted to PT 3)

Storage time and land application of manure

The fraction of the biocide that reaches the manure/slurry storage will remain there until the next land application of manure/slurry. The storage time of manure/slurry in the storage system depends on:

I. Period of land application
The period of the year during which land application can be legally made varies from several months to the whole year, depending on the country and the soil type.

II. Number of land applications
There are no countries within the EU where it is prohibited to apply the whole amount of manure (based on the immission standards) in one application. Agricultural practise indicates though that three or four applications can be applied. This may also differ for grassland and arable land.

For the period that land application takes place, the provisional default periods used in the model are presented in Table 12 of this document. Actual application dates for selected OECD countries are provided in Chapter 7 (of ESD for PT 18 No. 14) on refinement options.

The timing of the biocide application in relation to the timing of land application of manure/slurry determines the number of biocide applications in between subsequent manure applications and the amount of manure/slurry produced. Data on manure/slurry spreading periods other than the default are provided by Defra (2005).

Nitrogen immission standards

For the calculation of the concentration in soil, the approach of Defra (2005) is used. This means that the amount of biocide present in the manure is related to the nitrogen content and the nitrogen load, which is allowed according to the immission standard. However, in various countries there may be an immission standard for P_2O_5 instead. It is even possible that there are standards for both P_2O_5 and nitrogen. Information for different countries on tolerated N values for use of manure are taken from Defra (2005) and adapted to the decisions made of the member states at Technical Meeting I/08 and are presented in Table 13 of this document (please see also footnote to Table 13).

For the model calculations in this document, it is assumed that for arable land, the maximum application rates for manure as presented in Table 13 are applied in one application.

The **mixing depth of the soil** depends on the manure application system and on the type of soil (grassland or arable land). The default values are 0.05 m for grassland and 0.20 m for arable land. Further information on this topic is given in chapter 5.8 of the ESD for PT 18 No. 14.

Timing aspects

I. Grassland
When the time period between two biocide applications Tbioc-int is larger than the period between two land applications Tgr-int (for grassland) or Tar-int (for arable land), the number of biocide applications between two repeated manure applications equals 1. When the period between two manure applications is longer than the period between two repeated biocide applications, the number of biocide applications between two manure applications is calculated by dividing the manure storage period by the biocide application interval and rounding it to whole numbers.

As a worst-case situation for grassland the time between two land applications Tgr-int is used to estimate the amount of manure produced during that period.

II. Arable land
For biocides applied throughout the whole year, as it is regularly the case in PT 3 areas, the same estimation procedure as for grassland can be applied for both application on grassland and application on arable land.

For arable land there is assumed only one land application during the year.
For this situation, and for one biocide application, the amount of manure produced during the application interval, Tbioc-int, is used to calculate the concentration in manure. This implies a worst case situation as dilution with manure which may be collected in the period before is not considered.

On the other hand dilution with manure can be taken into account by taking the manure storage period (Tar-int = 212; see table 12) for calculation of the amount of manure produced and taking the number of biocide applications (Napp-bioc) to calculate the amount of biocide used.

In the following Tables 1a to 1d the emission scenario is provided. In order to make the table easier readable, it was split into the parts “Input parameters” (Table 1a), “Output parameters” (Table 1b), “Intermediate calculations” (Table 1c) and “End Calculation” (1d).

Table 1a: Emission scenario for calculating the release of disinfectants used for disinfection of animal housings - Input parameters

Parameters	Nomenclature	Value	Unit	Origin
Input				
Type of housing/manure storage (for application of the notification)	*cat-subcat (i1)*		[-]	P (Appendix1: Table 7)
Type of biocide	*bioctype (i2)*	i2 = 1	[-]	D (Appendix1: Table 7)
Type of application	*appway (i3)*	i3 = 1	[-]	D (Appendix1: Table 7)
Relevant emission stream	*stream (i4)*		[-]	P (Appendix1: Table 7)
Area of the housing for application	$AREA_{i1}$		[m^2]	P (Appendix1: Table 8)
Content of active ingredient in formulation (product)	*Fbioc*		[$g.l^{-1}$]	S
Amount of (undiluted) product prescribed to be used per m^2	$Vprod_{i1,i2,i3}$		[$l.m^{-2}$]	S
Dilution factor (for preparation of the working solution from the formulation (product))	F_{dil} [A)]		[-]	S
Fraction of active ingredient released	($F_{stp*} = F_{ww}$) $F_{stp*\_ \ i1,i2,i3,i4}$ $F_{slurry/manure\_ \ i1,i2,i3,i4}$ [E)]		[-]	D (Appendix 1: Table 10)
	F_{air}	0	[-]	D (ESD for PT 18 No. 14, p. 29)[F)]
Number of disinfectant applications in one year	*Napp-bioc*		[-]	D (Appendix 1: Table 9)
Biocide application interval	*Tbioc-int*		[d]	D (Appendix 1: Table 9)
Number of manure applications for grassland	*Nlapp-grass*	4	[-]	D
Number of manure applications for arable land	*Nlapp-arab*	1	[-]	D
Manure application time interval for grassland	*Tgr-int*		[d]	D/S (Appendix 1: Table 12)

Parameters	Nomenclature	Value	Unit	Origin
Manure application time interval for arable land	*Tar-int*		[d]	D/S (Appendix 1: Table 12)
Number of animals in housing for every relevant category/subcategory *i1*	$Nanimal_{i1}$		[-]	D/S (Appendix 1: Table 8)
Amount of phosphate per animal for every relevant category/subcategory *i1*	$Qphosph_{i1}$		$[kg.d^{-1}]$	D (Appendix 1: Table 11)
Amount of nitrogen per animal for every relevant category/subcategory *i1*	$Qnitrog_{i1}$		$[kg.d^{-1}]$	D (Appendix 1: Table 11)
If phosphate immission standards are applied: [B)]				
Phosphate immission standard for one year on grassland	$Q_{P2O5,grassland}$		$[kg.ha^{-1}]$	D (Appendix 1: Table 13)
Phosphate immission standard for one year on arable land	$Q_{P2O5,arable\_land}$		$[kg.ha^{-1}]$	D (Appendix 1: Table 13)
If nitrogen immission standards are applied: [B)]				
Nitrogen immission standard for one year on grassland	$Q_{N,grassland}$		$[kg.ha^{-1}]$	D (Appendix 1: Table 13)
Nitrogen immission standard for one year on arable land	$Q_{N,arable\_land}$		$[kg.ha^{-1}]$	D (Appendix 1: Table 13)
Mixing depth with soil, grassland	$DEPTH_{grassland}$ [C)]	0.05	[m]	D
Mixing depth with soil, arable land	$DEPTH_{arable\_land}$ [C)]	0.20	[m]	D
Density of wet bulk soil	$RHOsoil_{wet}$ [C,D)]	1700	$[kg.m^{-3}]$	D
Standard concentration in air at 100 m from source for a source strength of 1 $kg.d^{-1}$	$Cstd_{air}$ [D)]	$2.78 \bullet 10^{-4}$	$[mg.m^{-3}]$	D

A) For example: If the formulation is diluted 1/10 (= 1:10), the dilution factor is 10^{-1}. If the formulation (product) is also used as working solution, the dilution factor is 1.

B) At least one of the immission standards should be applied.

C) According to ESD for PT 18 No. 14.

D) According to Technical Guidance Document on Risk Assessment (TGD) in support of Directive 98/8/EC, Part II (EC 2003a).

E) Degradation of the active substance in slurry/manure is not considered in the first tier. A methodology to include biodegradation in manure and slurry as second-tier approach in the emission estimation is provided in the ESD for PT 18 No. 14.

F) ESD for PT 18 No. 14: "The main emission to air occurs when the diluted formulation or spraying powder is sprayed or fogging or aerosol treatment is applied. Most insecticide will settle soon within the housing with the droplets or powder. It is assumed for the model that the emission factor to air is zero, with the exception of fogging and aerosols for this application in which case an emission to the air will be relevant."

* STP= Sewage Treatment Plant

Table 1b: Emission scenario for calculating the release of disinfectants used for disinfection of animal housings - Output parameters

Parameters	Nomenclature	Value	Unit	Origin
Output				
Soil exposure				
For stream *i4* =1 and 3				
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for phosphate and land application on grassland	$PIECgrs\text{-}P_2O_{5i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for phosphate and land application on arable land	$PIECars\text{-}P_2O_{5i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for nitrogen and land application on grassland	$PIECgrs\text{-}N_{i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for nitrogen and land application on arable land	$PIECars\text{-}N_{i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Air exposure				
Emission to air from one application	$Qai\text{-}air_{i1,i2,i3,i4} = Edirect_{air\ i1,i2,i3,i4}$		[kg]	O
Annual average concentration in air at 100 m from source	$Cdirect_{air\ i1,i2,i3,i4}$		$[mg.m^{-3}]$	O
STP				
Emission from one application to a standard STP or an on-site waste water treatment plant for the relevant cases of *i1* = 8, 11, 12, 16, 17, 18	$Qai\text{-}stp_{i1,i2,i3,i4} = Elocal_{waste\ water}$		$[kg.d^{-1}]$	O

Table 1c: Emission scenario for calculating the release of disinfectants used for disinfection of animal housings - Intermediate calculations

Parameters	Nomenclature	Value	Unit	Origin
Intermediate Calculations				
Number of biocide applications during storage period for application on grassland	$Napp\text{-}manure_{gr}$		[-]	O
Number of biocide applications during storage period for application on arable land	$Napp\text{-}manure_{ar}$		[-]	O
For grassland and arable land: If *Tbioc-int* > *Tgr/ar-int,* then *Napp-manure = 1* If *Tbioc-int* < *Tgr/ar-int,* then *Napp-manure = ROUND (Tgr/ar-int/Tbioc-int)* (ROUND is the sign for rounding off to a whole number)				
Amount of active ingredient to be used for one application	$Qai\text{-}prescr_{i1,i2,i3}$		[kg]	O
$Qai\text{-}prescr_{i1,i2,i3} = 10^{-3}$ □ $\cdot\ Fbioc \cdot Vprod_{i1,i2,i3} \cdot F_{dil} \cdot AREA_{i1}$				
Amount of active ingredient in relevant stream *i4* after one application	$Qai_{\ i1,i2,i3,i4}$		[kg]	O
$Qai_{\ i1,i2,i3,i4} = F_{stp\ or\ slurry/manure\ i1,i2,i3,i4} \cdot Qai\text{-}prescr_{\ i1,i2,i3}$				
Amount of active ingredient in manure or slurry after the relevant number of biocide applications for the manure application to grassland	$Qai\text{-}grass_{i1,i2,i3,i4}$		[kg]	O
$Qai\text{-}grass_{i1,i2,i3,i4} = Qai_{\ i1,i2,i3,i4} \cdot Napp\text{-}manure_{gr}$				
Amount of active ingredient in manure or slurry after the relevant number of biocide applications for the manure application to arable land	$Qai\text{-}arab_{i1,i2,i3,i4}$		[kg]	O
$Qai\text{-}arab_{i1,i2,i3,i4} = Qai_{\ i1,i2,i3,i4} \cdot Napp\text{-}manure_{ar}$				
Amount of phosphate produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to grassland	$Qphosph\text{-}grass_{i1,i4}$		[kg]	O
$Qphosph\text{-}grass_{i1,i4} = Nanimal_{i1} \cdot Qphosph_{i1} \cdot Tgr\text{-}int_{i2}$				
Amount of phosphate produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to arable land	$Qphosph\text{-}arab_{i1,i4}$		[kg]	O
$Qphosph\text{-}arab_{i1,i4} = Nanimal_{i1} \cdot Qphosph_{i1} \cdot Tar\text{-}int_{i2}$				
Amount of nitrogen produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to grassland	$Qnitrog\text{-}grass_{i1,i4}$		[kg]	O
$Qnitrog\text{-}grass_{i1,i4} = Nanimal_{i1} \cdot Qnitrog_{i1} \cdot Tgr\text{-}int_{i2}$				
Amount of nitrogen produced during the relevant	$Qnitrog\text{-}arab_{i1,i4}$		[kg]	O

Parameters	Nomenclature	Value	Unit	Origin
period for every relevant (sub)category of animal/housing *i1* and application to arable land				
$Qnitrog\text{-}arab_{i1,i4} = Nanimal_{i1} \bullet Qnitrog_{i1} \bullet Tar\text{-}int_{i2}$				

Table 1d: Emission scenario for calculating the release of disinfectants used for disinfection of animal housings – End calculation [A)]

End calculation
Soil exposure *If the phosphate immission standard is applicable:*
Concentration of the active ingredient in soil based on the phosphate immission standard for arable land $PIECgrs\text{-}P_2O_{5i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}grass_{i1,i2,i3,i4} \bullet Q_{P2O5,\ grassland}}{Qphosph\text{-}grass_{i1,i4} \bullet Nlapp\text{-}grass \bullet DEPTH_{grassland} \bullet RHOsoil_{wet}}$
Concentration of the active ingredient in soil based on the phosphate immission standard for grassland $PIECars\text{-}P_2O_{5i1,i2,i3,I4} = \frac{100 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{P2O5,\ arable\text{-}land}}{Qphosph\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet}}$
If the nitrogen immission standard is applicable:
Concentration of the active ingredient in soil based on the nitrogen immission standard for grassland $PIECgrs\text{-}N_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}grass_{i1,i2,i3,i4} \bullet Q_{N,\ grassland}}{Qnitrog\text{-}grass_{i1,i4} \bullet Nlapp\text{-}grass \bullet DEPTH_{grassland} \bullet RHOsoil_{wet}}$
Concentration of the active ingredient in soil based on the nitrogen immission standard for arable land $PIECars\text{-}N_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{N,\ arable\text{-}land}}{Qnitrog\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet}}$
Air exposure: $Edirect_{air\ i1,i2,i3,i4} = Qai\text{-}air_{\ i1,i2,i3,i4} = F_{air} \bullet Qai\text{-}prescr_{i1,i2,i3}$ $Cdirect_{air\ i1,i2,i3,i4} = \frac{Edirect_{air\ i1,i2,i3,i4} \bullet Cstd_{air} \bullet Napp\text{-}bioc}{365}$
STP $Qai\text{-}stp_{i1,i2,i3,i4} = F_{stp\ i1,i2,i3,i4} \bullet Qai\text{-}prescr_{i1,i2,i3}$

[A] **Please note:** The formulae provided in Table 1d (as adopted from ESD for PT 18 No. 14) can be misleading when units (e.g. "ha") are inserted. Using the formulae as shown below (example given for PIECars-N) can avoid misunderstandings (ha is given as 10^4 m^2).

$$PIECars\text{-}N_{i1,i2,i3,i4} = \frac{10^6 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{N,\,arable\text{-}land} \qquad [kg]\ [kg]\ [m^3]}{Qnitrog\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet} \bullet 10^4 \qquad [kg]\ [kg]\ [m]\ [m^2]}$$

2.2 Disinfection of vehicles used for animal transport

2.2.1 Description of this use area

Professional transports of large numbers of animals can be sub-divided:

- Transport of slaughter animals: animals are transported from farms to slaughter houses;
- Transport of production animals: animals are transported from one farm to another (e.g. transport of piglets from piglet producing farms to fattening farms).

According to the information provided by common carriers (Knebusch 2009, Fischer 2009), slightly more slaughter animals are transported than production animals.

After each transport, trucks and transport boxes (only relevant for poultry transports), are cleaned and disinfected. Cleaning and disinfection are performed on special sites on the premises of the transport companies or of the slaughter houses. Disinfection takes place once per day on seven days per week (large slaughterhouses slaughter every day).

Strauch (2002) describes in detail the following cleaning and disinfection steps for trucks:

1. Cleaning of truck by sweeping, removal of straw and faeces.

2. Spraying of all surfaces with disinfectant solution; 5 minutes contact time.

3. Cleaning of the interior with a high pressure cleaner.

4. Removal of residual water with a suction cleaner.

5. 10 minutes drying time.

6. Second spraying of all surfaces with disinfectant solution; 30 minutes contact time.

In contrast to the above descriptions by Strauch (2002), on product labels and product information sheets, only one disinfection step instead of two is recommended. However, a longer contact time (at least 30 min) is suggested.

Transport boxes are regularly cleaned in automatic washing systems.

2.2.2 Biocidal active substances typically applied in these areas

According to Strauch (2002), the following biocidal active substances are used for the disinfection of transport vehicles and boxes:

- Formic acid and other organic acids;
- Peracetic acid;
- Formaldehyde and other aldehydes.

2.2.3 Environmental release pathways

The main emission pathway is emission to the waste water, but also emission to air may take place. Treatment of the waste water is carried out in on-site waste water treatment plants or in municipal sewage treatment plants (LWK NRW 2009; Fischer 2009; Knebusch 2009).

2.2.4 Emission scenario

In the emission scenario presented below, default values were calculated on the basis of data collected on transports of slaughter animals. The detailed deduction of default values is provided in Appendix 2 of this document.
Distinction is made between transports of mammals and poultry because slaughter houses are normally specialised. In the case of poultry, additional disinfection of the transport boxes needs to be considered. Data on mammals are based on a mix calculation for fattening pigs, beef cattle and veal calves. For poultry, data on broilers are used, since broilers form the main part of slaughter poultry.

For mammal transports, a default value for the surface area to be disinfected of 4546 m^2 (truck interior area) per day was deduced; the respective values for broilers are 3355 m^2 for boxes and of 1120 m^2 for the interior of the truck (for further details, please refer to Appendix 2 of this document).

Table 2: Emission scenario for the disinfection of vehicles used for animal transport

Parameters	Nomenclature	Value	Unit	Origin
Inputs				
Area of trucks (mammal transports)	*AREAmam*	4546	[m^2]	D (Appendix 2)
Area of trucks (poultry transports)	*AREApoul*	1120	[m^2]	D (Appendix 2)
Area of containers (poultry transports)	*AREAcont*	3355	[m^2]	D (Appendix 2)
Content of active ingredient in formulation (product)	*Fbioc*		[$g.l^{-1}$]	S
Amount of (undiluted) product prescribed to be used per m^2	$Vprod_{i2,i3}$		[$l.m^{-2}$]	S
Dilution factor (for preparation of the working solution from the formulation (product))	F_{dil} A)		[-]	S
Fraction released to air	$F_{air\ i2,i3,i4}$ B)	0.1	[-]	D
Fraction released to waste water	$F_{stp\ i2,i3,i4}$	(1-F_{air})	[-]	O
Number of disinfectant applications in one year	*Napp-bioc*	365	[-]	D
Standard concentration in air at 100 m from source for a source strength of 1 $kg.d^{-1}$	$Cstd_{air}$ C)	$2.78 \bullet 10^{-4}$	[$mg.m^{-3}$]	D
Outputs				
Air Exposure				
Emission to air from one application	$Qai\text{-}air_{i2,i3,i4} = Edirect_{air\ i2,i3,i4}$		[kg]	O
Annual average concentration in air at 100 m from source	$Cdirect_{air\ i2,i3,i4}$		[$mg.m^{-3}$]	O
STP				
Emission from one application to a standard STP or an on-site waste water treatment plant	$Qai\text{-}stp_{i2,i3,i4} = Elocal_{waste\ water\ i2,i3,i4}$		[$kg.d^{-1}$]	O
Intermediate calculations				
Amount of active ingredient to be used for one application	$Qai\text{-}prescr_{i2,i3}$		[kg]	O
Mammal transports: $Qai\text{-}prescr_{i2,i3} = 10^{-3} \bullet Fbioc \bullet Vprod_{i2,i3} \bullet F_{dil} \bullet AREAmam$				
Poultry transports: $Qai\text{-}prescr_{i2,i3} = 10^{-3} \bullet Fbioc \bullet Vprod_{i2,i3} \bullet F_{dil} \bullet (AREApoul + AREAcont)$				
Calculation				
Air exposure:				
$Edirect_{air\ i2,i3,i4} = Qai\text{-}air_{\ i2,i3,i4} = F_{air\ i2,i3,i4} \bullet Qai\text{-}prescr_{i2,i3}$				

Parameters	Nomenclature	Value	Unit	Origin
$Cdirect_{air\ i2,i3,i4} = \dfrac{Edirect_{air\ i2,i3,i4} \cdot Cstd_{air} \cdot Napp\text{-}bioc}{365}$				
STP $Qai\text{-}stp_{\ i2,i3,i4} = F_{stp\ i2,i3,i4} \cdot Qai\text{-}prescr_{i2,i3,i4}$				

A) For example: If the formulation is diluted 1/10 (= 1:10), the dilution factor is 10^{-1}. If the formulation (product) is also used as working solution, the dilution factor is 1.

B) Default value for F_{air} derived from the A-tables of the TGD (IC = 1: AGRICULTURAL INDUSTRY; Table A3.1 – Default emission factor to air).

C) According to Technical Guidance Document on Risk Assessment (TGD) in support of Directive 98/8/EC, Part II (EC 2003a).

2.3 Disinfection for veterinary hygiene: non-medicinal teat dips

2.3.1 Description of this use area

Udder hygiene comprises cleaning and disinfection of udder and teats. Disinfectants are mainly applied on teats after milking for hygiene reasons (post milking application) (DVG 2009).

Application methods are spraying, foaming and dipping of teats. Dipping is most commonly used. The teats are immersed ("dipped") immediately after milking using a cuplike container that holds the disinfectant. At least the lower third of the teats should be immersed. Dip solution remaining in the cuplike container should be discharged.

The applied teat dip is left to dry on the teat surface and remains there as a protective film (DVG 2009).

2.3.2 Biocidal active substances typically applied in these areas

According to WGMEV (2009), the following biocidal active substances are used for post milking application:

- Iodine;
- Chlorine compounds;
- Quaternary ammonium compounds.

Iodine is the disinfectant which is used most frequently. It is complex-bound to anionic surfactants, such as polyvinyl-pyrrolidone and nonoxinol-9. The iodine-surfactant complexes are called iodophores.

2.3.3 Environmental release pathways

After dipping, the remaining dipping solution in the cup is discharged. Two pathways are possible: emission to waste water or to the slurry. This depends on whether the cows are milked in the stable (emission to slurry) or in a milking parlour outside the stable (emission to waste water).

2.3.4 Emission scenario

The lactation period for dairy cows is normally 270 to 300 days (Ebermann 2008). Dairy cows are regularly milked twice per day (DVG 2009). Potentially spilled dipping solution can either reach the slurry or the waste water. The fraction of disinfectant remaining on teats depends on the viscosity of the application solution. Many products are quickly drying on the teats. As a conservative approach, the fraction of disinfectant remaining on teats is considered to be 0.5 as a worst case. The default value for a dairy cow herd size (100 dairy cows) is taken from Table 8 in Appendix 1 of this document (= 5.2 of the ESD for PT 18 No. 14), which provides default values for the average sizes of animal stocks in different animal categories.

Table 3a: Emission scenario for disinfectants used for veterinary hygiene: non-medicinal teat dips - Input parameters

Parameters	Nomenclature	Value	Unit	Origin
Input				
Type of housing/manure storage (for application of the notification)	*cat-subcat (i1)*	i1 = 1	[-]	D (Appendix1: Table 7)
Type of biocide	*bioctype (i2)*	i2 = 1	[-]	D (Appendix1: Table 7)
Type of application	*appway (i3)*	i3 = 2	[-]	D (Appendix1: Table 7)
Relevant emission stream	*stream (i4)*		[-]	P (Appendix1: Table 7)
Content of active ingredient in formulation (product)	*Fbioc*		$[g.l^{-1}]$	S
Amount of product prescribed to be used for one treatment (dipping of the four teats) of one animal	$Vprod_{i1,i2,i3}$		[l]	S
Dilution factor (for preparation of the working solution from the formulation (product))	F_{dil} A)		[-]	S
Fraction of active ingredient released	$(F_{stp} = F_{ww})$ $F_{stp\_i1,i2,i3,i4}$	$1 – F_{teat}$	[-]	D
	$F_{slurry/manure\_ \ i1,i2,i3,i4}$ F)	$1 – F_{teat}$	[-]	D
	F_{air}	0	[-]	D
	F_{teat}	0.5	[-]	D
Number of teat dipping events for one animal and one day (dipping of the four teats of one animal = one disinfectant application)	*Napp-teat*	2	[-]	D

Parameters	Nomenclature	Value	Unit	Origin
Number of days of lactation period (corresponds to number of emission days)	*Nday-lact* (*= Temission)*	300	[-]	D
Number of disinfectant applications in one year (equals number of disinfectant applications in one lactation period)	*Napp-bioc*	600	[-]	D
Interval between two disinfectant applications (dipping events)	*Tbioc-int* [B)]	0.5	[d]	D
Number of manure applications for grassland	*Nlapp-grass*	4	[-]	D
Number of manure applications for arable land	*Nlapp-arab*	1	[-]	D
Manure application time interval for grassland	*Tgr-int*		[d]	D/S (Appendix 1: Table 12)
Manure application time interval for arable land	*Tar-int*		[d]	D/S (Appendix 1: Table 12)
Number of animals in housing for category/subcategory *i1* =1	$Nanimal_{i1}$	100	[-]	D/S (Appendix 1: Table 8)
Amount of phosphate per animal for category/subcategory *i1* =1	$Qphosph_{i1}$	0.10466	[kg.d^{-1}]	D (Appendix 1: Table 11)
Amount of nitrogen per animal for category/subcategory *i1* =1	$Qnitrog_{i1}$	0.33890	[kg.d^{-1}]	D (Appendix 1: Table 11)
If phosphate immission standards are applied: [C)]				
Phosphate immission standard for one year on grassland	$Q_{P2O5,grassland}$		[kg.ha^{-1}]	D (Appendix 1: Table 13)
Phosphate immission standard for one year on arable land	$Q_{P2O5,arable\_land}$		[kg.ha^{-1}]	D (Appendix 1: Table 13)
If nitrogen immission standards are applied: [C)]				
Nitrogen immission standard for one year on grassland	$Q_{N,grassland}$		[kg.ha^{-1}]	D (Appendix 1: Table 13)
Nitrogen immission standard for one year on arable land	$Q_{N,arable\_land}$		[kg.ha^{-1}]	D (Appendix 1: Table 13)
Mixing depth with soil, grassland	$DEPTH_{grassland}$ [D)]	0.05	[m]	D
Mixing depth with soil, arable land	$DEPTH_{arable\_land}$ [D)]	0.20	[m]	D
Density of wet bulk soil	$RHOsoil_{wet}$ [D,E)]	1700	[kg.m^{-3}]	D

[A)] For example: If the formulation is diluted 1/10 (= 1:10), the dilution factor is 10^{-1}. If the formulation (product) is also used as working solution, the dilution factor is 1.

[B)] The interval between the end of a lactation period and the beginning of a new one was not taken into account in the default value for Tbioc-int in order not to underestimate the emission into the manure and consequently the soil exposure.

[C)] At least one of the immission standards should be applied.

[D)] According to ESD for PT 18 No. 14.

[E)] According to Technical Guidance Document on Risk Assessment (TGD) in support of Directive 98/8/EC, Part II (EC 2003a).

[F)] Degradation of the active substance in slurry/manure is not considered in the first tier. A methodology to include biodegradation in manure and slurry as second-tier approach in the emission estimation is provided in the ESD for PT 18 No. 14.

Table 3b: Emission scenario for disinfectants used for veterinary hygiene: non-medicinal teat dips - Output parameters

Parameters	Nomenclature	Value	Unit	Origin
Output				
Soil exposure For stream *i4* =1 and 3				
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for phosphate and land application on grassland	$PIECgrs\text{-}P_2O_{5 i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for phosphate and land application on arable land	$PIECars\text{-}P_2O_{5 i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for nitrogen and land application on grassland	$PIECgrs\text{-}N_{i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for nitrogen and land application on arable land	$PIECars\text{-}N_{i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
STP				
Local emission to a standard STP or an on-site waste water treatment plant	$Qai\text{-}stp_{i1,i2,i3,i4} = Elocal_{waste\ water}$		$[kg.d^{-1}]$	O

Table 3c: Emission scenario for disinfectants used for veterinary hygiene: non-medicinal teat dips - Intermediate calculations

Parameters	Nomenclature	Value	Unit	Origin
Intermediate Calculations				
Number of biocide applications during storage period for application on grassland	$Napp\text{-}manure_{gr}$		[-]	O
Number of biocide applications during storage period for application on arable land	$Napp\text{-}manure_{ar}$		[-]	O
For grassland and arable land: If *Tbioc-int* > *Tgr/ar-int,* then *Napp-manure = 1* If *Tbioc-int* < *Tgr/ar-int,* then *Napp-manure = ROUND (Tgr/ar-int/Tbioc-int)* (ROUND is the sign for rounding off to a whole number)				
Amount of active ingredient to be used for one application (one treatment of one animal)	$Qai\text{-}prescr_{i1,i2,i3}$		[kg]	O
$Qai\text{-}prescr_{i1,i2,i3} = 10^{-3}$ □ • $Fbioc \cdot Vprod_{i1,i2,i3} \cdot F_{dil}$				
Amount of active ingredient in relevant stream *i4* after one application for all animals	$Qai_{\ i1,i2,i3,i4}$		[kg]	O
$Qai_{\ i1,i2,i3,i4} = F_{stp\ or\ slurry/manure\ i1,i2,i3,i4} \cdot Qai\text{-}prescr_{\ i1,i2,i3} \cdot Nanimal_{i1}$				
Amount of active ingredient in manure or slurry after the relevant number of biocide applications for the manure application to grassland	$Qai\text{-}grass_{i1,i2,i3,i4}$		[kg]	O
$Qai\text{-}grass_{i1,i2,i3,i4} = Qai_{\ i1,i2,i3,i4} \cdot Napp\text{-}manure_{gr}$				
Amount of active ingredient in manure or slurry after the relevant number of biocide applications for the manure application to arable land	$Qai\text{-}arab_{i1,i2,i3,i4}$		[kg]	O
$Qai\text{-}arab_{i1,i2,i3,i4} = Qai_{i\ i1,i2,i3,i4} \cdot Napp\text{-}manure_{ar}$				
Amount of phosphate produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to grassland	$Qphosph\text{-}grass_{i1,i4}$		[kg]	O
$Qphosph\text{-}grass_{i1,i4} = Nanimal_{i1} \cdot Qphosph_{i1} \cdot Tgr\text{-}int_{i2}$				
Amount of phosphate produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to arable land	$Qphosph\text{-}arab_{i1,i4}$		[kg]	O
$Qphosph\text{-}arab_{i1,i4} = Nanimal_{i1} \cdot Qphosph_{i1l} \cdot Tar\text{-}int_{i2}$				
Amount of nitrogen produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to grassland	$Qnitrog\text{-}grass_{i1,i4}$		[kg]	O
$Qnitrog\text{-}grass_{i1,i4} = Nanimal_{i1} \cdot Qnitrog_{i1} \cdot Tgr\text{-}int_{i2}$				
Amount of nitrogen produced during the relevant	$Qnitrog\text{-}arab_{i1,i4}$		[kg]	O

Parameters	Nomenclature	Value	Unit	Origin
period for every relevant (sub)category of animal/housing *i1* and application to arable land				
$Qnitrog\text{-}arab_{i1,i4} = Nanimal_{i1} \bullet Qnitrog_{i1} \bullet Tar\text{-}int_{i2}$				

Table 3d: Emission scenario for disinfectants used for veterinary hygiene: non-medicinal teat dips – End calculation [A)]

End calculation
Soil exposure   *If the phosphate immission standard is applicable:*
Concentration of the active ingredient in soil based on the phosphate immission standard for grassland $PIECgrs\text{-}P2O5_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}grass_{i1,i2,i3,i4} \bullet Q_{P2O5,\ grassland}}{Qphosph\text{-}grass_{i1,i4} \bullet Nlapp\text{-}grass \bullet DEPTH_{grassland} \bullet RHOsoil_{wet}}$
Concentration of the active ingredient in soil based on the phosphate immission standard for arable land $PIECars\text{-}P2O5_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{P2O5,\ arable\text{-}land}}{Qphosph\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet}}$
If the nitrogen immission standard is applicable:
Concentration of the active ingredient in soil based on the nitrogen immission standard for grassland $PIECgrs\text{-}N_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}grass_{i1,i2,i3,i4} \bullet Q_{N,\ grassland}}{Qnitrog\text{-}grass_{i1,i4} \bullet Nlapp\text{-}grass \bullet DEPTH_{grassland} \bullet RHOsoil_{wet}}$
Concentration of the active ingredient in soil based on the nitrogen immission standard for arable land $PIECars\text{-}N_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{N,\ arable\text{-}land}}{Qnitrog\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet}}$
STP $Qai\text{-}stp_{i1,i2,i3,i4} = F_{stp\ i1,i2,i3,i4} \bullet Qai\text{-}prescr_{1,i2,i3} \bullet Nanimal_{i1} \bullet Napp\text{-}teat \bullet Temission / 365$

A) **Please note:** The formulae provided in Table 3d (as adopted from ESD for PT 18 No. 14) can be misleading when units (e.g. "ha") are put in. Using the formulae as shown below (exemplum given for PIECars-N) can avoid misunderstandings (ha is given as 10^4 m^2).

$$PIECars\text{-}N_{i1,i2,i3,i4} = \frac{10^6 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{N,\ arable\text{-}land} \qquad [kg]\ [kg]\ [m^3]}{Qnitrog\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet} \bullet 10^4 \qquad [kg]\ [kg]\ [m]\ [m^2]}$$

2.4 Disinfection for veterinary hygiene: footwear and animals' feet

2.4.1 Disinfection of footwear

2.4.1.1 Description of this use area

Disinfection of the footwear of personnel working in animal houses is an important part of stable hygiene. The workers walk over a mat which is soaked with a disinfectant solution or walk through a tub containing the disinfection solution. The tubs or mats are placed in such a way that any person entering an animal house cannot avoid it. The mats are soaked with 2 to 5 l, the tubs are filled with 5 to 10 l disinfectant solution (VDKO 2009; LWK NRW 2009). The disinfectant has to be regularly replaced. The recommendations for the replacement vary from once a week up to once a day (VDKO 2009; LWK NRW 2009).

2.4.1.2 Biocidal active substances typically applied in these areas

Conventional substances for footwear disinfection are organic acids (like peracetic acid, formic acid, glyoxylic acid), but also formaldehyde is used (LWK NRW 2009).

2.4.1.3 Environmental release pathways

The remaining solution in the footbath is either discharged to the waste water or to the manure (LWK RLP 2009). Emission to air is considered negligible, taking into account the low surface area of the tub and that the solution is only stirred up a few times per day.

2.4.1.4 Emission scenario

Since the volume of the tubs is bigger than the mats, disinfection with tubs was considered as worst case.
The following default values have been defined based on information provided by LWK NRW and VDKO (2009):

- One tub per entrance to an animal housing is assumed;
- The tubs are filled with 10 l disinfection solution, which is replaced once a day.

Table 4a: Emission scenario for calculating the release of disinfectants used for veterinary hygiene: footwear – Input parameters

Parameters	Nomenclature	Value	Unit	Origin
Input				
Type of housing/manure storage (for application of the notification)	*cat-subcat (i1)*		[-]	P (Appendix1: Table 7)
Type of biocide	*bioctype (i2)*	i2 = 1	[-]	D (Appendix1: Table 7)
Type of application	*appway (i3)*	i3 = 3	[-]	D (Appendix1: Table 7)

Parameters	Nomenclature	Value	Unit	Origin
Relevant emission stream	*stream (i4)*		[-]	P (Appendix1: Table 7)
Volume of the reservoir (tub)	$Vreserv_{i1,i2,i3}$	10	[l]	D
Content of active ingredient in formulation (product)	*Fbioc*		$[g.l^{-1}]$	S
Dilution factor (for preparation of the working solution from the formulation (product))	F_{dil} A)		[-]	S
Fraction of active ingredient released	$(F_{stp} = F_{ww})$ $F_{stp\_i1,i2,i3,i4}$	1	[-]	D
	$F_{slurry/manure\_ i1,i2,i3,i4}$ E)	1	[-]	D
Number of applications (tub fillings) in one year	*Napp-bioc*	365	[-]	D
Time interval between two applications (tub fillings)	*Tbioc-int*	1	[d]	D
Number of manure applications for grassland	*Nlapp-grass*	4	[-]	D
Number of manure applications for arable land	*Nlapp-arab*	1	[-]	D
Manure application time interval for grassland	*Tgr-int*		[d]	D/S (Appendix 1: Table 12)
Manure application time interval for arable land	*Tar-int*		[d]	D/S (Appendix 1: Table 12)
Number of animals in housing for every relevant category/subcategory *i1*	$Nanimal_{i1}$		[-]	P/S (Appendix 1: Table 8)
Amount of phosphate per animal for every relevant category/subcategory *i1*	$Qphosph_{i1}$		$[kg.d^{-1}]$	P (Appendix 1: Table 11)
Amount of nitrogen per animal for every relevant category/subcategory *i1*	$Qnitrog_{i1}$		$[kg.d^{-1}]$	P (Appendix 1: Table 11)
If phosphate immission standards are applied: B)				
Phosphate immission standard for one year on grassland	$Q_{P2O5,grassland}$		$[kg.d^{-1}]$	D (Appendix 1: Table 13)
Phosphate immission standard for one year on arable land	$Q_{P2O5,arable\_land}$		$[kg.d^{-1}]$	D (Appendix 1: Table 13)
If nitrogen immission standards are applied: B)				
Nitrogen immission standard for one year on grassland	$Q_{N,grassland}$		$[kg.ha^{-1}]$	D (Appendix 1: Table 13)
Nitrogen immission standard for one year on arable land	$Q_{N,arable\_land}$		$[kg.ha^{-1}]$	D (Appendix 1:

Parameters	Nomenclature	Value	Unit	Origin
				Table 13)
Mixing depth with soil, grassland	$DEPTH_{grassland}$ C)	0.05	[m]	D
Mixing depth with soil, arable land	$DEPTH_{arable\_land}$ C)	0.20	[m]	D
Density of wet bulk soil	$RHOsoil_{wet}$ C,D)	1700	[$kg.m^{-3}$]	D

A) For example: If the formulation is diluted 1/10 (= 1:10), the dilution factor is 10^{-1}. If the formulation (product) is also used as working solution, the dilution factor is 1.

B) At least one of the immission standards should be applied.

C) According to ESD for PT 18 No. 14.

D) According to Technical Guidance Document on Risk Assessment (TGD) in support of Directive 98/8/EC, Part II (EC 2003a).

E) Degradation of the active substance in slurry/manure is not considered in the first tier. A methodology to include biodegradation in manure and slurry as second-tier approach in the emission estimation is provided in the ESD for PT 18 No. 14.

Table 4b: Emission scenario for calculating the release of disinfectants used for veterinary hygiene: footwear - Output parameters

Parameters	Nomenclature	Value	Unit	Origin
Output				
Soil exposure For stream *i4* =1 and 3				
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for phosphate and land application on grassland	$PIECgrs\text{-}P_2O_{5i1,i2,i3,i4}$		[$mg.kg^{-1}{}_{wwt}$]	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for phosphate and land application on arable land	$PIECars\text{-}P_2O_{5i1,i2,i3,i4}$		[$mg.kg^{-1}{}_{wwt}$]	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for nitrogen and land application on grassland	$PIECgrs\text{-}N_{i1,i2,i3,i4}$		[$mg.kg^{-1}{}_{wwt}$]	O
Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) in the case of an immission standard for nitrogen and land application on arable land	$PIECars\text{-}N_{i1,i2,i3,i4}$		[$mg.kg^{-1}{}_{wwt}$]	O
STP				
Local emission to a standard STP or an on-site waste water treatment plant	$Qai\text{-}stp_{i1,i2,i3,i4} = Elocal_{waste\ water\ i1,i2,i3,i4}$		[$kg.d^{-1}$]	O

Table 4c: Emission scenario for calculating the release of disinfectants used for veterinary hygiene: footwear - Intermediate calculations

Parameters	Nomenclature	Value	Unit	Origin
Intermediate Calculations				
Number of biocide applications during storage period for application on grassland	$Napp\text{-}manure_{gr}$		[-]	O
Number of biocide applications during storage period for application on arable land	$Napp\text{-}manure_{ar}$		[-]	O
For grassland and arable land: If $Tbioc\text{-}int > Tgr/ar\text{-}int$, then $Napp\text{-}manure = 1$ If $Tbioc\text{-}int < Tgr/ar\text{-}int$, then $Napp\text{-}manure = ROUND\ (Tgr/ar\text{-}int/Tbioc\text{-}int)$ (ROUND is the sign for rounding off to a whole number)				
Amount of active ingredient to be used for one application (one tub filling)	$\text{Qai-prescr}_{i1,i2,i3}$		[kg]	O
$Qai\text{-}prescr_{i1,i2,i3} = 10^{-3}$ □ $\bullet\ Fbioc \bullet Vreserv_{i1,i2,i3} \bullet F_{dil}$				
Amount of active ingredient in relevant stream *i4* after one application	$Qai_{i1,i2,i3,i4}$		[kg]	O
$Qai_{i1,i2,i3,i4} = F_{stp\ or\ slurry/manure\ i1,i2,i3,i4} \bullet Qai\text{-}prescr_{i1,i2,i3}$				
Amount of active ingredient in manure or slurry after the relevant number of biocide applications for the manure application to grassland	$Qai\text{-}grass_{i1,i2,i3,i4}$		[kg]	O
$Qai\text{-}grass_{i1,i2,i3,i4} = Qai_{i1,i2,i3,i4} \bullet Napp\text{-}manure_{gr}$				
Amount of active ingredient in manure or slurry after the relevant number of biocide applications for the manure application to arable land	$Qai\text{-}arab_{i1,i2,i3,i4}$		[kg]	O
$Qai\text{-}arab_{i1,i2,i3,i4} = Qai_{i1,i2,i3,i4} \bullet Napp\text{-}manure_{ar}$				
Amount of phosphate produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to grassland	$Qphosph\text{-}grass_{i1,i4}$		[kg]	O
$Qphosph\text{-}grass_{i1,i4} = Nanimal_{i1} \bullet Qphosph_{i1} \bullet Tgr\text{-}int_{i2}$				
Amount of phosphate produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to arable land	$Qphosph\text{-}arab_{i1,i4}$		[kg]	O
$Qphosph\text{-}arab_{i1,i4} = Nanimal_{i1} \bullet Qphosph_{i1l} \bullet Tar\text{-}int_{i2}$				
Amount of nitrogen produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to	$Qnitrog\text{-}grass_{i1,i4}$		[kg]	O

Parameters	Nomenclature	Value	Unit	Origin
grassland				
$Qnitrog\text{-}grass_{i1,i4} = Nanimal_{i1} \bullet Qnitrog_{i1} \bullet Tgr\text{-}int_{i2}$				
Amount of nitrogen produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to arable land	$Qnitrog\text{-}arab_{i1,i4}$		[kg]	O
$Qnitrog\text{-}arab_{i1,i4} = Nanimal_{i1} \bullet Qnitrog_{i1} \bullet Tar\text{-}int_{i2}$				

Table 4d: Emission scenario for calculating the release of disinfectants used for veterinary hygiene: footwear – End calculation [A)]

End calculation
Soil exposure *If the phosphate immission standard is applicable:*
Concentration of the active ingredient in soil based on the phosphate immission standard for grassland $PIECgrs\text{-}P2O5_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}grass_{i1,i2,i3,i4} \bullet Q_{P2O5,\ grassland}}{Qphosph\text{-}grass_{i1,i4} \bullet Nlapp\text{-}grass \bullet DEPTH_{grassland} \bullet RHOsoil_{wet}}$
Concentration of the active ingredient in soil based on the phosphate immission standard for arable land $PIECars\text{-}P2O5_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{P2O5,\ arable\text{-}land}}{Qphosph\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet}}$
If the nitrogen immission standard is applicable:
Concentration of the active ingredient in soil based on the nitrogen immission standard for grassland $PIECgrs\text{-}N_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}grass_{i1,i2,i3,i4} \bullet Q_{N,\ grassland}}{Qnitrog\text{-}grass_{i1,i4} \bullet Nlapp\text{-}grass \bullet DEPTH_{grassland} \bullet RHOsoil_{wet}}$
Concentration of the active ingredient in soil based on the nitrogen immission standard for arable land $PIECars\text{-}N_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{N,\ arable\text{-}land}}{Qnitrog\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet}}$
STP $Qai\text{-}stp_{i1,i2,i3,i4} = F_{stp\ i1,i2,i3,i4} \bullet Qai\text{-}prescr_{i1,i2,i3}$

[A)] **Please note:** The formulae provided in Table 4d (as adopted from ESD for PT 18 No. 14) can be misleading when units (e.g. "ha") are put in. Using the formulae as shown below (exemplum given for PIECars-N) can avoid misunderstandings (ha is given as 10^4 m^2).

$$PIECars\text{-}N_{i1,i2,i3,i4} = \frac{10^6 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{N,\ arable\text{-}land} \quad [kg]\ [kg]\ [m^3]}{Qnitrog\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet} \bullet 10^4 \quad [kg]\ [kg]\ [m]\ [m^2]}$$

2.4.2 Disinfection of animal's feet

2.4.2.1 Description of this use area

Disinfection of animals' feet is applied for hygiene reasons. In particular the hooves of dairy cows are regularly disinfected. Cows walk through big tubs containing the disinfection solution on their way from or to the milking parlour. During the dry period of the dairy cows a regularly hoof disinfection is also recommended. According to recommendations from manufacturers and from agrarian institutions hoof disinfection should be performed routinely twice a week (once on two different days or twice on one day; the latter is considered the worst case) (DLG 2010). The disinfectant is not rinsed off the hooves. The volume of the bathing device can vary between 375 l and 675 l (2,5 to 3.0 m length x 1.0 to 1.5 m width x 0.15 m filling height) (DLG 2010). The disinfectant has to be regularly replaced; it is recommended to replace the tub content after maximal 100 walking-through events (DLG 2010).
Disinfection of other animals' hooves (especially sheep hooves) is in most cases due to medicinal reasons (UG 2010). Regular biocidal applications are not as frequent as with the cows and normally a minor amount of biocide is required. This scenario considers only the worst case which is represented by disinfection of cow hooves.

2.4.2.2 Biocidal active substances typically applied in these areas

According to LWK NRW (2009), biocidal active substances typically used for hoof disinfection are copper sulfate and organic acids (such as formic acid, glyoxylic acid) and per compounds (such as peracetic acid).

2.4.2.3 Environmental release pathways

As described above for footwear disinfection, two main emission pathways are possible: either discharge of left-over disinfectant into the slurry system or discharge to waste water (LWK RLP 2009), whereas discharge to the slurry system is more common. Furthermore, emission to the air can occur.

2.4.2.4 Emission scenario

The following assumptions have been made based on information provided by Ebermann (2008) LWK NRW (2009).
A herd size of 100 dairy cows and a milking frequency of twice a day are defined as default values. In order to cover a worst case, a tub content of 675 l is assumed, which is replaced after 100 walk-through events. For the emission via manure it does not make a difference if the hoof disinfection is performed either twice on one day a week or once at two days a week. Since the first of the above described two scenarios is worst case for STP, it was chosen as worst case in general.

Table 5a: Emission scenario for calculating the release of disinfectants used for veterinary hygiene: animal's feet - Input parameters

Parameters	Nomenclature	Value	Unit	Origin
Input				
Type of housing/manure storage (for application of the notification)	*cat-subcat (i1)*	i1 = 1	[-]	D (Appendix1: Table 7)
Type of biocide	*bioctype (i2)*	i2 = 1	[-]	D (Appendix1: Table 7)
Type of application	*appway (i3)*	i3 = 3	[-]	D (Appendix1: Table 7)
Relevant emission stream	*stream (i4)*		[-]	P (Appendix1: Table 7)
Number of animals in housing for category/subcategory *i1* =1	$Nanimal_{i1}$	100	[-]	D (Appendix 1: Table 8)
Volume of the reservoir (tub)	$Vreserv_{i1,i2,i3}$	675	[l]	D
Content of active ingredient in formulation (product)	*Fbioc*		[g.l^{-1}]	S
Dilution factor (for preparation of the working solution from the formulation (product))	F_{dil} A)	0	[-]	S
Fraction of active ingredient released	$F_{air\ i1,i2,i3,i4}$ B)	0.1	[-]	D
	$(F_{stp} = F_{ww})$ $F_{stp\_i1,i2,i3,i4}$	1 – F_{air}	[-]	O
	$F_{slurry/manure\_\ i1,i2,i3,i4}$ G)	1 – F_{air}	[-]	O
Number of tub fillings (= applications) per day	*Ntub_filling*	2	[-]	D
Number of days with disinfectant applications in one year	*Napp-bioc*	52	[-]	D
Interval between two days with applications	*Tbioc-int*	7	[d]	D
Number of manure applications for grassland	*Nlapp-grass*	4	[-]	D
Number of manure applications for arable land	*Nlapp-arab*	1	[-]	D
Manure application time interval for grassland	*Tgr-int*		[d]	D/S (Appendix 1: Table 12)
Manure application time interval for arable land	*Tar-int*		[d]	D/S (Appendix 1: Table 12)
Amount of phosphate per animal for category/subcategory *i1* =1	$Qphosph_{i1}$	0.10466	[kg.d^{-1}]	D (Appendix 1:

Parameters	Nomenclature	Value	Unit	Origin
				Table 11)
Amount of nitrogen per animal for category/subcategory *i1* =1	$Qnitrog_{i1}$	0.33890	[kg.d^{-1}]	D (Appendix 1: Table 11)
If phosphate immission standards are applied:[C)]				
Phosphate immission standard for one year on grassland	$Q_{P2O5,grassland}$		[kg.ha^{-1}]	D (Appendix 1: Table 13)
Phosphate immission standard for one year on arable land	$Q_{P2O5,arable\_land}$		[kg.ha^{-1}]	D (Appendix 1: Table 13)
If nitrogen immission standards are applied:[C)]				
Nitrogen immission standard for one year on grassland	$Q_{N,grassland}$		[kg.ha^{-1}]	D (Appendix 1: Table 13)
Nitrogen immission standard for one year on arable land	$Q_{N,arable\_land}$		[kg.ha^{-1}]	D (Appendix 1: Table 13)
Mixing depth with soil, grassland	$DEPTH_{grassland}$ [D)]	0.05	[m]	D
Mixing depth with soil, arable land	$DEPTH_{arable\_land}$ [D)]	0.20	[m]	D
Density of wet bulk soil	$RHOsoil_{wet}$ [D, E)]	1700	[kg.m^{-3}]	D
Standard concentration in air at 100 m from source for a source strength of 1 kg.d^{-1}	$Cstd_{air}$ [E)]	2.78 • 10^{-4}	[mg.m^{-3}]	D

A) For example: If the formulation is diluted 1/10 (= 1:10), the dilution factor is 10^{-1}. If the formulation (product) is also used as working solution, the dilution factor is 1.

B) Default value for F_{air} derived from the A-tables of the TGD (IC = 1: AGRICULTURAL INDUSTRY; Table A3.1 – Default emission factor to air).

C) At least one of the immission standards should be applied.

D) According to ESD for PT 18 No. 14.

E) According to Technical Guidance Document on Risk Assessment (TGD) in support of Directive 98/8/EC, Part II (EC 2003a).

F) Degradation of the active substance in slurry/manure is not considered in the first tier. A methodology to include biodegradation in manure and slurry as second-tier approach in the emission estimation is provided in the ESD for PT 18 No. 14.

Table 5b: Emission scenario for calculating the release of disinfectants used for veterinary hygiene: animal's feet - Output parameters

Parameters	Nomenclature	Value	Unit	Origin
Output				
Soil exposure For stream *i4* =1 and 3				
Concentration of the biocide (active ingredient) in soil (mg.kg-1) in the case of an immission standard for phosphate and land application on grassland	$PIECgrs\text{-}P_2O_{5i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil (mg.kg-1) in the case of an immission standard for phosphate and land application on arable land	$PIECars\text{-}P_2O_{5i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil (mg.kg-1) in the case of an immission standard for nitrogen and land application on grassland	$PIECgrs\text{-}N_{i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Concentration of the biocide (active ingredient) in soil (mg.kg-1) in the case of an immission standard for nitrogen and land application on arable land	$PIECars\text{-}N_{i1,i2,i3,i4}$		$[mg.kg^{-1}{}_{wwt}]$	O
Air exposure				
Emission to air from one day (= 2 applications = 2 tub fillings)	$Qai\text{-}air_{\ i1,i2,i3,i4} = Edirect_{air\ i1,i2,i3,i4}$		[kg]	O
Annual average concentration in air at 100 m from source	$Cdirect_{air\ i1,i2,i3,i4}$		$[mg.m^{-3}]$	O
STP				
Local emission from one day (= 2 applications = 2 tub fillings) to a standard STP or an on-site waste water treatment plant	$Qai\text{-}stp_{i1,i2,i3,i4} = Elocal_{waste\ water}$		$[kg.d^{-1}]$	O

Table 5c: Emission scenario for calculating the release of disinfectants used for veterinary hygiene: animal's feet - Intermediate calculations

Parameters	Nomenclature	Value	Unit	Origin
Intermediate Calculations				
Number of days with disinfectant applications during storage period for application on grassland	$Napp\text{-}manure_{gr}$		[-]	
Number of days with disinfectant applications during storage period for application on arable land	$Napp\text{-}manure_{ar}$		[-]	
For grassland and arable land: If *Tbioc-int* > *Tgr/ar-int,* then *Napp-manure = 1* If *Tbioc-int* < *Tgr/ar-int,* then *Napp-manure = ROUND (Tgr/ar-int/Tbioc-int)*				

Parameters	Nomenclature	Value	Unit	Origin
(ROUND is the sign for rounding off to a whole number)				
Amount of active ingredient to be used for one tub filling	$Qai\text{-}prescr_{i1,i2,i3}$		[kg]	O
$Qai\text{-}prescr_{i1,i2,i3} = 10^{-3}$ □• $Fbioc \cdot Vreserv_{i1,i2,i3} \cdot F_{dil}$				
Amount of active ingredient in relevant stream *i4* after one day with disinfectant applications (= 2 tub fillings)	$Qai_{i1,i2,i3,i4}$		[kg]	O
$Qai_{i1,i2,i3,i4} = F_{air\ or\ stp\ or\ slurry/manure\ i1,i2,i3,i4} \cdot Qai\text{-}prescr_{i1,i2,i3} \cdot Ntub\_filling$				
Amount of active ingredient in manure or slurry after the relevant number of biocide applications for the manure application to grassland	$Qai\text{-}grass_{i1,i2,i3,i4}$		[kg]	O
$Qai\text{-}grass_{i1,i2,i3,i4} = Qai_{i1,i2,i3,i4} \cdot Napp\text{-}manure_{gr}$				
Amount of active ingredient in manure or slurry after the relevant number of biocide applications for the manure application to arable land	$Qai\text{-}arab_{i1,i2,i3,i4}$		[kg]	O
$Qai\text{-}arab_{i1,i2,i3,i4} = Qai_{i1,i2,i3,i4} \cdot Napp\text{-}manure_{ar}$				
Amount of phosphate produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to grassland	$Qphosph\text{-}grass_{i1,i4}$		[kg]	O
$Qphosph\text{-}grass_{i1,i4} = Nanimal_{i1} \cdot Qphosph_{i1} \cdot Tgr\text{-}int_{i2}$				
Amount of phosphate produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to arable land	$Qphosph\text{-}arab_{i1,i4}$		[kg]	O
$Qphosph\text{-}arab_{i1,i4} = Nanimal_{i1} \cdot Qphosph_{i1l} \cdot Tar\text{-}int_{i2}$				
Amount of nitrogen produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to grassland	$Qnitrog\text{-}grass_{i1,i4}$		[kg]	O
$Qnitrog\text{-}grass_{i1,i4} = Nanimal_{i1} \cdot Qnitrog_{i1} \cdot Tgr\text{-}int_{i2}$				
Amount of nitrogen produced during the relevant period for every relevant (sub)category of animal/housing *i1* and application to arable land	$Qnitrog\text{-}arab_{i1,i4}$		[kg]	O
$Qnitrog\text{-}arab_{i1,i4} = Nanimal_{i1} \cdot Qnitrog_{i1} \cdot Tar\text{-}int_{i2}$				

Table 5d: Emission scenario for calculating the release of disinfectants used for veterinary hygiene: animal's feet – End calculation [A)]

End calculation
Soil exposure   *If the phosphate immission standard is applicable:*
Concentration of the active ingredient in soil based on the phosphate immission standard for grassland $PIECgrs\text{-}P2O5_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}grass_{i1,i2,i3,i4} \bullet Q_{P2O5,\ grassland}}{Qphosph\text{-}grass_{i1,i4} \bullet Nlapp\text{-}grass \bullet DEPTH_{grassland} \bullet RHOsoil_{wet}}$
Concentration of the active ingredient in soil based on the phosphate immission standard for arable land $PIECars\text{-}P2O5_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{P2O5,\ arable\text{-}land}}{Qphosph\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet}}$
If the nitrogen immission standard is applicable:
Concentration of the active ingredient in soil based on the nitrogen immission standard for grassland $PIECgrs\text{-}N_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}grass_{i1,i2,i3,i4} \bullet Q_{N,\ grassland}}{Qnitrog\text{-}grass_{i1,i4} \bullet Nlapp\text{-}grass \bullet DEPTH_{grassland} \bullet RHOsoil_{wet}}$
Concentration of the active ingredient in soil based on the nitrogen immission standard for arable land $PIECars\text{-}N_{i1,i2,i3,i4} = \frac{100 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{N,\ arable\text{-}land}}{Qnitrog\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet}}$
Air exposure $Edirect_{air\ i1,i2,i3,i4} = Qai\text{-}air_{\ i1,i2,i3,i4} = F_{air\ i1,i2,i3,i4} \bullet Qai\text{-}prescr_{i1,i2,i3} \bullet Ntub\text{-}filling$
$Cdirect_{air\ i1,i2,i3,i4} = \frac{Edirect_{air\ i1,i2,i3,i4} \bullet Cstd_{air} \bullet Napp\text{-}bioc}{365}$
STP $Qai\text{-}stp_{i1,i2,i3,i4} = F_{stp\ i1,i2,i3,i4} \bullet Qai\text{-}prescr_{i1,i2,i3} \bullet Ntub\_filling$

[A)] **Please note:** The formulae provided in Table 5d (as adopted from ESD for PT 18 No. 14) can be misleading when units (e.g. "ha") are put in. Using the formulae as shown below (exemplum given for PIECars-N) can avoid misunderstandings (ha is given as 10^4 m^2).

$$PIECars\text{-}N_{i1,i2,i3,i4} = \frac{10^6 \bullet Qai\text{-}arab_{i1,i2,i3,i4} \bullet Q_{N,\ arable\text{-}land} \qquad [kg]\ [kg]\ [m^3]}{Qnitrog\text{-}arab_{i1,i4} \bullet Nlapp\text{-}arab \bullet DEPTH_{arable\text{-}land} \bullet RHOsoil_{wet} \bullet 10^4 \qquad [kg]\ [kg]\ [m]\ [m^2]}$$

2.5 Disinfection in hatcheries

2.5.1 Description of this use area

The hatcheries considered in this ESD are poultry hatcheries. Eggs are hatched under optimized artificial conditions. The high density of livestock in hatcheries demands a high standard of hygiene in the production process. For this reason, disinfections are generally carried out. Incubated eggs as well as the machinery (setter, hatcher) and the premises are disinfected to reduce the microbial load. Disinfection of eggs is carried out by fumigation or fogging. Surfaces are mainly disinfected by aerosols, spraying or fogging (Baumann 2000).

In the following, typical disinfection measures in a hatchery are described. The information on which the description is based was provided by a large German hatchery. The surface area of this hatchery is 8,000 m^2; the processing rate of eggs is 1.3 Mio per week. These parameters are typical for large hatcheries in Germany.

The following disinfections are typically performed:

- Disinfection of eggs (twice): one time after arrival in a fumigation sluice and one time in the hatchery.
- Disinfection of premises and breeders: four times per week up to once per day.

Chicks and eggshells after hatching are not disinfected nowadays.

Disinfection of eggs:

Eggs are daily delivered from farms, transferred to trays - each containing 126 eggs - on a setter trolley (see picture) and then disinfected in a fumigation sluice. The disinfection is either performed by fumigation with formaldehyde (this is the standard application) or by fogging of an acid/peroxide mixture.
In the case of fumigation, formaldehyde is released from a precursor solution by reaction with $KMnO_4$ or from para-formaldehyde by heating in a heating pan.

Source: Agrarmarkt, Austria

The fumigation sluice has a volume of 49 m^3. The number of fumigations is 6 to 7 per day, on 7 days per week.

After leaving the sluice, the eggs are transferred to setters where they are incubated for 18 days. During this time the eggs are not disinfected.

The eggs are then transferred to hatchers, where they remain for three days. During this time, disinfection is carried out once with liquid formaldehyde, which is vaporized from heated pans. Each hatcher has a capacity of 12,000 eggs. A typical hatchery is equipped with several hatchers, which are charged with eggs in an alternating way so that only on four days per week hatching takes place in the hatchery. Consequently, four fumigations need to be performed per week as well. A hatchery is normally in operation 365 days a year.

Disinfection of rooms and furniture:

Rooms and equipment such as setters and hatchers, trays and hatcher baskets are disinfected by spraying, foaming or sometimes by fogging. If setter and hatcher rooms are disinfected by fogging (also sometimes referred to as misting), the equipment is usually left in the room so that it is disinfected by the same treatment.

In the hatchery described above, between ca. 65% and 75% of the surface is covered by breeders such as setters or hatchers.

Two different kinds of setters can be distinguished:

- Multi-stage setters with six so called “time-variable” inlets;
- Single-stage setters.

Multi-stage setters are disinfected twice per year when empty; single-stage setters are disinfected after the end of each pre-breeding period (every 18 days).

Hatchers are disinfected after every hatching. Since, as described above, the hatchers are charged in such a way that hatching takes place on four days per week, four disinfections of hatchers are carried out per week.

Hatcher baskets and chick boxes are disinfected by spraying immediately after cleaning. Trays, hatcher baskets and chick boxes are disinfected - like hatchers - after every hatching, i.e. four times per week. For trays, special washing machines are in place. After leaving the washing machine, they are disinfected by spray application.

Hatchers have the following dimensions: 2.08 m (height) x 2.87 m (length) x 1.63 m (width), corresponding to a volume of 9.73 m^3. The dimensions of setters are similar.

2.5.2 Biocidal active substances typically applied in these areas

According to Strauch (2002), the following biocidal active substances are used for the disinfection of **eggs** in hatcheries:

- Formaldehyde
- Peracetic acid
- Hydrogen peroxide
- Chlorocresole

- Quaternary ammonium compounds (quats)
- Chlorine dioxide.

Premises and **breeders** are usually disinfected by spray application, using e. g.

- Chlorine compounds
- Quaternary ammonium compounds (quats)
- Glutaraldehyde or other aldehydes.

2.5.3 Environmental release pathways

Depending on the way of application two main emission pathways are possible: either discharge to waste water after spraying or foaming or release to air after fumigation or fogging. For the sake of completeness the emission to air was considered in this ESD, but usually hatcheries are equipped with air filter systems to prevent release of odour and microbes to the outside air. Thus, the biocide emission to outside air is limited.

2.5.4 Emission scenario

The following scenario was prepared by German Federal Environmental Agency and is based on data collected by SCC from a representative hatchery:

- Disinfection of eggs takes place twice: once in the fumigation sluice (stage 1) and once in the hatcher (stage 2); disinfection of rooms and equipment takes place in stage 3

- The fumigation sluice has a volume of 49 m³. The number of fumigations is 6 to 7 per day, on 7 days per week.

- The default values for hatchers and setters for stage 2 and stage 3 are calculated as follows:

  Stage 2:

  - 1.3×10^6 eggs are bred every week.
  - Eggs are disinfected once while they reside in the hatcher and on four days per week hatching takes place in the hatchery.
  - Consequently, 325,000 eggs are disinfected per day on four days per week (1.3×10^6 eggs/4 d).
  - One hatcher has a capacity of 12,000 eggs
  - ➔ Hence, the hatchery needs 27 hatchers (325,000/12,000) for the disinfection on one day of the four days per week;
  - ➔ According to chapter 2.5.1 a hatcher has a volume of 9.73 m³;
  - ➔ Disinfection events take place four times per week (4/7 d = 0.57 d^{-1}).

Stage 3:

- According to chapter 2.5.1, the dimensions of setters are similar to those of hatchers
- ➔ Therefore the setter volume is set to 9.73 m^3.

- While eggs remain in hatchers for 3 days, they are in setters for 18 days (according to chapter 2.5.1).
- In order to be able to operate a 'four days per week – hatching', six times more setters than hatchers (18 d / 3 d = 6) are necessary
- ➔ Therefore, the hatchery needs 162 setters (27 hatchers • 6 = 162 setters) for the ability to operate on one day of the 'four days per week – hatching'.

- A single-stage setter is disinfected at the end of each pre-breeding period (every 18 days)
- ➔ Therefore, disinfection events take place every 18 days during the year (365 d / 18 d = 20.3 disinfection events per year → 20.3 / 365 d = 0.06 d^{-1}).

- Disinfection of premises (rooms) and equipment (hatchers, trolleys, hatching baskets) corresponding to stage 3 takes place between four times (premises and equipment after hatching) and seven times per week (premises in general). For the present approach only rooms are considered and it is assumed that the equipment is usually left in the rooms so that it is disinfected by the same treatment (see chapter 2.5.1). The use of single-stage setter values for the calculation is supposed to be the appropriate way to consider disinfection of the equipment.

- The default value for the fraction released to air after fumigation is taken from Van der Poel and Bakker (2002). For spraying and fogging, default values for F_{air}, as proposed in the ESD for PT 8 (OECD: Emission scenario document for wood preservatives. Part I. OECD Series on Emission Scenario Documents Number 2) are used.

Default values for the "Quantity of disinfectant used per cubic meter" ($Qa.i._{appl}$) are provided in a pick list in Table 6b below.

Table 6a: Emission scenario for disinfection in hatcheries

Parameters	Nomenclature	Value	Unit	Origin
Input				
Quantity of disinfectant used per cubic meter	$Qa.i._{appl}$		$[g.m^{-3}]$	S/P (Table 6b)
Application stages:				
Stage 1 – eggs in fumigation sluice:				
Volume of the fumigation sluice	V_{sluice}	49	$[m^3]$	D
Number of fumigation sluices	N_{sluice}	1	[-]	D
Number of disinfection events	$Nappl_{sluice}$	7	$[d^{-1}]$	D
Stage 2 – eggs in hatcher:				
Volume of the hatcher	$V_{hatcher}$	9.73	$[m^3]$	D
Number of hatchers	$N_{hatcher}$	27	[-]	D
Number of disinfection events	$Nappl_{hatcher}$	0.57	$[d^{-1}]$	D
Stage 3 – rooms and equipment:				
Volume of the setter	V_{setter}	9.73	$[m^3]$	D
Number of setters	N_{setter}	162	[-]	D
Number of disinfection events (single-stage setter)	$Nappl_{setter}$	0.06	$[d^{-1}]$	D
Volume of the hatcher	$V_{hatcher}$	9.73	$[m^3]$	D
Number of hatchers	$N_{hatcher}$	27	[-]	D
Number of disinfection events	$Nappl_{hatcher}$	0.57	$[d^{-1}]$	D
Fraction released to air after fumigation	F_{air_fum}	0.98	[-]	D
Fraction released to air after aerosol or fogging treatment	F_{air_fog}	0.1	[-]	D
Fraction released to waste water	F_{water}	$(1 - F_{air})$	[-]	O
Output				
Local emission rate to water (on the day of hatching)	$Elocal_{water}$		$[kg.d^{-1}]$	O
Local emission rate to air (on the day of hatching)	$Elocal_{air}$		$[kg.d^{-1}]$	O

Calculation

$$Elocal = \sum_{stage=1}^{3} Qa.i._{appl} \bullet 10^{-3} \bullet V \bullet N \bullet N_{appl} \bullet F$$

$$Elocal_{water} = Qa.i._{appl} \bullet 10^{-3} \bullet F_{water} [(V_{sluice} \bullet N_{sluice} \bullet Nappl_{sluice}) + (V_{hatcher} \bullet N_{hatcher} \bullet Nappl_{hatcher}) \bullet 2 + (V_{setter} \bullet N_{setter} \bullet Nappl_{setter})]$$

Parameters	Nomenclature	Value	Unit	Origin
$Elocal_{air}$	$= Qa.i._{appl} \bullet 10^{-3} \bullet F_{air} [(V_{sluice} \bullet N_{sluice} \bullet Nappl_{sluice}) + (V_{hatcher} \bullet N_{hatcher} \bullet Nappl_{hatcher}) \bullet 2 + (V_{setter} \bullet N_{setter} \bullet Nappl_{setter})]$			

Table 6b: Pick list for the amount of active ingredient $Qa.i._{appl}$ ($g.m^{-3}$) used for disinfection of hatcheries used as defaults for various types of disinfectants

Active ingredient	$Qa.i._{appl}$ [$g.m^{-3}$]
Formaldehyde	1.2
Paraformaldehyde	7
Others	7

3 FURTHER RESEARCH

One scope of the UBA project was to identify gaps in knowledge and requirements for further research. The following has been identified for PT 3:

- No degradation during application of the disinfectant (e.g. degradation upon contact with surfaces) was considered in the scenarios. If the scenarios presented should provide an a priori possibility to take degradation during the application into account, further work is needed to adapt the presented scenarios.

- Disinfection of vehicles used for animal transport: The scenario presented considers the transport of animals in trucks. If animal transports by ship, aeroplane and train should be considered, further research is needed to define respective default values for these transport media.

- Disinfection for veterinary hygiene, non-medicinal teat dips: the scenario considers the most common use, post milking teat dipping. In some countries also a pre-milking dipping can be carried out. If this application is considered relevant, further research is needed in order to define representative default values.

- Hatcheries: Further research is needed to deduce representative default values for the surface area to be treated and for adapting the scenario accordingly.

- Disinfection in aquaculture is not covered by this ESD. If this is a relevant scenario further research is needed in order to develop a respective emission scenario.

- During TM I 09 the Netherlands asked to include in an additional Appendix respective example calculations using a standard application dose to evaluate which animal groups would be most critical in the evaluation. It was decided to not include these Appendix but to mention it here as an item for further research.

4 REFERENCES

AEAT (2007): "Service contract for the development of environmental emission scenarios for active agents used in certain biocidal products", draft final report to European Commission, Directorate General Environment

Baumann et al. (2000): Gathering and review of Environmental Emission Scenarios for biocides; Institute for Environmental Research (INFU), University Dortmund. 06/30/00. And references therein.

Balk, F., Roorda, A., Rutten, A.L.M., de Kok, M. Th. (1999) Identification and description of biocidal product types and establishment of scores based on the level of exposure of humans and the environment, Biocides Study DG XI/E2/ETU/980056

Bodenschatz (2006): Kompaktwissen Desinfektion; B. Behr's Verlag, Hamburg.

Defra (2005): VetCalc: Exposure Modelling Tool for Veterinary Medicines. Draft User's Manual, 2005. Defra Research Project VM02133 Veterinary Medicines Directorate, Addlestone, UK.

DLG [Deutsche Landwirtschaftliche Gesellschaft] (2010): personal communication (G. Nickel, SCC GmbH).

DVG [Deutsche Veterinärmedizinische Gesellschaft] (2009): personal communication (G. Nickel, SCC GmbH).

Ebermann and Elmada (2008): Lehrbuch Lebensmittelchemie und Ernährung: Springer Verlad, Hamburg.

Fischer [Viehtransporte Fischer, Wilkau-Haßlau, Germany] (2009): personal communication (G. Nickel, SCC GmbH).

EC (2003a): TGD PART II. Technical Guidance Document (TGD) in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and on commission regulation (EC) No. 1488/94 on risk assessment for existing substances and on directive 98/8/EC of the European parliament and of the council concerning the placing of biocidal products on the market.

EC (2003b): Integrated Pollution Prevention and Control (IPPC). Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs. European Commission, July 2003.

EC (2007): Workshop on environmental risk assesment for insecticides, acaricides and products to control other arthropods (Product Type 18). Brussels, Belgium, 11th of December 2007.

EC (2008): Workshop on environmental risk assessment for Product Types 1 to 6; Arona, Italy (11 March 2008).

Hüfner (2009): http://www.oswald-huefner.de/fahrzeughandel.html

IMA [information medien agrar] (2009): www.ima-agrar.de

Knebusch [Hans-Achim Knebusch GmbH C. KG, Quakenbrück, Germany] (2009a): personal communication (G. Nickel, SCC GmbH).

Knebusch [Hans-Achim Knebusch GmbH C. KG, Quakenbrück, Germany] (2009b): http://www.gefluegeltransporte.de/transportgeraete.html

KTBL (2006): Nationaler Bewertungsrahmen Tierhaltungsverfahren (KTBL Schrift 446, mit Internetzugang); Kuratorium für Technik und Bauwesen in der Landwirtschaft e. V., Darmstadt.

LWK NRW [Landwirtschaftskammer Nordrhein-Westfalen, Germany] (2009): personal communication (G. Nickel, SCC GmbH)

LWK RLP [Landwirtschaftskammer Rheinland-Pfalz, Germany], (2009): personal communication (G. Nickel, SCC GmbH)

Montfoort et al. (1996): The use of disinfectants in livestock farming - Supplement to the evaluation method of non-agricultural pesticides of the Uniform system for Evaluation of substances (USES), RIVM report no. 679102033.

Montforts (1999): Environmental risk assessment for veterinary medicinal products. Part 1. Other than GMO-containing and immunological products. First update. National Institute of public health and environment, Bilthoven, The Netherlands. RIVM report no. 601300001.

OECD. Emission scenario document for wood preservatives. Part I. OECD Series on Emission Scenario Documents Number 2.

OECD (2006) Emission Scenario Document for Insecticides for stables and manure storage Systems. OECD Series on Emission Scenario Documents No. 14. And references therein.

Strauch and Böhm (2002): Reinigung und Desinfektion in der Nutztierhaltung und Veredelungswirtschaft; Enke Verlag, Stuttgart.

UG [University of Göttingen, Germany, Institut für Tierzucht und Haustiergenetik] (2010): personal communication (G. Nickel, SCC GmbH).

Van der Poel (2000): Supplement to the methodology for risk evaluation. Proposal for the formats of names, parameters, variables, units and symbols to be used in emission scenario documents. RIVM report no. 601450 007, Bilthoven, the Netherlands.

Van der Poel and Bakker (2002): Emission Scenario Document for Biocides: Emission Scenarios for all 23 Product types of EU. RIVM report 601 450 009. And references therein.

Van Bruggen (2005): Productie van dierlijke mest en gebruiksnormen per bedrijfstype , 2004 (Production of manure and application standards by farm type 2004, only in Dutch), Centraal Bureau voor de Statistiek, Voorburg/Heerlen.

VDKO [Veterinärdienst Kreis Osnabrück, Gemany] (2009): personal communication (G. Nickel, SCC GmbH).

Westfleisch Hamm (2009): http://www.westfleisch.de/unternehmen/standorte/hamm1.php

WGMEV [Wissenschaftliche Gesellschaft der Milcherzeugerberater. e.V.] (2009): http://cms.wgmev.de/modules.php?name=Content&pa=showpage&pid=9

ZMP (2008): ZMP-Marktbilanz Eier und Geflügel 2008; Zentrale Markt- und Preisberichtstelle für Erzeugnisse der Land-, Forst- und Ernährungswirtschaft, Bonn.

5 APPENDICES

Appendix 1: Pick Lists and Tables

Table 7 [based on Table 5.1, ESD for PT 18 No. 14, modified for PT 3]:
Pick list for the variables based on the user's instructions; the variable names are used as subscripts or representing indices in various parameters involved in the model.

Value	Description of variable content
Variable name: cat-subcat = Index i1	
1	Dairy cows
2	Beef cattle
3	Veal calves
4	Sows, in individual pens
5	Sows in groups
6	Fattening pigs
7	Laying hens in battery cages without treatment
8	Laing hens in battery cages with aeration (belt drying)
9	Laying hens in batters cages with forced drying (deep pit, high rise)
10	Laying hens in compact battery cages
11	Laying hens in free range with litter floor (partly litter floor, partly slatted)
12	Broilers in free range with litter floor
13	Laying hens in free range with grating floor (aviary system)
14	Parent broilers in free range with grating floor
15	Parent broilers in rearing with grating floor
16	Turkeys in free range with litter floor
17	Ducks in free range with litter floor
18	Geese in free range with litter floor
19	Manure storage "wet" (slurry pits)
20	Manure storage "dry" (manure heaps)
Variable name: bioctype : Index i2	
1	Disinfectant
Variable name: appway = Index i3	

1	Spraying
2	Dipping
3	Bath
Variable name: stream = Index i4	
1	Manure
2	Waste water (wwater)
3	Slurry
4	Air

Table 8 [based on Tables 5.2 and 5.3, ESD for PT 18 No. 14, modified for PT 3]:
Defaults for surfaces of animal housings with the numbers of animals present and of surfaces of manure and spilled feeding; the subscript cat-subcat presents the animal (sub)category and for poultry the type of housing.

index *i1* Category-subcategory					Number of animals [-]	Floor area [m²]	Slatted area [1) [m²]	Wall and Roof area [m²]	Other areas inside [m²]	Manure area inside [m²]
1	Cattle	Dairy cattle			100	1170	360	1670	30[2)]	
2		Beef cattle			125	370	340	1000	40[2)]	
3		Veal calves			80	160	140	330	20[2)]	
4	Pigs	Sows		Individual	132	560	390	910	70[2)]	
5		Sows		Group	132	710	290	1160	40[2)]	
6		Fattening pigs			400	600	400	970	50[2)]	
7	Poultry	Battery	no treatment	Laying hens	21000	750	n.r.	1100	1360[3)]	1200[5)]
8			belt trying	Laying hens	21000	750	n.r.	1100	1360[3)]	1200[5)]
9			deep pit, high rise	Laying hens	21000	750	n.r.	1100	1360[3)]	600[6)]
10			Compact	Laying hens	21000	750	n.r.	1100	1360[3)]	300[7)]
11		Free range	litter floor	Laying hens	10000	1430	950	2030	200[4)]	
12		(indoors)	litter floor	Broilers	20000	1110	n.r.	1600	20[2)]	
13			grating floor	Laying hens	20000	1270	n.r.	1822	300[4)]	1600[5)]
14			grating floor	Parent boilers	7000	390	260	600	40[2)]	
15			grating floor	Parent boilers in rearing	9000	500	330	750	60[2)]	
16			litter floor	Turkey	10000	3330	n.r.	4650	60[2)]	
17			litter floor	Ducks	10000	2000	n.r.	2820	60[2)]	

18			litter floor	Geese	10000	2500	n.r.	3500	60[2)]	

* the treated area for the various manure storage systems depends on the amount of manure produced for each animal category for detailed information see Appendix 5 of ESD for PT 18 No. 14

n.r.: not relevant

1) The slatted area can be considered as the treated area for the manure storage inside (under) the housing
2) This is the area under feed troughs
3) This is the front side area of all cages
4) This is the area under nesting places and feed troughs
5) This is the area of manure belts
6) Area of manure heaps in deep pit system
7) Manure collection area under cage, cleaned by scrapers

Table 9: Number of disinfection events and biocide application intervals; the subscript cat-subcat presents the animal (sub)category and for poultry the type of housing.

Cat-subcat	Category	Subcategory	Housing	Number of disinfection events in one year Napp-bioc [-]	Biocide application intervall Tbioc-int [d]	Reference
1	Cattle	Dairy cow		1	365	KTBL 2006 [A)]
2		Beef cattle		1	365	KTBL 2006
3		Veal calf		4	91	KTBL 2006
4/5	Pigs	Sows		5	73	KTBL 2006
6		Fattening pig		3	122	KTBL 2006
7	Poultry	Laying hen	Battery aeration	1	365	KTBL 2006
8			Deep pit, high-rise	1	365	KTBL 2006
9			Compact	1	365	KTBL 2006
10			Battery (no treatm.)	1	365	KTBL 2006
11			Free range, litter	1	365	KTBL 2006
12		Broiler	Free range, litter	7	52	KTBL 2006
13		Laying hen	Free range, grating	1	365	KTBL 2006
14		Parent broiler ≥18 weeks	Free range, grating	1	365	deduced from ESD for PT 18 No. 14, Table 5.6
15		Parent broiler in rearing = Parent broilers < 18 weeks	Free range, grating	3	122	KTBL 2006
16		Turkeys	Freer range, litter	2	182	KTBL 2006
17		Ducks	Free range, litter	13	28	KTBL 2006
18		Geese	Free range, litter	6	61	deduced from animal cvclus (= 9 weeks)

						(IMA 2009)

[A] KTBL 2006 provides detailed data on animal husbandry (especially in the online version from which the information provided in the table is taken). For few animal categories or housing types only data on the number of stable cleaning events were available. In these cases, it is assumed that the number of cleaning events equals the number of disinfection events since disinfection of stables normally is carried out immediately after cleaning.

Table 10: [based on Table 5.4, ESD for PT 18 No. 14, modified for PT 3]: Estimates for the fraction of active ingredient released to the relevant streams for animal (sub)category and housing (variable cat subcat).

Category (cat-subcat)	Fraction released to [-]		
	Manure	Waste water	Slurry
Cattle, Veal calves, Pigs			
1, 2, 3, 4, 5, 6	• [A)]	•	0.5
Poultry			
8	•	0.2	0.5
9	0.5	•	•
7,10	•	•	0.5
11, 12, 16, 17, 18	0.3	0.2	•
13, 14, 15	•	•	0.5

[A)] • = not aplicable

Table 11 [based on Table 5.5, ESD for PT 18 No. 14, modified for PT 3]: Defaults for the average amounts of liquid waste in relevant cases, phosphate (Qphosph) [kg.animal^{-1}.d^{-1}] and nitrogen (Qnitrog) [kg.animal^{-1}.d^{-1}] per animal (sub)category *i1*.

Cat-subcat	**Category**	**Subcategory**	**Housing**	**Amounts of liquid waste**	P_2O_5	**N** [A)]
1	Cattle	Dairy cow			0.10466	0.33890
2		Beef cattle			0.07123	0.28819
3		Veal calf			0.01422	0.02382
4/5	Pigs	Sow			0.05566	0.07106
6		Fattening pig			0.02033	0.03043
7	Poultry	Laying hen	Battery + aeration	0.08 [B)]	0.00111	0.00181
8			Deep pit, high-rise	0.08 [B)]	0.00111	0.00181
9			Compact		0.00111	0.00181
10			Battery (no treatm.)		0.00122 [C)]	0.00202 [C)]
11			Free range, litter	0.08 [B,C)]	0.00111	0.00171
12		Broiler	Free range, litter	0.08 [B,C)]	0.00066	0.00156
13		Laying hen	Free range, grating	0.08 [B,C)]	0.00111	0.00171
15		Parent broiler in rearing (< 18 weeks)	Free range, grating		0.00077	0.00137
14		Parent broiler ≥18 weeks	Free range, grating		0.00188	0.00298
16		Turkeys	Free range litter		0.00230	0.00482
17		Ducks	Free range litter		0.00164	0.00274
18		Geese	Free range litter		0.00230 [D)]	0.00482 [D)]

[A)] Excluding the nitrogen which volatilised during excretion in the housing and storage.

[B)] If relevant separate calculation of load to STP.

[C)] In the case of authorisation for both battery (no treatment) and free-range (litter floor) combination of slurrystream battery and liquid waste stream free-range (only for battery without treatment: 0.0011).

[D)] Mineral production from manure for Geese is assumed to be the same as for turkeys.

Table 12 [based on Table 5.8, ESD for PT 18 No. 14]:
Default values (Northern Hemisphere) for the periods of land application by target field and the manure storage time interval (Tar-int for arable land and Tgr-int for grassland) in days .

Target field	Start date	End date	Period [d]	Tar/gr-int [d]
Arable land	1st September	1st February	153	212
Grassland	1st February	1st September	212	53

Table 13:
Maximum immission standards [$kg.ha^{-1}.yr^{-1}$] on arable land and grassland for nitrogen ($Q_{N,grassland}$, $Q_{N,arable\_land}$) and phosphate (Q_{P2O5},grassland and Q_{P2O5},arable_land)

Arable land		Grassland	
$Q_{N,arable-land}$	$Q_{P2O5,arable-land}$	$Q_{N,grassland}$	$Q_{P2O5,grassland}$
170 A)	85 B)	170 A)	110 B)

A) At TM (Technical Meeting) I/08, when the draft workshop report for ESD for PT 18 No. 14 was discussed, the Member States agreed to use the nitrogen immission standards from the EC Nitrates Directive (91/676/EC) of 170 kg N ha^{-1} yr^{-1} for all soils.

B) Uniquely in the EU, NL has set a maximum on the application of manures on the basis of P-content for arable land of 85 kg $P_2O_5.ha^{-1}.year^{-1}$ and for grassland of 110 kg $P_2O_5.ha^{-1}.year^{-1}$ (Van Bruggen, 2005).

Appendix 2: Deduction of the default values for disinfection of vehicles used for animal transport (related to chapter 2.2)

1. Mammals

The capacities of different slaughter houses were compared. Due to the increasing concentration and the corresponding increase of capacity, one of the large-size slaughter houses was taken for reference capacity (German slaughterhouse Westfleisch Hamm; Westfleisch Hamm 2009).

Animal category	Slaughtering per year	Corresponds to: Slaughtering per day
Fattening pigs	1,340,000	3,671
Beef cattle	73,000	200
Veal cattle	39,000	107

According to legal regulations, minimum areas per animal have to be assured in the transport vehicle. The Council Regulation (EC) 1/2005 on the protection of animals during transport and related operations prescribes:

Animal category	Transportation floor area for one animal [m^2]	Corresponds to: Floor area size needed for total amount of animals transported in one day [m^2]	Corresponds to: Ceiling area size needed for total amount of animals transported in one day [m^2]
Fattening pigs (average size 100 kg)	0.45	1652	1652
Beef cattle (average weight 550 kg)	1.60	320	320
Veal cattle (average weight 110 kg)	0.70	75	75

According to the information provided by common carriers the height of the walls of transportation units is 0.95 m for pigs and 1.65 m for cattle and the length-width relation is 5.33 (for most common used semi-trailer trucks) (Fischer 2009; Hüfner 2009).

Hence, the area of the walls can be calculated:

$5.33 \cdot x \cdot x$ = floor area [m^2]
x = one unit of length or width
$((5.33 \cdot 2 \cdot x) + (2 \cdot x)) \cdot$ height of the walls = wall area [m^2]

Animal category	Floor area size needed for total amount of animals transported in one day [m^2]	Unit of length or width [m]	Height of the walls [m]	Corresponds to: Area of the walls needed for total amount of animals transported in one day [m^2]	Sum of areas needed for total amount of animals transported in one day [m^2]
Fattening pigs (average size 100 kg)	1652	17.6	0.95	212	3516
Beef cattle (average weight 550 kg)	320	7.75	1.65	162	802
Veal cattle (average weight 110 kg)	75	3.74	1.65	78	228
All animals					**4546**

In some European countries sheep meat is consumed in a considerable amount. The assumption was made that the consumption of considerable amounts of sheep meat is related to the consumption of less amounts of other animal's meat. Therefore, the total amount of slaughter animal transports equals in the different countries.

2. Poultry

In Germany, an average poultry slaughterhouse has a capacity of 1,000,000 and more chickens per month (ZMP-Marktbilanz 2008), corresponding to ca. 33,000 chickens per day. Since some very large slaughterhouses may have higher throughputs, an average capacity of 50,000 chickens per day was assumed in order to prevent an underestimation of the daily amount of chicken transported to a slaughterhouse.

Slaughter poultry is transported in specialised trucks and in mobile containers which are unitized in compartments. The following calculation is based on 7-compartment-containers, which are often used.

The size of these containers is 1.82 m height, 0.97 m length, 0.46 m width (Knebusch 2009b).

Area of containers which has to be disinfected per day:

According to legal regulations minimum areas per animal has to be assured in the vehicle. The Council Regulation (EC) 1/2005 on the protection of animals during transport and related operations prescribes a minimal area of 160 cm^2 per kg of chicken from 1.6 up to 3 kg weight. Accordingly, 13 broilers of 2 kg (= average slaughter weight) can be transported at any one time in one compartment (91 per container).

For transporting 50,000 broilers, 550 containers are needed, which have a surface area of **3355 m^2** (one container has a surface of 6.1 m^2). The surfaces and the dividing walls (between the compartments) of the containers are coarse meshed gratings. In the forgoing calculation it was assumed that the surfaces are continuous and not cancelled. Due to this overestimation of the surface the area of the dividing walls is included.

Area of trucks which has to be disinfected per day:

One poultry truck contains normally 70 to 75 containers (Knebusch 2009a). The calculation is based on 72 containers (4 in the width, 18 in the length of the truck). For these containers an area of 135 m^2 is needed (rounded to 140 m^2, assuming 5 cm distance between containers and truck interior walls; corresponds to 1 truck with all truck interior walls: surface, ceiling and 4 walls). For 550 containers (corresponds to (rounded) 8 trucks), a total truck area of **1120 m^2** (8 • 140 m^2) has to be disinfected per day.

European Commission

EUR 25116 EN – Joint Research Centre – Institute for Health and Consumer Protection
Title: Emission Scenario Document for Product Type 3
Author(s): Drafted by Scientific Consulting Company (SCC) GmbH, Revised by the Biocides Technical Meeting, Endorsed by the Biocides Competent Authorities Meeting, Edited by B. Raffael and E. van de Plassche
Luxembourg: Publications Office of the European Union
2011 – 61 pp. – 21 x 29 cm
EUR – Scientific and Technical Research series – ISSN 1018-5593 (print), ISSN 1831-9424 (online)

ISBN 978-92-79-22401-0 (PDF)
ISBN 978-92-79-22400-3 (print)

doi:10.2788/29747

Abstract
Following the entry into force of the Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market, all active substances in the European market have to be reviewed to ensure that under normal conditions of use they can be used without unacceptable risk for people, animals or the environment. Thus, in the frame of the review process, the risk assessment of each active substance plays a fundamental role and providing technical guidance to the assessments that must be performed ensures a correct and uniform implementation of the Directive for the different Member States.
According to Annex VI of Directive 98/8/EC the risk assessment shall cover the proposed normal use of the biocidal product together with a 'realistic worst case scenario'.
The aim of this Emission Scenario Document (ESD) is to set up methods for the estimation of the emission of disinfectants, used for the disinfection of vehicles used for animal transport, for veterinary hygiene and in hatcheries.
The present ESD is intended to be used by Member States as a basis for assessing applications submitted with a view to include existing active substances used in PT3 in Annex I or IA of Directive 98/8/EC or for assessing applications for product authorisation. It can be a useful tool also for Industry, when assessing requirements for a submission.
This ESD have been developed in the context of project FKZ 360 04 023 of the German Federal Environmental Agency (UBA), who contracted SCC GmbH for a first draft of the document. The first draft was then revised by the Biocides competence group of Chemical assessment and toxicology (CAT) Unit of the Institute for Health and Consumer Protection (IHCP) of the JRC, taking into account the comments of the Member States. The final version, approved by the Biocides Technical Meeting, was endorsed by the Biocides Competent Authority Meeting in May 2011.The Biocides Technical Meeting and the Biocides Competent Authorities Meeting agreed in asking the JRC to publish the present Emission Scenario Document as a Scientific and Technical Report.

How to obtain EU publications

Our priced publications are available from EU Bookshop (http://bookshop.europa.eu), where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents. You can obtain their contact details by sending a fax to (352) 29 29-42758.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

LB-NA-25116-EN-N

EUROPEAN COMMISSION

Publications Office

ISBN 978-92-79-22401-0