RIVM report 601450009

Emission Scenario Document for Biocides

Emission scenarios for all 23 product types of the Biocidal Products Directive (EU Directive 98/8/EC)

P. van der Poel and J. Bakker

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RIVM, P.O. Box 1, 3720 BA Bilthoven, telephone: 31 - 30 - 274 91 11; telefax: 31 - 30 - 274 29 71

Abstract

The Biocidal Products Directive (98/8/EC) has been developed to control the risk of biocides at EU level. For this purpose a registration and admission procedure was developed, based on the risk assessment of biocides. Emission estimations are a prerequisite for this assessment and influence the results of risk assessments to a large extent. To enforce the Biocidal Products Directive it is important to have methods for emission estimation at one's disposal for as many product types as possible.
Since 1993 RIVM has been developing emission scenarios for biocides, some of which have been incorporated in USES (Uniform System for the Evaluation of Substances), versions 1, 2 and 3. The EUBEES working group, who supervised the project 'Gathering, review and development of environmental emission scenarios for biocides' from January 2000 – June 2001, also produced several emission scenario documents. At the moment various countries are preparing emission scenario documents. Here, an overview is provided of existing scenarios for environmental emissions for all the 23 biocidal product types distinguished in the Biocidal Products Directive. The status of each product type and the emission scenarios (if available) are presented in separate chapters, one per product type, with an overview of the emission scenarios and their respective status given in tabular form (Table 5). All scenarios for biocides apply, so far, to emissions from (large) point sources on a local scale. For diffuse emissions – such as those from households – the sewage treatment plant is considered as a point source.

The life cycle for each product type is presented schematically, with the general form of the life cycle illustrated graphically (Figure 1). Appendices are incorporated to overview the uniform symbols used for variables and parameters. For parameter and variable types, such as dimensions and half-life times, these symbols differ from those used in USES and the original documents from which they are derived – and the tables in which they occur. The parameters and variables used in the emission scenario concerned are also taken up in the appendices, along with the symbols as they occur in USES and/or the original report (if appropriate).

Contents

Samenvatting

Dit rapport geeft een overzicht van bestaande scenario's voor emissies naar het milieu voor alle 23 productgroepen van de Europese richtlijn 98/8/EG betreffende het op de markt brengen van biociden. De productgroepen uit deze richtlijn worden gepresenteerd in Tabel 1 tot en met 4. De biociderichtlijn is ontwikkeld ten behoeve van de beheersing van de risico's van biociden op EU niveau. Daartoe is een registratie- en toelatingsprocedure ontwikkeld, waarvoor risicobeoordeling van biociden een basis vormt. In die risicobeoordeling is de beoordeling van blootstelling een belangrijk onderdeel. Emissieschattingen zijn een eerste vereiste voor deze beoordeling en hebben een grote invloed op de resultaten van risicobeoordelingen. Derhalve is voor de uitvoering van de biociderichtlijn van belang om methoden voor emissieschattingen ter beschikking te hebben voor zoveel mogelijk productgroepen. Een recent uitgevoerd EU pilot-project voor beoordeling van biociden heeft het belang hiervan nog eens onderstreept.

Sinds 1993 zijn meerdere emissiescenario’s voor biociden ontwikkeld bij het RIVM. Een deel van deze emissiescenario's is geïmplementeerd in USES (Uniform System for the Evaluation of Substances) versies 1, 2 en 3. De EUBEES werkgroep, die het EU project "Verzameling, herzieningen en ontwikkeling van milieu-emissiescenario's voor biociden" leidde van januari 2000 tot juni 2001 produceerde eveneens verscheidene emissiescenario documenten. Momenteel worden diverse emissiescenario documenten door diverse landen geproduceerd.

In dit rapport wordt de status van elke productgroep – en de emissiescenario's daarvoor (indien beschikbaar) – in afzonderlijke hoofdstukken per productgroep besproken. Een overzicht van de emissiescenario's en hun huidige status wordt in Tabel 5 weergegeven. Tot dusverre zijn alle emissiescenario's voor biociden alleen van toepassing op de lokale schaal waarbij (grote) puntbronnen worden beschouwd. Voor de diffuse emissies – zoals emissies uit huishoudens -wordt de communale waterzuiveringsinstallatie als puntbron beschouwd.

Een schema van de levenscyclus wordt voor iedere productgroep gepresenteerd (een algemeen schema van de levenscyclus staat in Figuur 1). De stadia van de levenscyclus waarvoor een emissiescenario in dit rapport wordt gepresenteerd zijn afgebeeld met een vette rand in afzonderlijke schema's.

In de emissiescenario's worden uniforme symbolen gebruikt voor variabelen en parameters. In veel gevallen verschillen zij van de symbolen die in USES en de oorspronkelijke documenten waaraan zij ontleend zijn voorkomen. Derhalve zijn de Bijlagen 6 en 7 aan dit rapport toegevoegd. Bijlage 6 geeft voor parameters en variabelen typen, zoals bijvoorbeeld dimensies en halfwaardetijden, een overzicht van de voorkomende symbolen en de tabellen waarin zij in dit rapport voorkomen. Bovendien worden de symbolen, zoals zij in het oorspronkelijke rapport staan, met name emissiescenario documenten en de handleiding van USES 3.0, vermeld. De parameters en variabelen zijn gegroepeerd zoals in Van der Poel (2000). Bijlage 7 presenteert voor iedere tabel van voorliggend rapport de parameters en variabelen die in het emissiescenario voorkomen, samen met de symbolen zoals deze voorkomen in USES en/of het oorspronkelijke rapport (indien van toepassing).

Summary

This report presents an overview of existing scenarios for emission into the environment for all 23 biocidal product types distinguished in the Biocidal Products Directive 98/8/EC (EC, 1998). An overview of the product types is presented in Tables 1 up to and including 4. The Biocidal Products Directive has been developed to control the risk of biocides at EU level. For that purpose a registration and admission procedure was developed based on the risk assessment of biocides. Emission estimations are a prerequisite for this assessment and influence the results of risk assessments to a large extent. To enforce the Biocidal Products Directive it is important to have methods for emission estimation at disposal for as many product types as possible.

Since 1993 various emission scenarios for biocides have been developed at RIVM. Some of these emission scenarios have been incorporated in USES (Uniform System for the Evaluation of Substances) versions 1, 2 and 3. The EUBEES working group that supervised the project 'Gathering, review and development of environmental emission scenarios for biocides' from January 2000 – June 2001 also produced several emission scenario documents. At the moment various countries prepare several emission scenario documents. In this report the status for each of the product types and the emission scenarios (if available) are presented in separate chapters for each product type. An overview of the emission scenarios and their status is presented in Table 5. All emission scenarios for biocides so far apply to emissions at a local scale considering (large) point sources. For diffuse emissions – such as emissions from households – the STP (sewage treatment plant) is considered as a point source.

The life cycle is presented for each product type in a scheme (the general form of the life cycle is presented in Figure 1). The stages of the life cycle for which emission scenarios are available have bolded borders in the specific schemes presented in this report.

In the emission scenarios uniform symbols are used for variables and parameters. Often they differ from the symbols used in USES and the original documents from which they are derived. Therefore, Appendices 9 and 10 have been added to this report.

Appendix 9 presents an overview of the symbols occurring in this report – and the tables in which they occur – for parameter and variable types such as, for example, dimensions and half-life times. Furthermore, the symbols as they occur in the original report, such as emission scenario documents and the USES 3.0 manual, are listed. The parameters and variables have been grouped in the way as in Van der Poel (2000). Appendix 10 presents for every table of this report the parameters and variables used in the emission scenario concerned together with the symbols as they occur in USES and/or the original report (if appropriate). Appendix 11 contains the original reports to which is referenced in Appendices 9 and 10.

Introduction

In the framework of the first National Environmental Policy Plan, the government of the Netherlands developed the first version of the Uniform System for the Evaluation of Substances (USES 1.0). USES 1.0, available in 1994, harmonized the risk assessment of new and existing substances, biocides (non-agricultural pesticides) and plant protection products. USES 1.0 was tailored to the corresponding EC and national legislation. USES 1.0 was subsequently used as one of the basic documents for the development of the EU Technical Guidance Document for the risk assessment of new and existing substances in support of the corresponding EC legislation and its computer implementation in the European Union System for Evaluation of Substances (EUSES 1.00).

Simultaneous with the development of EUSES a second and third USES version have been developed by VROM (Ministry of Housing, Spatial Planning and the Environment), mainly for use in the Netherlands. USES 2.0 and 3.0 comprise risk assessment methods for biocides and plant protection products in addition to those for new and existing substances. The risk assessment methods for biocides and plant protection products are in accordance with the corresponding national legislation and, as much as possible, with the corresponding EC legislation. In USES 2.0 and 3.0 the risk assessment methods for new and existing substances are fully equivalent to EUSES 1.00.

This report presents an overview of existing emission scenarios for all 23 biocidal product types distinguished in the Biocidal Products Directive 98/8/EC (EC, 1998); an overview of the product types is presented in Tables 1 up to and including 4. The first emission scenarios were already developed and presented in 1993 (Luttik *et al.*, 1993). Afterwards more RIVM reports covered various biocide applications (Luttik *et al.*, 1995; Montfoort *et al.*, 1996; Van der Poel, 1999a; Van der Poel, 1999b). Also in some other countries emission scenario documents were presented for various biocide applications. The Finnish Environmental Institute for example produced calculation models for wood preservatives for wood in service and for slimicides in the paper industry (FEI, 1999a; FEI, 1999b). The Danish Environmental Protection Agency produced guidelines for assessment of the environmental risks associated with industrial wood preservatives (DEPA, 1997). For wood preservatives the OECD (Organisation for Economic Co-operation and Development) started a project to produce emission scenario documents for all aspects of wood preservation (treatment, service, waste). It is expected that the documents will be finished this year. From January 2000 – June 2001 the EUBEES working group supervised the project 'Gathering, review and development of environmental emission scenarios for biocides'. This EU working group produced several emission scenario documents.

The status for each of the product types and the emission scenarios (if available) are presented in separate chapters for each product type. An overview of the emission scenarios and their status is presented in Table 5.

Table 1 The product types of main group 1 of biocidal products according to Annex V of Directive 98/8/EC (EC, 1998)

MAIN GROUP 1: Disinfectants and general biocidal products

Product-type 1: Human hygiene biocidal products

Products in this group are biocidal products used for human hygiene purposes.

Product-type 2: Private area and public health area disinfectants and other biocidal products

Products used for the disinfection of air, surfaces, materials, equipment and furniture which are not used for direct food or feed contact in private, public and industrial areas, including hospitals, as well as products used as algaecides.

Usage areas include, inter alia, swimming pools, aquariums, bathing and other waters; air-conditioning systems; walls and floors in health and other institutions; chemical toilets, wastewater, hospital waste, soil or other substrates (in playgrounds).

Product-type 3: Veterinary hygiene biocidal products

Products in this group are biocidal products used for veterinary hygiene purposes including products used in areas in which animals are housed, kept or transported.

Product-type 4: Food and feed area disinfectants

Products used for the disinfection of equipment, containers, consumption utensils, surfaces or pipelines associated with the production, transport, storage or consumption of food, feed or drink (including drinking water) for humans and animals.

Product-type 5: Drinking water disinfectants

Products used for the disinfection of drinking water (for both humans and animals).

Table 2 The product types of main group 2 of biocidal products according to Annex V of Directive 98/8/EC (EC, 1998)

MAIN GROUP 2: Preservatives

Product-type 6: In-can preservatives

Products used for the preservation of manufactured products, other than foodstuffs or feeding stuffs, in containers by the control of microbial deterioration to ensure their shelf life.

Product-type 7: Film preservatives

Products used for the preservation of films or coatings by the control of microbial deterioration to protect the initial properties of the surface of materials or objects such as paints, plastics, sealants, wall adhesives, binders, papers, art works.

Product-type 8: Wood preservatives

Products used for the preservation of wood, from and including the sawmill stage or wood products by the control of wood-destroying or wood-disfiguring organisms. This product type includes both preventive and curative products.

Table 2 The product types of main group 2 of biocidal products according to Annex V of Directive 98/8/EC (EC, 1998) (continued)

Product-type 9: Fibre, leather, rubber and polymerised materials preservatives
Products used for the preservation of fibrous or polymerised materials, such as leather, rubber or paper or textile products and rubber by the control of microbiological deterioration.

Product-type 10: Masonry preservatives
Products used for preservation and remedial treatment of masonry or other construction materials other than wood by the control of microbiological and algal attack.

Product-type 11: Preservatives for liquid-cooling and processing systems
Products used for the preservation of water or other liquids used in cooling and processing systems by the control of harmful organisms such as microbes, algae and mussels. Products used for the preservation of drinking water are not included in this product type.

Product-type 12: Slimicides
Products used for the prevention or control of slime growth on materials, equipment and structures, used in industrial processes, e.g. on wood and paper pulp, porous sand strata in oil extraction.

Product-type 13: Metalworking-fluid preservatives
Products used for the preservation of metalworking fluids by the control of microbial deterioration.

Table 3 The product types of main group 3 of biocidal products according to Annex V of Directive 98/8/EC (EC, 1998)

MAIN GROUP 3: Pest control

Product-type 14: Rodenticides
Products used for the control of mice, rats or other rodents.

Product-type 15: Avicides
Products used for the control of birds.

Product-type 16: Molluscicides
Products used for the control of molluscs.

Product-type 17: Piscicides
Products used for the control of fish; these products exclude products for the treatment of fish diseases.

Product-type 18: Insecticides, acaricides and products to control other arthropods
Products used for the control of arthropods (e.g. insects, arachnids and crustaceans).

Product-type 19: Repellents and attractants
Products used to control harmful organisms (invertebrates such as fleas, vertebrates such as birds), by repelling or attracting, including those that are used for human or veterinary hygiene either directly or indirectly.

Table 4 The product types of main group 4 of biocidal products according to Annex V of Directive 98/8/EC (EC, 1998)

MAIN GROUP 4: Other biocidal products

Product-type 20: Preservatives for food or feedstocks

Products used for the preservation of food or feedstocks by the control of harmful organisms.

Product-type 21: Antifouling products

Products used to control the growth and settlement of fouling organisms, microbes and higher forms of plant or animal species) on vessels, aquaculture equipment or other structures used in water.

Product-type 22: Embalming and taxidermist fluids

Products used for the disinfection and preservation of human or animal corpses, or parts thereof.

Product-type 23: Control of other vertebrates

Products used for the control of vermin.

All emission scenarios for biocides so far apply to emissions at a local scale considering (large) point sources. For diffuse emissions – such as emissions from households – the STP (sewage treatment plant) is considered as a point source. Also in this report emissions at a regional scale have not been considered.

Table 5 Overview of emission scenarios and their status

Pt	Description of product type	Life cycle stage	Status	Remark(s)
1	Human hygiene biocidal products	Private use	New	Existing generic EUSES scenario based on annual tonnage
		Private use	New	Based on average consumption
		Industrial use	New	Existing generic EUSES scenario based on annual tonnage
2	Private area and public health area disinfectants and other biocidal products:			
	- Swimming pools	Industrial use	USES 3.0	Public swimming pools; acute and chronic situations
		Industrial/Private use	USES 3.0	Public and private swimming pools; acute situation
	- Sanitary sector	Formulation	New	Existing emission scenario document 1 of TGD + generic B-tables for industrial category 5
		Private use	EUBEES (RIVM report 601450 008)	Based on annual tonnage
		Private use	EUBEES (RIVM report 601450 008)	Based on average consumption
	- Horticulture	Industrial use	New	Existing emission scenario of USES 3.0 for household products used for fogging
	- Tiles and surfaces	Formulation	New	Existing emission scenario document 1 of TGD + generic B-tables for industrial category 5
		Private/Industrial use	New	Existing generic EUSES scenario based on annual tonnage
	- Medical sector:			
	-- Disinfection of rooms, furniture and objects	Industrial use/Service life	EUBEES (RIVM report 601450 008)	Based on annual tonnage
		Industrial use/Service life	EUBEES (RIVM report 601450 008)	Based on average consumption
	-- Disinfection of instruments	Industrial use/Service life	EUBEES (RIVM report 601450 008)	Disinfection of scopes in washers
		Industrial use/Service life	EUBEES (RIVM report 601450 008)	Disinfection of other instruments

Table 5 Overview of emission scenarios and their status (continued)

Pt	Description of product type	Life cycle stage	Status	Remark(s)
	-- Laundry disinfectants	Industrial use/Service life	EUBEES (RIVM report 601450 008)	Washing streets
		Industrial use/Service life	EUBEES (RIVM report 601450 008)	Tumbler washing machines
	-- Hospital waste disinfectants	-		
	-- Disinfectants with more than one application	-		Summoning of outcomes scenarios of medical sector
	- Disinfection of air conditioning systems	-		
	- Disinfection of industrial areas	-		
	- Disinfectants for sewage and wastewater	Industrial use	New	Preliminary emission scenario
	- Soil and other disinfectants, …..	-		
	- Disinfection of chemical toilets	-		
3	Veterinary hygiene biocidal products:			
	- Disinfection of animal housing	Industrial use	New	Adaptation of RIVM report 679102 033 and draft EUBEES report
	- Disinfection of footwear and animals' feet	Industrial use	New	Adaptation of RIVM report 679102 033 and draft EUBEES report
	- Disinfection of milk extraction systems	Industrial use	New	Adaptation of RIVM report 679102 033 and draft EUBEES report
	- Disinfection of means of transport	Industrial use	New	Adaptation of RIVM report 679102 033
	- Disinfection of hatcheries	Industrial use	New	Adaptation of RIVM report 679102 033
	- Disinfection of fish farms	-		
4	Food and feed area disinfectants	-	Under development	EUBEES: RIVM
5	Drinking water disinfectants	-	Under development	EUBEES: Umweltbundesamt

Table 5 Overview of emission scenarios and their status (continued)

Pt	Description of product type	Life cycle stage	Status	Remark(s)
6	In-can preservatives			
	- Washing and cleaning fluids, human hygienic products and cosmetics	Private use	New; based on annual tonnage	
		Private use	New; based on average consumption	
	- Detergents	Private use	as previous product subtype	
	- Paints and coatings	Industrial use 1)	New	Existing emission scenario document 14 of TGD + generic B-tables for industrial category 14
		Industrial use 2)	New	Existing emission scenario document 14 of TGD + generic B-table for industrial category 14
		Waste treatment	New	Based on RIVM report 601450 003
	- Fluids used in paper production	Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-nº01DR0165)	Drying sections after size-pressing
		Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-nº01DR0165)	Broke
		Recycling	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-nº01DR0165)	
	- Fluids used in textile production	Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-nº01DR0176)	
	- Fluids used in leather production	Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi-nº01DR0176)	
	- Lubricants	-		
	- Machine oils	-		
	- Fuels	-		

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1) product formulation) 2) product application

Table 5 Overview of emission scenarios and their status (continued)

Pt	Description of product type	Life cycle stage	Status	Remark(s)
7	Film preservatives:			
	- Paints and coatings	Industrial use [1]	New	Existing emission scenario document 14 of TGD + generic B-tables for industrial category 14
		Industrial use [2]	New	Existing emission scenario document 14 of TGD + generic B-table for industrial category 14
		Waste treatment	New	Based on RIVM report 601450 003
	- Plastics	-		
	- Glues and adhesives	Waste treatment	New	Based on RIVM report 601450 003
- Paper and cardboard		Industrial use	EUBEES (INERIS report DRC-01-25582- ECOT-CTi/VMi-nº01DR0165)	Drying sections after size-pressing
		Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-nº01DR0165)	Broke
		Recycling	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-nº01DR0165)	
8	Wood preservatives	Industrial use	USES 3.0	Preventive application: Creosote impregnation
		Industrial use	USES 3.0	Preventive application: Salt impregnation
		Industrial use	USES 3.0	Preventive application: Drenching and dipping
		Industrial use	USES 3.0	Curative application: Remedial timber treatment in buildings
		Service life	USES 3.0	Leaching from impregnated wood to surface water
		Service life	USES 3.0	Leaching from impregnated wood to sandy soil and groundwater
		Service life	USES 3.0	Leaching from impregnated wood to soil
		Waste treatment	New	Based on RIVM report 601450 003

[1] product formulation) [2] product application

Table 5 Overview of emission scenarios and their status (continued)

Pt	Description of product type	Life cycle stage	Status	Remark(s)
9	Fibre, leather, rubber and polymerised materials preservatives			Biocide present in imported material
	- Textile and fabrics	Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-n°01DR0176)	Application steps in textile processing
		Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-n°01DR0176)	
		Service life	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-n°01DR0176)	
	- Leather and hides	Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi-n°01DR0176)	
	- Rubber, plastics and other polymerised materials	-		
	- Paper and cardboard	Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-n°01DR0165)	Drying sections after size-pressing
		Industrial use	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-n°01DR0165)	Broke
		Recycling	EUBEES (INERIS report DRC-01-25582-ECOT-CTi/VMi-n°01DR0165)	
10	Masonry preservatives	-	Under development	EUBEES: INERIS
11	Preservatives for liquid-cooling and processing systems	Industrial use	USES 3.0	
12	Slimicides	Industrial use	USES 3.0	
		Industrial use	New	Draft report RIVM/FEI
13	Metalworking-fluid preservatives	Industrial use	USES 3.0	
14	Rodenticides	Industrial use	USES 3.0	Fogging of buildings and silos
		Industrial use	Under development	EUBEES: MST Danmark (Baits)

Table 5 Overview of emission scenarios and their status (continued)

Pt	Description of product type	Life cycle stage	Status	Remark(s)
15	Avicides	-		
16	Molluscicides	-		
17	Piscicides	-		
18	Insecticides, acaricides and products to control other arthropods:			
	- Insecticides for manure	Industrial use	Draft EUBEES report	i.e. manure storage systems
	- Insecticides for stables	Industrial use	Draft EUBEES report	i.e. animal housings
	- Refuse dumps	-		
	- Insecticides for empty spaces and spaces with stocks	Industrial use	New	Existing emission scenario of USES 3.0 for household products used for fogging
	- Aerosols/fumigants used outdoors	Industrial use	New	
	- Aerosols/fumigants used within fumigation installations	Industrial use	New	Existing emission scenario of USES 3.0 for household products used for fogging
	- Aerosols/fumigants used indoors	Industrial use	New	Existing emission scenario of USES 3.0 for household products used for fogging
19	Repellents and attractants	-		
20	Preservatives for food or feedstocks	-		
21	Antifouling products	Service life	USES 3.0	
22	Embalming and taxidermist fluids	Industrial use	EUBEES (INERIS report DRC-01-25582- ECOT-CTi/VMi-nº01DR0175)	Taxidermy
		Industrial use	EUBEES (INERIS report DRC-01-25582- ECOT-CTi/VMi-nº01DR0175)	Embalming

23	Control of other vertebrates	-

The life cycle of substances such as biocides is presented in Figure 1. The life cycle of a biocide starts – as holds for every substance – with chemical synthesis. For this stage no specific emission scenarios exist with the exception of chemical intermediates. Within the framework of the risk assessment of new and existing substances (Commission Directive 93/67/EEC and Commission Regulation (EC) 1488/98) generic release tables have been published in the Technical Guidance Document, TGD (EC, 1996a), and implemented in the European Union System for the Evaluation of Substances, EUSES (EC, 1996b). These tables have not been reproduced in this report.

Also for the stage of formulation the TGD and EUSES provide generic release (A- & B-) tables. For the formulation of detergents the emission scenario document for industrial categories 5 (Personal/domestic) and 6 (Public domain) of the TGD contains a table with emission factors for washing powders and liquids. It has been assumed that the same emission factors are applicable for biocidal products belonging to product type 2 for sanitary purposes (section 2.2) and for tiles and surfaces section 2.4). The emission scenario document for industrial category 14 (Paints, lacquers and varnishes) of the TGD provides tables with emission factors for paint formulation as well (section 6.3.1).

The stage of private and industrial use comprises the application of the biocides as such or of the biocidal formulations. The use may comprise "short-term" applications where emissions occur over a short period, for example spraying of an insecticide preparation in a stable, and "long-term" applications where emissions occur over a long period, for example spraying of an anti-fouling paint. In the 1st example the biocide is released immediately in the environment and acts directly against target organisms that are present; this action may last for a certain – relatively short – period. In the 2nd example some of the biocide is released to the environment due to spraying inefficiency. The main fraction of the biocide will be present in the coating layer and acts over a relatively long period – the service life – against algal attack.

In the use stage a distinction is made between substances that are used as a processing aid and substances that are incorporated in a product. An example of a processing aid is a slimicide that prevents fouling of equipment in industrial installations.

After use, the remainder of a biocide goes to the last stage, i.e. waste treatment or recovery. An example of a processing aid is a slimicide used in paper production. The remains are released with the wastewater to an STP. Applications as processing aids generally lead to relatively high emission factors. An example of a biocide that is incorporated in a product is a film preservative for paint. The emissions at application of such paint in car repair shops are related to spraying inefficiencies. The emission factors will generally be low. The stage "service life" applies to substances contained in products until disposal of these products. This may be an article such as a plastic ball where the substance is contained in the matrix of the polymer. However, it may also be a painted article such as a doorpost where the substance is contained in the coating layer. In both cases emission factors will be rather low and decreasing with time. However, the period

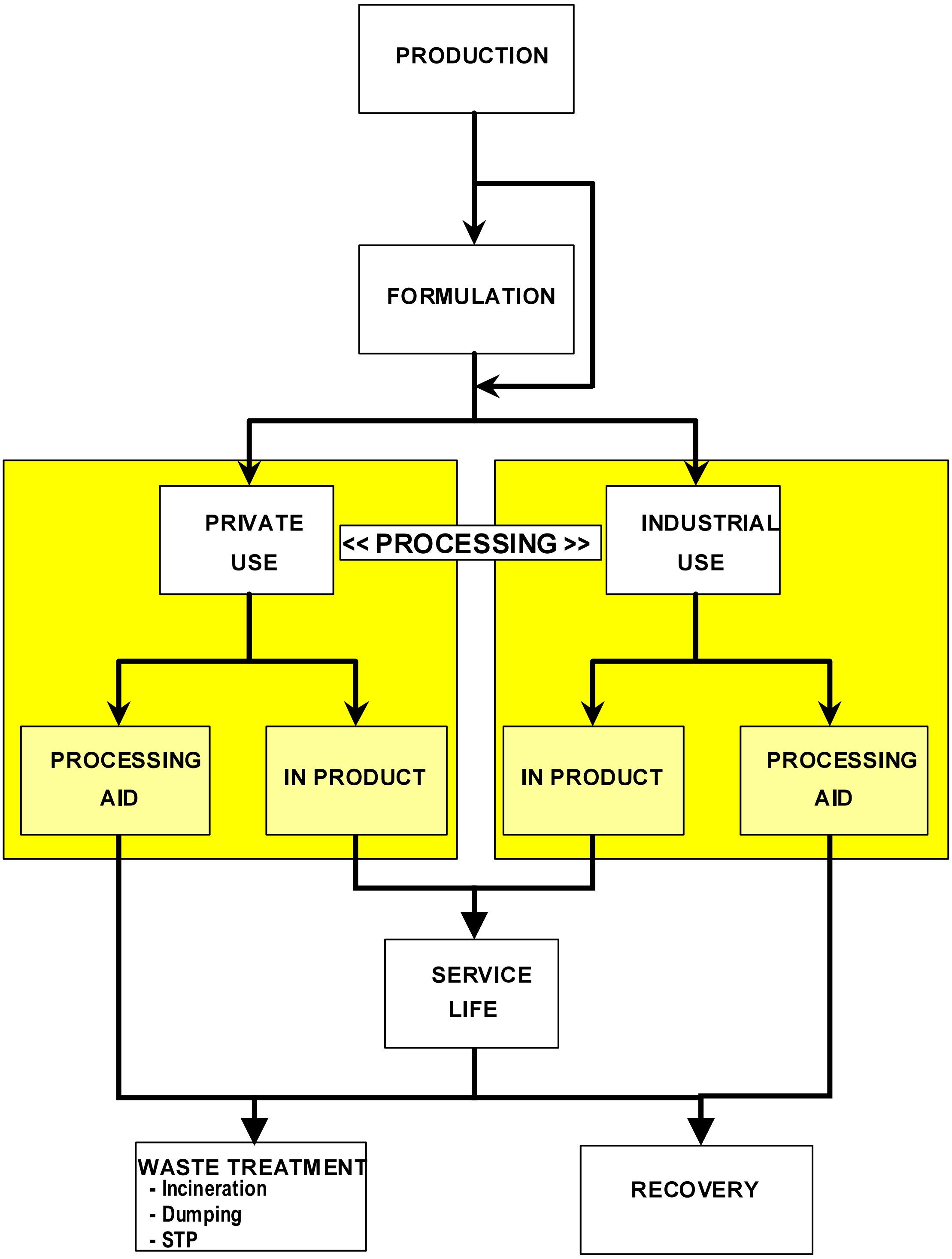


Figure 1 *Schematic representation of the life cycle of a biocide*

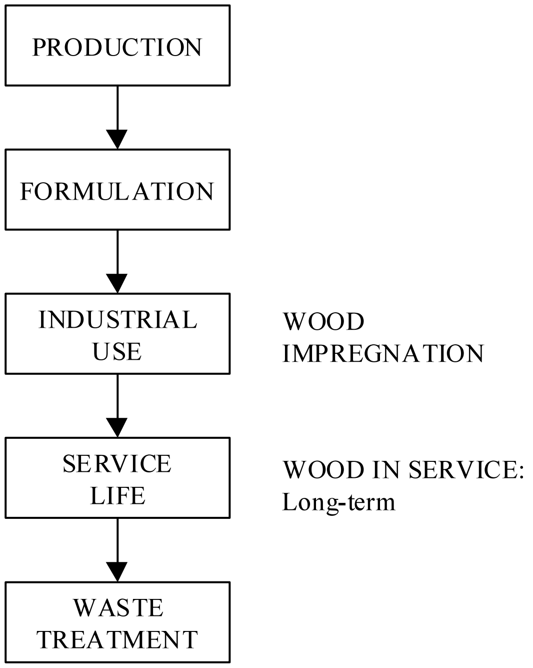
over which these – diffuse – emissions occur may be very long. As far as biocides are concerned product types 6 (in-can preservatives), 7 (film preservatives), 8 (wood preservatives), 9 (fibre, leather, rubber and polymerised materials preservatives), 10 (masonry preservatives) and 21 (antifouling products) are of interest with respect to this life cycle stage.

Finally, there is the stage of waste treatment and recovery. Waste treatment may be the discharge with wastewater to an STP. This often occurs when biocides are applied as processing aids in aqueous solutions. The other two forms of waste treatment are incineration and dumping in landfills. Waste streams may contain articles with biocides such as the plastic ball and doorpost mentioned before. A first report with emission scenarios for waste treatment was published in 1999 (Van der Poel, 1999b). This report contains a model for the emissions from landfills. Biocidal product types have been identified that are likely to end up in waste streams. As the life cycle stage "service life" has not yet been worked out for risk assessment general "overall" emission factors were estimated by introducing fractions for diffuse releases and degradation during service life.
Recycling may consist of recovery and re-use of a substance as such or of recycling of a product such as paper. Biocides will normally not be recovered and re-used.

Often the various stages of the life cycle are distinct. Sometimes, however, it is disputable whether the relevant stage for emission is the use stage or the waste treatment stage. This illustrated with two examples, one for a wood preservative (clear distinction between life cycle stages) and a disinfectant for an antiseptic cream.

<u>Example 1</u>: wood preservative

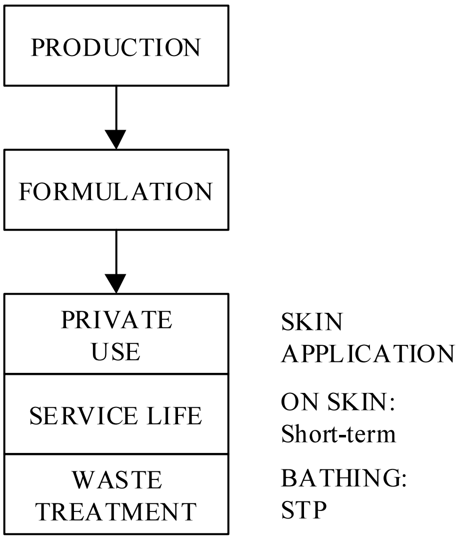
The life cycle looks like:



All life cycle stages are clearly distinguished. The processing stage, industrial use, is in fact the impregnation of the wood. Wood impregnation can be done in several ways, which are characterised by typical emission factors. This is described in an emission scenario document (e.g. Luttik *et al.*, 1993). Wood in service may be in the form of the use of the impregnated wood for fences, embankments, etc. The period of service is usually rather long, i.e. up to 20 years or more. Characteristic situations are described in emission scenario documents (e.g. Luttik *et al.*, 1993; Luttik *et al.*, 1995).

Example 2: disinfectant for an antiseptic cream

The life cycle looks like:



For this biocide application only the stages production and formulation are distinct. The cream will be used by the public at large (stage of private use). Applications may be at irregular intervals ("when needed") and only by a fraction of the population. It will act as long it is on the skin, i.e. until it has been rubbed off by clothes or at washing and bathing. The time that the disinfectant is "active" is relatively short. When clothes are washed and when the body is washed the disinfectant is transferred to the sewer. So, the life cycle stages are interrelated.

For every product type this will be shown in a flow chart as depicted for these two examples. If a specific stage of the life cycle is described in a separate section – and in most cases – has been provided with an emission scenario the box has a thicker borderline.

The emission scenarios in this report are presented in the form of tables with the following format:

Variable/parameter (unit)	Symbol	Default	S/D/O/P

Input

These parameters are the input to the scenario. The S, D, O or P classification of a parameter indicates the status:

S	Parameter must be present in the input data set for the calculation to be executed (there has been no method implemented in the system to estimate this parameter; no default value is set).
D	Parameter has a standard value (most defaults can be changed by the user)
O	Parameter is the output from another calculation (most output parameters can be overwritten by the user with alternative data).
P	Parameter value can be chosen from a "pick-list" of values.
^{c}	Default or output parameter is closed and cannot be changed by the user.

Output

[Symbol] [Description]

Intermediate calculations

Parameter description (Unit)

[Parameter = equation] (Equation no.)

End calculations

[Parameter = equation] (Equation no.)

Before EUSES and USES were produced several precursors have been developed and a variety of use category documents and emission scenario documents appeared. As the use of names and parameters for variables vary a lot in the various documents a report with a proposal for future emission scenario documents was made (Van der Poel, 2000). In writing this report that integrates all existing emission scenarios and scenarios under development for biocides it became urgent to use the same symbols, names and formats throughout the document for the same parameters. So, in this report names may deviate from the names used in the original report and/or the manual of USES. Therefore, Appendices 8 and 9 have been added to this report.

Appendix 9

Appendix 9 presents an overview of the various symbols and the tables in which they occur. Furthermore, the symbols as they occur in the original report, such as emission scenario documents and the USES manual 3.0 manual, are listed. The parameters and variables have been grouped in the way as in Van der Poel (2000). The header of Appendix 9 looks like:

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks

The footnote reads " [1)]Report number according to the list of Appendix 10 + [Table number]". In this header "Table" and "Symbol" refer to the table number and symbol of the present report. "Report[1)]" and "Symbol" refer to the original report (see footnote explained above) and the symbol used in that original report. Under "USES 3.0" the symbol used in USES 3.0 for the parameter is stated if appropriate. If there is a new scenario in the present report a hyphen is placed for the original report with a point for symbol. If the parameter does not occur yet in USES 3.0 a point is used as well.

Appendix 10

Appendix 10 presents for every table of this report the parameters and variables with their symbols. Also in this appendix the symbols which are used in the emission scenarios documents and in the USES manual (if appropriate) are listed. The header of Appendix 10 looks like:

This report	Original report No. # table ##	USES 3.0

In the first column, "This report", the symbol used in the present report is given and in the second column, "Original report", the number of the original report (listed in Appendix 10) with the table or section number concerned. In the last column the symbol for the parameter used in USES 3.0 is given if appropriate.

Remarks related to symbols for parameters and variables

Preparing the present report it turned out that some of the proposals of the report with the proposals (Van der Poel, 2000) were not consistent. So, Appendix 9 presents also some hints how names with specifications and subscripts may be used in a logic and consistent way. The general line to be followed in drawing up symbols is:

NAME	Name in capitals for a parameter or variable such as a dimension (LENGTH, WIDTH, DEPTH, etc.).
specification	A whole word, logical abbreviation or words/abbreviations connected with an underscore in lower case such as "fence" (LENGTHfence), "wway" (DEPTHwway) or "form_uins" (Qform_uins); the last example stands for the

	amount ("Q") of a formulation ("form") to be used according to the user's instructions ("uins").
subscript	A) A whole word or logical abbreviation to distinguish between specific cases (e.g. concentration of a substance in a formulation expressed by weight and by volume: $Cform_{weight}$ and $Cform_{vol}$ respectively). B) Indices for variables such as stage of the life cycle and receiving compartment such as for example $F_{i,j}$, which means for e.g. i = 3 and j = 1 ($F_{3,1}$) $F_{processing,water}$.

So, to avoid confusion with frequently occurring subscripts specifications should be used whenever possible. Furthermore, the same names should be used for the same type of parameter/variable (e.g. length of something LENGTH, quantity by weight Q, quantity by volume V). This applies also to specifications and subscripts; a list of specifications and subscripts is presented in Appendix 10.

It should be noted that a number refers to the original report; this number corresponds with the referenced report of Appendix 11. Between square brackets, [ ], the number of table in the original report is specified. If that number is in *italic* it concerns a section of the original report (no table present).

1. Product type 1: Human hygiene biocidal products

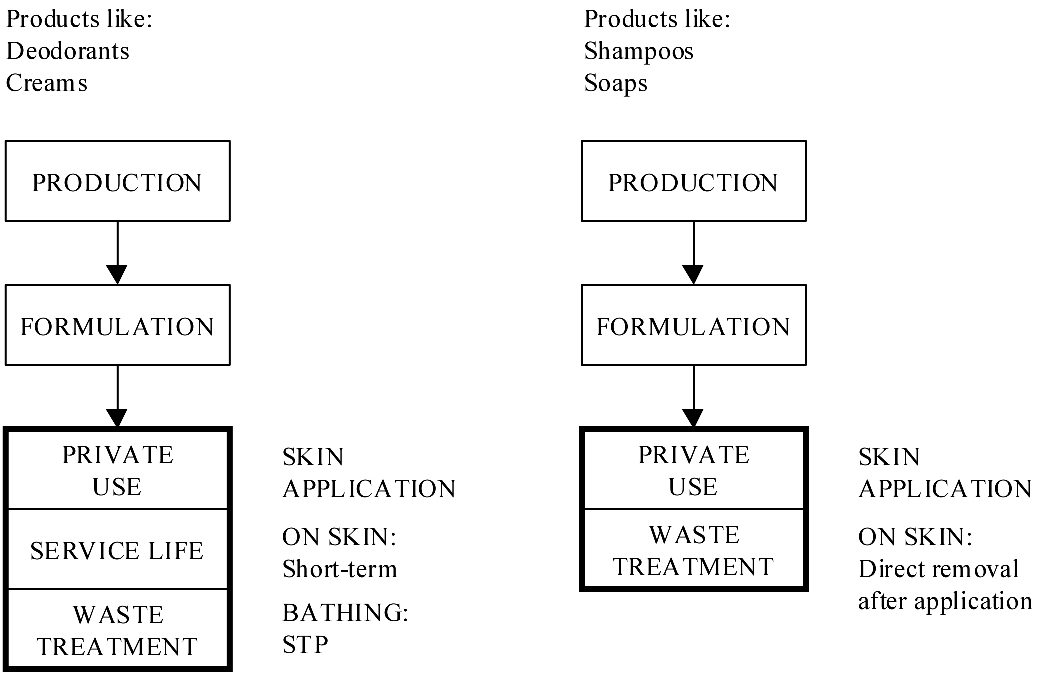
According to the description in Annex V to Directive 98/8/EC these are biocidal products that are used for human hygiene purposes. Products that can be regarded as such (Van Dokkum *et al.*, 1998) are:

- Antiperspirants and deodorants
- Anti-dandruff shampoos
- Products to combat acne

Another report distinguishes the following subgroups:

- Skin antiseptic (professional and non- professional use)
- Antimicrobial soap (professional and non- professional use)
- Health care personnel hand wash (professional use)
- Suntan (non-professional use)

Possibly other products also other disinfecting products such as creams may be considered here. The scheme of the life cycle for products belonging to product type 1 consists of two parts:



For almost all products it may be assumed that the main emission route will be to wastewater. The product is directly released with wastewater at washing and bathing after application (shampoos at hair washing for example and other products at bathing) or indirectly when substances that have been transferred to clothing are removed at washing (deodorants for example). Most products are applied as solutions (shampoos), soaps, creams, roll-ons and sticks (anti-perspirants and deodorants), gels, bars, lotions and aerosols (deodorants) (Van Dokkum *et al.*, 1998). The release to wastewater will be 100 % for most products or almost

100 %, probably with the exception of aerosols. However, at cleaning of surfaces where the droplets of the aerosol have settled most of it will be transferred to wastewater at last. So the release to wastewater is 100% by default (emission factor $F_{4,water} = 1$).
There is no specific emission scenario document for this product type. However, the same scenarios as for disinfectants used in the sanitary sector may be used as presented in Van der Poel (2001a) for non- professional use (life cycle stage private use). For professional use (life cycle stage industrial use) the emission scenarios may be used as presented in Van der Poel (2001a) for disinfectants used for sanitary purposes in hospitals based on the tonnage. For average consumption the emission scenario for non- professional use may be used. Instead of an average per inhabitant the average per bed is used. The average hospital size for the Netherlands of 400 beds and occupancy rate of about 75 % (300 beds) is used as default.

1.1 Private use

The first scenario uses the regional tonnage and follows the scenario approach as in EUSES for cleaning products in industrial category 5 (Personal/domestic) at the stage of private use. This means that the standard STP of EUSES is considered as a point source where a fraction of 0.002 ($Fmainsource_2$) of the disinfectant ends up (see part 1 of Appendix 2). This scenario is presented in Table 1.1.
As the tonnage of biocides has not to be supplied by the notifier at present a second scenario can be used. This scenario uses post-consumer release prediction and consumption data as applied in the emission scenario document for soaps and detergents used in industrial categories 5 (Personal/domestic) and 6 (Public domain) (EC, 1996a). The problem is that often no average consumption data per inhabitant per day will be available for human hygiene biocidal products. For example, average consumption data per inhabitant per day for shampoos are present but not for anti-dandruff shampoo. Therefore, the emission scenario has been extended in such way that average amounts of product per application can be used together with a factor for the fraction of inhabitants using a specific product (e.g. for an anti-dandruff shampoo the known data for the average consumption per application may be used). The extended consumption scenario is presented in Table 1.2
It should be noted that the same biocide might be applied in different biocidal products. For the emission scenario based on the tonnage this is not important. For the emission scenario based on the average consumption's the calculations should be carried out for every specific product. At the end the individual emissions calculated have to be summed. This has not been expressed in the emission scenario of Table 1.2.
The default values for average consumption, number of applications and fractions are available in the pick-list presented in Table 1.3. As no data were available arbitrary defaults have been chosen for the fraction of inhabitants for the various products. For products such as shampoo and deodorant the TGD (EC, 1996a) contains some data. Furthermore data from a draft fact sheet on cosmetics was used (Bremmer and Van Veen, 2000).
The concentration of the active ingredient − i.e. the biocide concerned − has to be supplied by the notifier. The density of the detergents is assumed to be 1000 kg.m^{-3} by default. The

scenario involves the market share, which means that the fraction of the specific product containing the same disinfectant. The market share is called penetration factor in the scenario. As no market shares for disinfectants applied for this purpose are known, a "best guess" of 0.5 is used. If better data for the specific products become available the pick-list should be updated.

Table 1.1 Emission scenario for calculating the releases of disinfectants used in human hygiene biocidal products based on the annual tonnage applied

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
A)			
Relevant tonnage in the region for this application ($tonnes.yr^{-1}$)	TONNAGEreg [1)]		S
B)			S
Relevant tonnage in EU for this application ($tonnes.yr^{-1}$)	TONNAGE [1)]		
Fraction for the region	$Fprodvol_{reg}$	0.1	D
A + B)			
Fraction of the main source (STP) (-)	$Fmainsource_4$	0.002	D
Fraction released to wastewater (-) [2)]	$F_{4,\ water}$	1	D
Number of emission days for life cycle stage 4 (private use) ($d.yr^{-1}$)	$Temission_4$	365	D
Output:			
$Elocal_{4,water}$ = Emission rate to wastewater ($kg.d^{-1}$) [2)]			
Intermediate calculations:			
B)			
Relevant tonnage in the region for this application ($tonnes.yr^{-1}$)			
$TONNAGEreg = Fprodvol_{reg} * TONNAGE$ (1.1)			
End calculations:			
A + B)			
$Elocal_{4,water} = TONNAGEreg * 10^3 * Fmainsource_{water} * F_{4,water} / Temission_4$ (1.2)			

[1)] In principle this should be $TONNAGE_k$ to identify usage in product *k* but this is not shown just as in the EUSES documentation

[2)] The subscript "4" refers to the stage of private use in conformity with EUSES 1.0 and USES 3.0 (RIVM, VROM, VWS, 1999).

Table 1.2 Emission scenario for calculating the releases of disinfectants used in human hygiene biocidal products based on an average consumption for k products[3)] with the biocide considered

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Number of inhabitants feeding one STP (eq)	Nlocal	10000	D [1)]
Fraction released to wastewater (-) [2)]	$F_{4,water}$	1	D

Active substance in product:			
A) ($g.l^{-1}$)	$Cform_{volume}$		S
B) ($g.kg^{-1}$)	$Cform_{weight}$		S
C) Consumption per inhabitant per day:			
C1) ($ml.d^{-1}.eq^{-1}$)	$Vform_{inh}$		P
C2) ($g.d^{-1}.eq^{-1}$)	$Qform_{inh}$		P
D) Consumption per application:			
D1) (ml)	$Vform_{appl}$		P
D2) (g)	$Qform_{appl}$		P
Number of applications (d^{-1})	Nappl		P
Fraction of inhabitants using product *k* [3] (-)	Finh		P
Penetration factor of disinfectant (-)	Fpenetr	0.5	D
Specific density of product *k* ($kg.m^{-3}$) [3]	RHOform	1000	D

Output:

$Elocal_{4,water}$ = Emission rate to wastewater ($kg.d^{-1}$) [1]

Model calculations:

C1 and A)

$$Elocal_{4,water} = Nlocal * F_{4,water} * Vform_{inh} * Cform_{volume} * Fpenetr * 10^{-6} \quad (1.3)$$

C1 and B)

$$Elocal_{4,water} = Nlocal * F_{4,water} * Vform_{inh} * RHOform * Cform_{weight} * Fpenetr * 10^{-9} \quad (1.4)$$

C2 and A)

$$Elocal_{4,water} = Nlocal * F_{4,water} * Qform_{inh} / RHOform * Cform_{volume} * Fpenetr * 10^{-3} \quad (1.5)$$

---

[1] Default number as used in EUSES for the standard STP

[2] The subscript "4" refers to the stage of private use in conformity with EUSES 1.0 and USES 3.0.

[3] The subscript *k* identifying usage of the biocide in product *k* is not shown (see text)

Table 1.2 Emission scenario for calculating the releases of disinfectants used for sanitary purposes based on an average consumption for k products[1] with the biocide considered (continued)

C2 and B)

$$Elocal_{4,water} = Nlocal * F_{4,water} * Qform_{inh} * Cform_{weight} * Fpenetr * 10^{-6} \quad (1.6)$$

D1 and A)

$$Elocal_{4,water} = Nlocal * Nappl * Finh * F_{4,water} * Vform_{appl} * 10^{-6} * Cform_{volume} * Fpenetr \quad (1.7)$$

D1 and B)

$$Elocal_{4,water} = Nlocal * Nappl * Finh * F_{4,water} * Vform_{appl} * 10^{-9} * RHOform * Cform_{weight} * Fpenetr \quad (1.8)$$

D2 and A)

$$Elocal_{4,water} = Nlocal * Nappl * Finh * F_{4,water} * Qform_{appl} / RHOform * Cform_{volume} * Fpenetr * 10^{-3} \quad (1.9)$$

D2 and B)

$$Elocal_{4,water} = Nlocal * Nappl * Finh * F_{4,water} * Qform_{appl} * Cform_{weight} * Fpenetr * 10^{-6} \quad (1.10)$$

---

1) The subscript *k* identifying usage of the biocide in product *k* is not shown (see text)

Above a certain tonnage – at the break-even point –the scenario based on the tonnage should be applied preferably; this is explained in Appendix 2. For the number of emission days $Temission_{4,}$ = 365 and the fraction for the model STP of 0.002 the break-even point can be calculated according to the appropriate formulas of Appendix 2 if necessary.

Table 1.3 Pick-list for average consumptions per inhabitant per day, $Vform_{inh}$ ($ml.d^{-1}$) & $Qform_{inh}$ ($g.d^{-1}$), per application, $Vform_{appl}$ (ml) & $Qform_{appl}$ (g), number of applications, Nappl (d^{-1}), and the fraction of inhabitants using the product, Finh [-]

Product	$Vform_{inh}$ $Qform_{inh}$	$Vform_{appl}$ $Qform_{appl}$	Nappl	Finh
Anti-dandruff shampoo	.	12 $^{1)}$	0.71 $^{2)}$	0.1
Anti-perspirants/Deodorants:				
- aerosol	.	3 $^{1)}$	2 $^{3)}$	0.2
- stick, roll-on	.	0.5 $^{1)}$	1 $^{1)}$	0.8
Creams (e.g. anti-acne)	.	0.8 $^{4)}$	2 $^{4)}$	0.1
Mouth wash	.	10	3	0.05

1) TGD (EC, 1996a)

2) TGD: 2-7 times per week; default 5 times per week = 0.71 times per day

3) TGD: 1-3 times per day

4) Data from the TGD for facial cream: 1-2 times per day

As can be seen in Table 1.3 no defaults for average consumptions have been given at all. This means that part "C)" of the emission scenario presented in Table 1.2 is not applicable at all. It should be noted, however, that such an average might be used if – e.g. in the case of shampoo – an accurate value is known for a country or region and when it is known that a disinfectant is always present.

1.2 Industrial use

Table 1.4 presents the scenario for disinfectants in human hygiene biocidal products based on the tonnage. The fraction of the main source, $Fmainsource_3$, concerns hospitals. As the average Dutch hospital size is used fraction of the main source is 0.007. This is basically the same emission scenario as for private use (and as such as the generic scenario of EUSES).

Table 1.4 Emission scenario for calculating the releases of disinfectants used for skin and hand application in hospitals based on the annual tonnage applied

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
A)			
Relevant tonnage in the region for this application (tonnes.yr^{-1})	TONNAGEreg $^{1)}$		O
B)			
Relevant tonnage in EU for this application (tonnes.yr^{-1})	TONNAGE $^{1)}$		
Fraction for the region	Fprodvol$_{reg}$	0.1	D
A + B)			
Fraction of the main source (STP) (-)	Fmainsource$_3$	0.007	D
Fraction released to wastewater (-) $^{2)}$	$F_{3,water}$	1	D
Number of emission days for life cycle stage 3 (processing) (d.yr^{-1})	Temission$_3$	365	D
Output:			
Elocal$_{3,water}$ = Emission rate to wastewater (kg.d^{-1}) $^{2)}$			

Intermediate calculations:

B)

Relevant tonnage in the region for this application (tonnes.yr^{-1})

$$TONNAGEreg = Fprodvol_{reg} * TONNAGE \quad (1.11)$$

End calculations:

A + B)

$$Elocal_{3,water} = TONNAGEreg * 10^3 * Fmainsource_3 * F_{3,water} / Temission_3 \quad (1.12)$$

---

1) In principle this should be TONNAGE$_k$ to identify usage in product *k* but this is not shown just as in the EUSES documentation

2) The subscript "3" refers to the stage of processing in conformity with EUSES 1.0 and USES 3.0.

Table 1.5 presents the scenario for disinfectants in human hygiene biocidal products based on the average consumption per bed. Information on the average consumption per bed was found in Gartiser and Stiene (1999). These values came from six hospitals in Germany and were given for several chemical groups and concern the beds present. The defaults are averages from these data if 5 or more hospitals used chemicals from a group or otherwise the maximum. The average may be known as an average per bed present in the hospital or per bed occupied over the year. Therefore, an occupancy rate (Foccup) – averaged over the year – has been introduced.

Above a certain tonnage (at the break-even point), as explained in Appendix 2, the scenario based on the tonnage should be applied preferably.

Table 1.6 presents the pick-list for disinfectants of some chemical groups expressed in $g.d^{-1}$ for beds present and for occupied beds assuming an occupancy rate of 75% (Foccup = 0.75).

Table 1.6 Pick-list for the average use of disinfectant for professional use ($Qsubst_{pres\text{-}bed}$) per hospital bed ($g.d^{-1}$) for beds present (I) and $Qsubst_{occup\text{-}bed}$ for occupied beds (II)

Chemical type	I	II
Alcohols	15	20
Quaternary ammonium compounds	0.004	0.005
Guanidines	0.015	0.02
Compounds splitting off oxygen	0.038	0.05
Compounds splitting off halogen	0.10	0.13
Others	0.038	0.05

Table 1.5 Emission scenario for calculating the releases of disinfectants used for skin and hand application in hospitals based on an average consumption

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
A)			
Number of beds in model hospital (-)	$Nbeds_{pres}$	400	D
Occupancy rate (-)	Foccup	0.75	D
B)			
Number of occupied beds in model hospital (-)	$Nbeds_{occup}$	300	D
Fraction released to wastewater (-) [1]	$F_{3,water}$	1	D
C)			
Consumption of active ingredient per bed ($g.d^{-1}$)	$Qsubst_{pres\_bed}$		P
D)			
Consumption of active ingredient per occupied bed ($g.d^{-1}$)	$Qsubst_{occup\_bed}$		P

Output:

$Elocal_{3,water}$ = Emission rate to wastewater ($kg.d^{-1}$) [1]

Model calculations:

A + C)

$$Elocal_{3,water} = Nbeds_{pres} * Qsubst_{pres\_bed} * 10^{-3} * F_{3,\,water} \qquad (1.13)$$

A + D)

$$Elocal_{3,water} = Nbeds_{pres} * Foccup * Qsubst_{occup\_bed} * 10^{-3} * F_{3,\,water} \qquad (1.14)$$

B + C)

$$Elocal_{3,water} = Nbeds_{occup} * Qsubst_{pres\_bed} * Foccup / 10^{-3} * F_{3,\,water} \qquad (1.15)$$

B + D)

$$Elocal_{3,water} = Nbeds_{occup} * Qsubst_{occup\_bed} * 10^{-3} * F_{3,\,water} \qquad (1.16)$$

---

[1] The subscript "3" refers to the stage of processing in conformity with EUSES 1.0 and USES 3.0.

2. Product type 2: Private area and public health area disinfectants and other biocidal products

This product type concerns a heterogeneous group of products used for disinfection, for example bathrooms, toilets, chemical closets, walls and floors in private homes and institutions such as offices, workshops, schools, hospitals and sport facilities (Van Dokkum *et al.*, 1998). All disinfectants not included in one of the other product types belong here. The CTB (National Board of the Authorisation of Pesticides) in the Netherlands applies the following division for the fields of application:

2.1 Swimming pools
2.2 Sanitary sector
2.3 Horticulture
2.4 Tiles and surfaces
2.5 Medical sector

Both Van Dokkum *et al.* (1998) and Baumann *et al.* (2000) mention furthermore:

2.6 Disinfection of air conditioning systems
2.7 Disinfection of industrial areas
2.8 Disinfection of sewage and wastewater
2.9 Soil and other disinfectants, e.g. children playgrounds, horticulture

These items are discussed in the following sections.

2.1 Swimming pools

The emission scenarios for swimming pools of USES 3.0 (RIVM, VROM, VWS, 1999) were presented in the first report on non-agricultural pesticides (Luttik *et al.*, 1993). The emission scenario for public swimming pools discharging their water to the sewage system is presented in Table 2.1. It calculates the emissions to the municipal STP of active ingredients (and metabolites or reaction products used or formed). The user must specify whether the discharge is 'acute' (the whole pool is emptied completely in the STP) or 'chronic' (a fixed amount of water per visitor is discharged). The emission scenario for public and private pools discharging into surface water is presented in Table 2.2. This scenario is for the 'acute' situation at release of the whole pool capacity.

The scheme for the life cycle stages is shown on top of the next page. As can be seen in the scheme the processing stage has been merged with the service life stage. The disinfectant is added to the water up to the desired concentration and kept at that level during utilisation of the water.

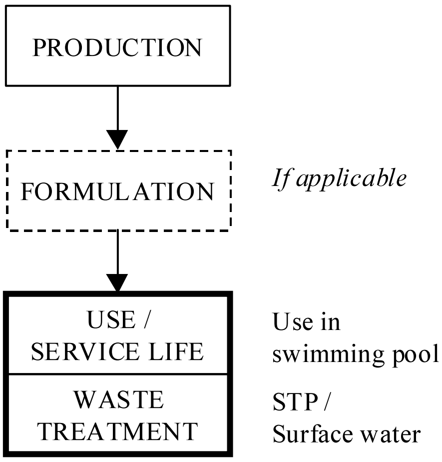


Table 2.1 Discharge of swimming water by public swimming pools into the sewage system for the acute and chronic situation

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Water surface (m^2)	AREAswimw	440	D
Average depth of water (m)	DEPTHswimw	1.8	D
Number of visitors per day (-)	Nvisit	400	D
Concentration in swimming water ($kg_c.m^{-3}$)	Cproc		S
Water replaced per visitor (m^3)	Vrepl	0.05	D
Parameters required for distribution modules:			
Number of emission days (d) for the:	$Temission_3$ 1)		D
acute situation ($Temission_{swimw,ac}$ 2))		2	
chronic situation ($Temission_{swimw,chr}$ 2))		300	

Output:

$Elocal_{3,water}$ = Emission to wastewater for the chronic situation ($mg.l^{-1}$)

Calculations:

Acute situation (complete discharge of the whole pool):

$$Elocal_{3,water} = \frac{AREAswimw * DEPTHswimw * Cproc}{1} \quad {}^{3)} \tag{2.1}$$

Chronic situation (discharge of fixed amount per visitor):

$$Elocal_{3,water} = \frac{Nvisit * Vrepl * Cproc}{1} \quad {}^{3)} \tag{2.2}$$

---

1) Defined in USES 3.0 as an output of a calculation

2) Symbol in USES 3.0 for the input of the default for emission duration with symbol $Temission_3$

3) The 1 in the formula in one day of the emission period

Table 2.2 Discharge of swimming water by public and private swimming pools into the surface water for the acute situation

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Type of swimming pool (public/private)	POOLTYPE		P
Dilution factor for (-):	DILUTION		D
public swimming pools		4	
private swimming pools		2	
Depth of ditch (m)	DEPTHditch [1)]	0.3	D
Concentration in swimming water ($kg.m^{-3}$)	Cproc		S
Parameters required for distribution modules [2)]*:*			
Fraction drift related to location and way of application (-)	Fdrift	1	O^c
Application interval (d)	Tint	1	O^c
Number of applications in one year (-)	Nappl	1	O^c

Output:

$Cwater_{pest\text{-}1\ appl}$ = Peak concentration in surface water ($kg.m^3$)

Calculations:

If *POOLTYPE* = 'public' (life cycle stage 3):

$$Cwater_{pest-1\ appl} = \frac{Cproc}{DILUTION} \tag{2.3}$$

If *POOLTYPE* = 'private' (life cycle stage 4):

$$Cwater_{pest-1\ appl} = \frac{Cproc}{DILUTION} \tag{2.4}$$

[1)] Already defined in distribution model for pesticides (symbol $DEPTH_{ditch}$ in USES 3.0)

[2)] Internally calculated in USES 3.0; the symbols in the USES 3.0 documentation use symbols with subscripts (F_{drift}, $T_{interval}$ and N_{appl} respectively)

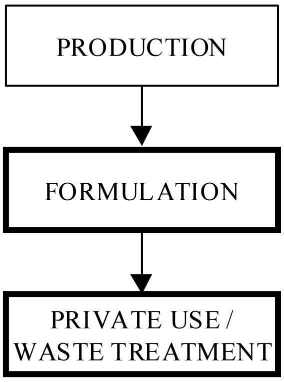
2.2 Sanitary sector

The field of the sanitary sector was treated in an RIVM report produced for the Dutch situation (Van der Poel, 1999a). Discussions in the working group for the EU project "Gathering , review and development of environmental emission scenarios for biocides" and data supplied by some member states enabled to draw up emission scenarios that are presented in Van der Poel (2001a). The emission scenarios are applicable in all European Union member states. The first scenario uses the regional tonnage and follows the scenario approach as in EUSES for cleaning products in industrial category 5 (Personal/domestic) at the stage of private use. This means that the standard STP (sewage treatment plant) of EUSES is considered as a point source where a fraction of 0.002 ($Fmainsource_2$) of the disinfectant ends up. The release to wastewater is 100% by default.

As the tonnage of biocides has not to be supplied by the notifier at present a second scenario is presented as well. This scenario uses the post-consumer release prediction and consumption data of the emission scenario document for soaps and detergents used in industrial categories 5 (Personal/domestic) and 6 (Public domain) (EC, 1996a). That emission scenario document gives an estimate of a 100% release to wastewater, and applies a consumption of detergents for surface cleaning at the level of 5 and 2 grams per capita per day for general purpose and lavatory cleaners respectively. The density of the detergents is assumed to be 1000 $kg.m^{-3}$.
The scenario has been adapted in such a way that the market shares is taken into account; this means the fraction of the cleaning product containing the same disinfectant. The market share is called penetration factor in the scenario. As no market shares for disinfectants applied for this purpose are known a "best guess" of 0.5 is used.
The emission scenario document of the TGD mentioned above also presents emission factors for compact washing powders and washing liquids. The general scenario approach of EUSES can be applied here; the emission scenario as present in EUSES is presented in Table 2.3. As general purpose and lavatory cleaners are liquid formulations the emission factors for washing liquids can be used. Table 2.4 presents the relevant information of the emission scenario document for industrial categories 5 and 6. However, the emission scenario document does not supply information to establish the size of a point source for emission estimation at a local scale. Therefore the B-tables for industrial categories 5 and 6 of the TGD may be used, which are presented in Table 2.5. The tonnage in the table, $TONNAGEreg_{form}$, can be considered the tonnage of product formulated in the Netherlands. If no specific information has been made available by the notifier the product is not considered as a high production volume chemical (HPVC). It should be noted that the regional tonnage, TONNAGEreg, is corrected for the calculation of the fraction of the main source and the number of emission days by the concentration of the substance in the formulation, $Fchem_{form}$. The concentration in the product (cleaner) has to be supplied by the notifier. The correction occurs according to the formula:

$$\mathrm{TONNAGEreg}_{\mathrm{form}} = \frac{1}{\mathrm{Fchem}_{\mathrm{form}}} * \mathrm{TONNAGEreg} \qquad (2.5)$$

Table 2.6 presents the emission scenario applying the tonnage of the disinfectant and Table 2.7 the scenario for the average consumption. It should be noted that the standard STP of EUSES and USES is used, with 10,000 inhabitants feeding the system and an amount of 0.2 m^3 wastewater per inhabitant per day.
The scheme of the life cycle stage is shown below. As can be seen in the scheme the stage of private use has been merged with the stage of waste treatment. The stage of service life has been omitted completely as the time that the disinfectant exerts its action is very short and release to the sewer follows the cleaning/disinfection step immediately.



2.2.1 Formulation

Table 2.3 presents the emission scenario for the stage of formulation for new and existing substances according to EUSES that are applicable to liquid cleaning products based on the annual tonnage applied. The default values for the emission factors are derived from the emission scenario document for industrial categories 5 and 6 in the TGD and are presented in Table 2.4. Table 2.5 presents the default values for the establishment of the size of the point source, which are based on the generic B-tables of the TGD and EUSES for industrial categories 5 and 6.

Table 2.3 Emission scenario for calculating the releases of disinfectants used for sanitary purposes based on the annual tonnage applied at formulation

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
A)			
Relevant tonnage in the region for this application (tonnes.yr^{-1})	TONNAGEreg [1)]		O
B)			
Relevant tonnage in the EU for this application (tonnes.yr^{-1})	TONNAGE [1)]		O
Fraction for the region (-)	$Fprodvol_{reg}$	0.1	D
A + B)			
Fraction of the tonnage released during formulation to air (-)	$F_{2,air}$ [2)]		D [2.4]
Fraction of the tonnage released during formulation to wastewater (-)	$F_{2,water}$ [2)]		D [2.4]
Code for high production volume chemical (yes/no)	HPVC	no	D
Fraction of the main local source (-)	$Fmainsource_2$ [2)]		D [2.5]
Number of emission days per year (d.yr^{-1})	$Temission_2$ [2)]		D [2.5]

Output:

$Elocal_{2,air}$ = Emission rate to air (kg.d^{-1}) [2)]

$Elocal_{2,water}$ = Emission rate to wastewater (kg.d^{-1}) [2)]

Intermediate calculation:

B)

Relevant tonnage in the region for this application (tonnes.yr^{-1})

$$TONNAGEreg = Fprodvol_{reg} * TONNAGE \quad (2.6)$$

End calculations:

A + B)

$$Elocal_{2,air} = TONNAGEreg * 10^3 * Fmainsource_2 * F_{2,air} / Temission \quad (2.7)$$

$$Elocal_{2,water} = TONNAGEreg * 10^3 * Fmainsource_2 * F_{2,water} / Temission \quad (2.8)$$

[1)] In principle this should be TONNAGE, or respectively TONNAGEreg, to identify usage in product *k* but this is not shown just as in the EUSES documentation.

[2)] The subscript "2" refers to the stage of the life cycle formulation in conformity with EUSES 1.0 and USES 3.0.

Table 2.4 Emission factors to air, $F_{2,air}$ *(-), and wastewater,* $F_{2,water}$ *(-), for the formulation of general purpose and lavatory cleaners (liquid formulations)*

Compartment	Emission factor
Air	0.000 02
Wastewater	0.000 9

Table 2.5 Fraction of the main source, $Fmainsource_2$ *(-), and number of emission days,* $Temission_2$ *(d), for the formulation stage of general purpose and lavatory cleaners based on the corrected regional tonnage,* $TONNAGEreg_{form}$ *(tonnes.yr*$^{-1}$*), of the biocide*

$TONNAGEreg_{form}$	$Fmainsource_2$	$Temission_2$
HPVC[1)] = yes		
< 3500	1	300
3500 – 10,000	0.8	300
10,000 – 25,000	0.7	300
25,000 – 50,000	0.6	300
≥50,000	0.4	300
HPVC[1)] = no		
< 100	1	$2 * Fmainsource_2 * TONNAGEreg_{form}$
100 – 500	0.6	$Fmainsource_2 * TONNAGEreg_{form}$
500 – 1000	0.6	$0.5 * Fmainsource_2 * TONNAGEreg_{form}$
≥1000	0.4	300

[1)] HPVC is the code to specify if the substance is a so-called high production volume chemical

2.2.2 Private use

For the life cycle stage private the emission scenario based on the annual tonnage of the biocide is presented in Table 2.6. Table 2.7 presents the emission scenario based on an average consumption per capita. Above a certain tonnage (at the break-even point), as explained in Appendix 2, the scenario based on the tonnage should be applied preferably.

Table 2.6 Emission scenario for calculating the releases of disinfectants used for sanitary purposes based on the annual tonnage applied at private use

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
A)			
Relevant tonnage in the region for this application (tonnes.yr^{-1})	TONNAGEreg [1]		O
B)			
Relevant tonnage in EU for this application (tonnes.yr^{-1})	TONNAGE [1]		
Fraction for the region	$Fprodvol_{reg}$	0.1	D
A + B)			
Fraction of the main source (STP) (-)	$Fmainsource_4$	0.002	D
Fraction released to wastewater (-) [1]	$F_{4,water}$	1	D
Number of emission days for life cycle stage 4 (private use) (d.yr^{-1})	$Temission_4$	365	D
Output:			
$Elocal_{4,water}$ = Emission rate to wastewater (kg.d^{-1}) [2]			

Intermediate calculations:

B)

Relevant tonnage in the region for this application (tonnes.yr^{-1}) (2.9)

$$TONNAGEreg = Fprodvol_{reg} * TONNAGE$$

End calculations:

A + B)

$$Elocal_{4,water} = TONNAGEreg * 10^3 * Fmainsource_{water} * F_{4,water} / Temission_4 \quad (2.10)$$

---

[1] In principle this should be $TONNAGE_k$ to identify usage in product *k* but this is not shown just as in the EUSES documentation

[2] The subscript "4" refers to the stage of private use in conformity with EUSES 1.0 and USES 3.0.

Table 2.7 Emission scenario for calculating the releases of disinfectants used for sanitary purposes based on an average consumption

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Number of inhabitants feeding one STP (eq)	Nlocal	10000	D [1]
Fraction released to wastewater (-) [2]	$F_{4,water}$	1	D
Active substance in biocidal product ($g.l^{-1}$)	Cform		S
Consumption per capita ($l.eq^{-1}.d^{-1}$)	Vform		
General purpose (tiles, floors, sinks)		0.005	D
Lavatory		0.002	D
Penetration factor of disinfectant	Fpenetr	0.5	D
Output:			
$Elocal_{4,water}$ = Emission rate to wastewater ($kg.d^{-1}$) [1]			
Model calculations:			
$Elocal_{4,water}$ = Nlocal * Vform* Cform * 10^{-3}* Fpenetr * $F_{4,\ water}$ (2.11)			

[1] Default number as used in EUSES for the standard STP

[2] The subscript "4" refers to the stage of private use in conformity with EUSES 1.0 and USES 3.0.

2.3 Horticulture

Van Dokkum *et al.* (1998) mentions for this product type disinfection of soil. It is most likely that this concerns agricultural soil for horticulture. Little is known regarding application techniques but environmental emission to (outdoors) air, soil and (to some extent) surface water can be expected (Van Dokkum, 1998). As no data were available and no biocides could be found that are admitted for this purpose no emission scenario has been developed yet. More specifically there is the possibility of disinfection of greenhouses. In the past soil disinfection was carried out with methyl bromide. The same emission scenario as for household products used for fogging can be applied. This emission scenario is presented in Table 2.8 (Table 2.9 presents the defaults for the parameters needed for the distribution modules of USES 3.0). It should be noted that this scenario is rather limited as the input for the biocide has to be specified as the amount for a single application. In future this scenario might be extended to include parameters such as volume and floor area of the model greenhouse; then application details from the user's instructions – such as amount per m^3 volume or m^2 floor area – can be used.

The scheme of the life cycle stage is shown below. It should be noted that service life is rather short, i.e. in the order of several hours up to 24 hours. The emission is directly to the local air.

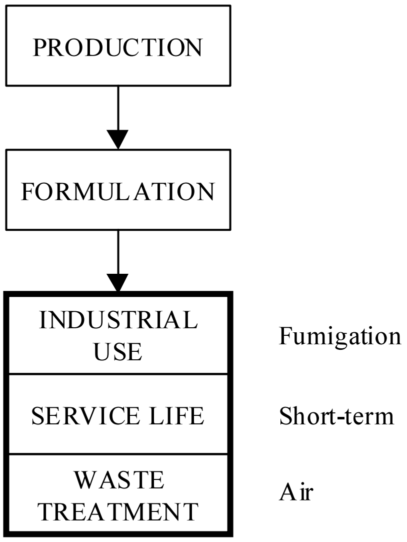


Table 2.8 Emission scenario for calculating the releases of disinfectants used for fogging at disinfection of greenhouses in agriculture

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Amount of active ingredient used (kg)	Qsubst		S
Fraction of retention in goods (-) 1)	Fret	0.02	D
Fraction of disintegration (-)	Fdisin	0.001	D
Parameters required for distribution modules:			
Number of emission days for fogging (d)	$Temission_3$ 2)	1	D

Output:

$Elocal_{3,air}$ = Local emission to air during episode ($kg.d^{-1}$) 1)

Model calculations:

$$Elocal_{3,air} = Qsubst * (1 - Fret) * (1 - Fdisin) \tag{2.12}$$

---

1) In the case of greenhouses the "goods" will predominantly consist of soil

2) In the USES 3.0 documentation the symbol $Temission_{fogging}$ is used

Table 2.9 Default values of parameters required for distribution models of USES 3.0

Parameters required	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Number of emission days (d)	Temission	$Temission_{fogging}$	$Temission_3$	1

2.4 Tiles and surfaces

In Annex V to Directive 98/8/EC (EC, 1998) product type 2 is described as "Products used for the disinfection of air, surfaces, materials, equipment and furniture which are not used for direct food or feed contact in private, public and industrial areas, including hospitals, as well as products used as algaecides". For tiles and surfaces we can think of small-scale applications at home and medium to large-scale applications in food processing industry. It is unclear at this moment if a biocidal product has specifically been notified for private application on one hand and for industrial use on the other.

For the life cycle stage formulation the emission scenario for the sanitary sector is applicable as well. So, the emission scenario presented in Table 2.3 is used with the defaults presented in Tables 2.3 and 2.4 (section 2.2).

It is assumed here that the usage of the product will be more or less evenly distributed over the country/region. This means that the emission scenario of product type 1 for the 'tonnage' can be used. The default value of 100% for the release to wastewater is assumed. The emission scenario is presented in Table 2.10. It should be noted that the scenario uses life cycle stage 4 "private use" and not 3 "processing" (industrial use); this is simply because only one can be chosen.

The scheme of the life cycle stage is presented below. The grey box around the two stages of the life cycle for the use of the biocidal product means that separation is not possible/useful; as said before an – arbitrary – choice has been made for private use.

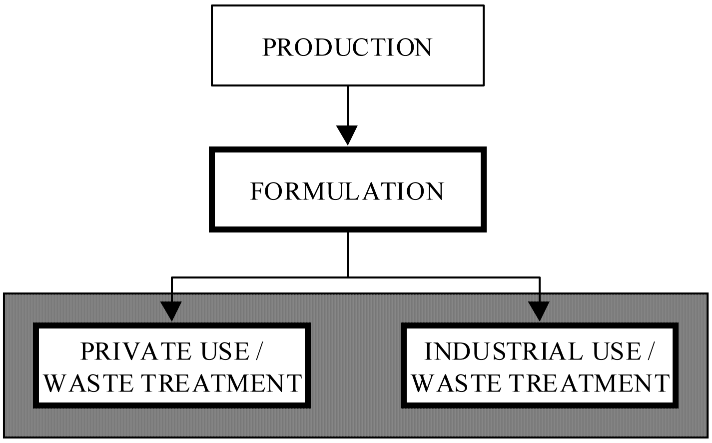


Table 2.10 Emission scenario for calculating the releases of disinfectants used for tiles and surface in both private and industrial use

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
A)			
Relevant tonnage in the region for this application (tonnes.yr^{-1})	TONNAGEreg [1]		O
B)			
Relevant tonnage in EU for this application (tonnes.yr^{-1})	TONNAGE [1]		
Fraction for the region	$Fprodvol_{reg}$	0.1	D
A + B)			
Fraction of the main source (STP) (-)	$Fmainsource_4$	0.002	D
Fraction released to wastewater (-) [1]	$F_{4,water}$	1	D
Number of emission days for life cycle stage 4 (private use) (d.yr^{-1})	$Temission_4$	365	D

Output:

$Elocal_{4,water}$ = Emission rate to wastewater (kg.d^{-1}) [2]

Intermediate calculations:

B)

Relevant tonnage in the region for this application (tonnes.yr^{-1})

$$TONNAGEreg = Fprodvol_{reg} * TONNAGE \quad (2.13)$$

End calculations:

A + B)

$$Elocal_{4,water} = TONNAGEreg * 10^3 * Fmainsource_4 * F_{4,water} / Temission_4 \quad (2.14)$$

---

[1] In principle this should be $TONNAGE_k$ to identify usage in product *k* but this is not shown just as in the EUSES documentation

[2] The subscript "4" refers to the stage of private use in conformity with EUSES 1.0 and USES 3.0.

2.5 Medical sector

The field of the medical sector was treated together with the sanitary sector in an RIVM report produced for the Dutch situation (Van der Poel, 1999a). Discussions in the working group for the EU project "Gathering , review and development of environmental emission scenarios for biocides" and data supplied by some member states enabled an emission scenario that is presented in Van der Poel (2001a). The emission scenarios are applicable in all European Union member states.

Annex V of Directive 98/8/EC (EC, 1998) does not specify the medical sector as a separate area. Several aspects of the use of product type 2 as disinfectant are related to this sector.

Table 2.11 gives an overview of the subdivision of product type 2 and the sections where the emission scenarios – according to Van der Poel (2001a) – are presented.

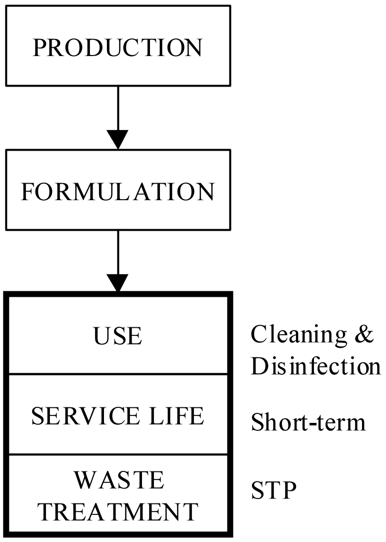
Table 2.11 Subdivision of product type 2 for topics relevant to the medical sector according to Annex V (EC, 1998) and the sections where the emission scenarios are presented.

Annex V		Description	Section
2.1	Medical equipment	Sterilisation of medical instruments in hospital	- [1)]
		Disinfection of medical instruments in hospital	2.5.2
2.4	Accommodation for man	Disinfection in accommodations for man (bathrooms, toilets, chemical closets, walls and floors in institutions [amongst others hospitals])	2.5.1
2.8	Hospital waste	Infectious waste (including hospital waste)	2.5.4
2.10	Others	Laundry disinfectants (hospitals)	2.5.3

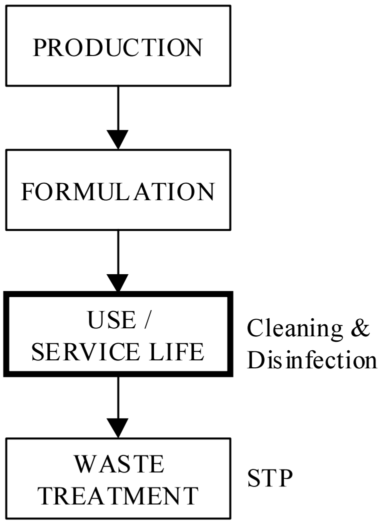
[1)] not considered here as this is covered in the Medical Device Directive 93/42/EC (EC, 1993)

The schemes for the life cycle stages are shown below. It should be noted that despite the same scheme for 2.5.1 and 2.5.4 the period for service life differs.

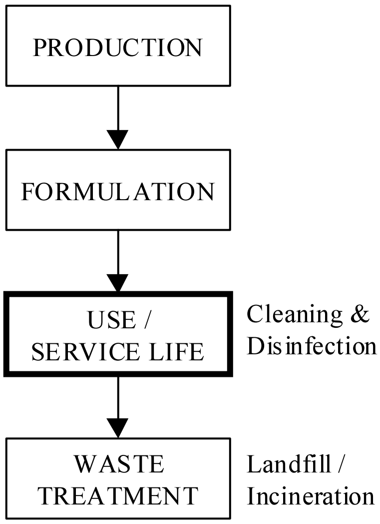
2.5.1 Accommodations
2.5.4 Hospital waste



2.5.2 Medical instruments



2.5.3 Laundry disinfection



2.5.1 Disinfection of rooms, furniture and objects

As for disinfectants used for sanitary purposes two scenarios are presented, viz. one with the basis of the tonnage and one applying an amount of aqueous solution. In both scenarios it is difficult to establish a representative emission factor. Because of the lack of data a best guess for the fraction released to wastewater of 0.75 has been made.

In the scenario where that the tonnage is used a fraction of the tonnage has to be estimated for the model hospital. This is not the fraction of the main source as here the relation is used between a realistic worst case size hospital connected to the standard STP of EUSES. For this fraction the ratio of the average number of beds : number of beds in the region is used. The values for the Dutch (CBS, 1997) situation have been used (because the area of the Netherlands is approximately the same as the regional area of EUSES, i.e. 200 x 200 km^2 and the fact that the data for the number of beds and the number of patient days were available). The fraction for the model hospital, Fhospital = 0.007.
For the second scenario it is assumed that 25 litres of water are used for surfaces and 25 litres for objects (brushes).
Table 2.12 presents the emission scenario applying the tonnage of the disinfectant and Table 2.13 the scenario for the amount of aqueous solution used.

Table 2.12 Emission scenario for calculating the releases of disinfectants used for sanitary purposes in hospitals based on the annual tonnage applied

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
A)			
Relevant tonnage in the region for this application (tonnes.yr^{-1})	TONNAGEreg [1)]		O
B)			
Relevant tonnage in EU for this application (tonnes.yr^{-1})	TONNAGE [1)]		
Fraction for the region	$Fprodvol_{reg}$	0.1	D
A + B)			
Fraction for the hospital (-)	Fhospital	0.007	D
Fraction released to wastewater (-) [2)]	$F_{3,water}$	0.75	D
Number of emission days for life cycle stage 3 (processing) (d.yr^{-1})	$Temission_3$	260	D
Output:			
$Elocal_{3,water}$ = Emission rate to wastewater (kg.d^{-1}) [2)]			

Intermediate calculations:

B)

Relevant tonnage in the region for this application (tonnes.yr^{-1})

$$TONNAGEreg = Fprodvol_{reg} * TONNAGE \qquad (2.15)$$

End calculations:

A + B)

$$Elocal_{3,water} = TONNAGEreg * 10^3 * Fhospital * F_{3,water} / Temission_3 \qquad (2.16)$$

[1)] In principle this should be $TONNAGE_k$ to identify usage in product *k* but this is not shown just as in the EUSES documentation

[2)] The subscript "3" refers to the stage of processing in conformity with EUSES 1.0 and USES 3.0.

Table 2.13 Emission scenario for calculating of the releases of disinfectants used for sanitary purposes in hospitals based on the amount of solution of disinfectant used on a day

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Fractions released to wastewater [1]			
Sanitary purposes	Fsan	0.55	D
Brushes	Fobj	0.95	D
Concentration at which active substance is used (kg.l^{-1})			
Sanitary purposes	$Cproc_{san}$	.	S
Brushes	$Cproc_{obj}$	.	S
Amount of water with active substance (l.d^{-1})			
Sanitary purposes	$Vcons_{san}$	25	D
Brushes	$Vcons_{obj}$	25	D

Output:

$Elocal_{3,water}$ = Emission rate to wastewater (kg.d^{-1}) [1]

Model calculations:

$Elocal_{3,water} = Vcons_{san} * Cproc_{san} * Fsan$ (sanitary purposes) (2.17)

$Elocal_{3,water} = Vcons_{obj} * Cproc_{obj} * Fobj$ (brushes) (2.18)

$Elocal_{3,water} = Vcons_{san} * Cproc_{san} * Fsan + Vcons_{obj} * Ccons_{obj} * Fobj$ (sanitary purposes + brushes) (2.19)

---

[1] The subscript "3" refers to the stage of processing in conformity with EUSES 1.0 and USES 3.0.

Above a certain tonnage (at the break-even point), as explained in Appendix 2, the scenario based on the tonnage should be applied preferably. If the default values are filled out in the formulas for the calculation of the local emissions to wastewater, $Elocal_{3,water}$, the break-even point can be written in the form:

$TONNAGEreg = 956 * Cproc_{san}$	sanitary purposes
$TONNAGEreg = 1650 * Cproc_{obj}$	brushes
$TONNAGEreg = 956 * Cproc_{san} + 1650 * Cproc_{obj}$	sanitary purposes

If, for example, the prescription for the working concentration is 0.04 kg.l^{-1} the break-even point- above which the scenario of Table 2.12 should be taken preferably – is reached at a regional tonnage of 38.2 tonnes.yr^{-1} for sanitary purposes, 66 tonnes.yr^{-1} for objects and 104 tonnes.yr^{-1} for sanitary purposes + objects respectively.

2.5.2 Disinfection of instruments

Disinfection of instruments like endoscopes – called scopes in most cases – should be done in automated washers/disinfectors (BSG, 1998). The majority of the hospitals with endoscopy units performing several thousands procedures per year use these washers nowadays (Van Gossum *et al.*, 1989). There are two types: a) washers/disinfectors with replacement of the disinfectant solutions at regular intervals (called "replacement" in the scenario) and b) washers/disinfectors where a fresh disinfectant solution is applied every disinfection operation; the substance is discarded into the sewer after disinfection (called "once-through" in the scenario). The emission scenario for washers/disinfectors is presented in Table 2.14.
Other instruments are disinfected in solutions (or suspensions) of disinfectants to prevent adhesion of blood, pus, etc. These baths are discarded into the sewer after use. The emission scenario for other instruments is presented in Table 2.15.
If a biocide is notified for both disinfection of scopes and other instruments, the emission for a single point source (one hospital) should be calculated by summing the results of both emission scenarios (Tables 2.14 and 2.15).

Table 2.14 Emission scenario for calculating the release of disinfectants used in hospitals for disinfection of scopes and other articles in washers/disinfectors

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
A + B) Replacement + Once-through			
Working concentration of active ingredient ($g.l^{-1}$)	Cproc	.	S
Maximum number of washers / disinfectors 1)	$Nmax_{mach}$	3	D
Volume of solution in machine (l)	Vproc		
A) Replacement		100	D
B) Once-through		10	D
A) Replacement			
Replacement interval (d)	$Tint_{repl}$	14	D
Fraction carry-over (-)	Fcarry_over	0.015	D
Rate constant for chemical conversion (d^{-1})	$kdeg_{disinf}$	0	S/D 2)

Output:

$Elocal_{3,water}$ = Maximum emission rate to water ($kg.d^{-1}$) 3)

Intermediate calculations:

A) Replacement

Concentration at day of replacement due to carry-over ($mg.l^{-1}$)

$$Cproc_{carry\_over} = \frac{Cproc * 10^3}{(1 + Fcarry\_over)^{Tint_{repl}}} \tag{2.20}$$

Concentration at day of replacement including conversion ($mg.l^{-1}$)

$$Cproc_{repl} = Cproc_{carry\_over} * e^{-kdeg_{disinf} * Tint_{repl}} \tag{2.21}$$

End calculations:

A) Replacement

$$Elocal_{3,water} = Nmax_{mach} * Vproc * Cproc_{repl} * 10^{-6} \tag{2.22}$$

B) Once-through

$$Elocal_{3,water} = Nmax_{mach} * Vproc * Cproc * 10^{-6} \tag{2.23}$$

---

1) For 'replacement' assumption that replacement occurs on the same day

2) Zero by default if no data are supplied

3) The subscript "3" refers to the stage of processing in conformity with EUSES 1.0 and USES 3.0

Table 2.15 Emission scenario for calculating the releases of disinfectants used in hospitals for disinfection of contaminated instruments

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Amount of active substance ($kg.yr^{-1}$)	Qsubst	250	D
Emission days, i.e. replacements (yr^{-1})	$Temission_3$ 2)	100	D
Rate constant for chemical conversion (d^{-1})	$kdeg_{disinf}$	0	S/D 1)
Output:			
$Elocal_{3,water}$ = Maximum emission rate at the day of a replacement ($kg.d^{-1}$) 2)			

Intermediate calculations:

Average time a disinfectant solution is in use (replacement interval) (d)

$$Tint_{repl} = INT\ (365\ /\ Temission_3 + 0.5)\ ^{3)} \qquad (2.24)$$

End calculations:

$$Elocal_{3,water} = \frac{Qsubst}{Temission_3} * e^{-kdeg_{disinf} * Tint_{repl}} \qquad (2.25)$$

---

1) Zero by default if no data are supplied

2) The subscript "3" refers to the stage of processing in conformity with EUSES 1.0 and USES 3.0

3) INT = Integer (this notation has been used to ensure that in computer calculations a whole number for the number of days will be returned)

2.5.3 Laundry disinfectants

Two emission scenarios are presented, one for commercial laundries where hospitals send their laundry and one for laundries or hospitals using tumbler washing machines. The size of commercial laundries can vary considerably but large laundries may have three or more washing tubes with a capacity of 8000 $kg.d^{-1}$ per tube, producing 48 $m^3.d^{-1}$ of wastewater (Van Kasteren, 1998) (personal communication with Dr.ir. P. Brasser of the Technical University of Delft, 1998). It is assumed here that a commercial laundry connected to the standard STP of EUSES/USES (2000 m^3 wastewater per day) can have three washing tubes ($3 * 48 = 144$ m^3 wastewater per day). On the other hand, the situation is considered where a hospital is doing its own laundry or where the contaminated laundry is done at a commercial laundry using a tumbler washing machine. It is estimated that per kg of dirty laundry 6 g of detergent ("soap") is used, 4 g for soaking and 2 g for the washing cycle (Van Kasteren, 1998). In the case of disinfection, it is estimated that about 10% of the amount of soap are disinfectant.

The scenario for washing streets is presented Table 2.16 as this represents the worst case situation, using the assumptions stated above. The scenario for tumbler washing machines is presented in Table 2.17. This scenario is of importance for the overall calculation if a disinfectant is also notified for one or more other purposes such as disinfection of rooms, objects and instruments.

Table 2.16 Emission scenario for calculating the release of disinfectants used for doing biologically contaminated laundry from hospitals in washing streets

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Number of washing tubes (with disinfectant) (-)	Nmach	3	D
Capacity of washing tube ($kg.d^{-1}$) *(laundry)*	Qmat	8000	D
Amount of disinfectant for laundry ($l.kg^{-1}$)	$Vform_{weight}$		S
Concentration active substance in disinfectant solution ($kg.l^{-1}$)	Cform		S
Concentration reduction in washing process (-)	Fred	0	D
Output:			
$Elocal_{3,water}$ = Maximum emission rate at the day of a replacement ($kg.d^{-1}$) [1]			

[1] The subscript "3" refers to the stage of processing in conformity with EUSES 1.0 and USES 3.0.

Model calculations:

a) Washing street

$$Elocal_{3,water} = Nmach * Qmat * Vform_{weight} * Cform * (1 - Fred) \qquad (2.26)$$

Table 2.17 Emission scenario for calculating the release of disinfectants used for doing biologically contaminated laundry from hospitals in tumbler washing machines

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Capacity of machine (kg)	Qmat	25	D
Number of batches (d^{-1})	Nbatch	3	D
Amount of disinfectant solution for laundry ($l.kg^{-1}$)	$Vform_{weight}$		S
Concentration active substance in disinfectant solution ($kg.l^{-1}$)	Cform		S
Concentration reduction in washing process (-)	Fred	0	D
Output:			
$Elocal_{3,water}$ = Maximum emission rate at the day of a replacement ($kg.d^{-1}$) [1)]			

[1)] The subscript "3" refers to the stage of processing in conformity with EUSES 1.0 and USES 3.0.

Model calculations:

b) Tumbler washing machine

$$Elocal_{3,water} = Nbatch * Qmat * Vform_{weight} * Cform * (1 - Fred) \quad (2.27)$$

2.5.4 Hospital waste disinfectants

In the General Administrative Order Decree Hazardous Waste (Stb., 1993) of the Environmental Protection Act a definition is given for the waste streams which are regarded as hazardous waste (see Table 3.11). This category of potentially infectious hazardous waste is usually called 'hospital waste'. Hospital waste has to be incinerated at ZAVIN in Dordrecht. ZAVIN is the only competent processor for hospital waste in the Netherlands (in cases of peaks, the kiln oven of AVR at Rotterdam is allowed to function as a "catch"). The waste is packed in sealed containers immediately after creation, so no disinfectants are used. Sometimes hospital waste is sterilised in an autoclave at the source. After this sterilisation the remaining waste can be treated as normal waste. However, it is known that in one case the remaining waste is still sent for incineration to ZAVIN after removal of components suitable for recycling, e.g. glass. At the moment pilot projects are planned for three places in the Netherlands in which a combined shredder / disinfection system, as mentioned in the BIOEXPO report (Van Dokkum, 1998), will be used. In France there are two routes for the disposal of waste with infectious risks according to the Ministry of the Environment (Migné, 2001). This waste should be either incinerated or undergo preliminary treatment. The preliminary treatment processes are carried out in disinfection equipment as mentioned earlier, which is validated by the Upper Council of Public Health of France (Conseil supérieur d'hygiène publique de France, CSHPF). Of the ca 15 machines validated at the moment

(MES, 1999) two apply chemicals for disinfection. One machine states that a disinfectant with a large antimicrobial activity and the other that acetic acid plus hydrogen peroxide is used. Preliminary treated hospital waste is assumed to be comparable to household waste; it may be incinerated or landfilled but composting has been excluded.

As no data were available at present on amounts of hospital waste treated and disinfectant used no emission scenario estimating the amount of disinfectants landfilled and incinerated. For the fate of biocides at the stage of waste treatment a report has been generated already (Van der Poel, 1999b).

2.5.5 Disinfectants with more than one application

If a disinfectant has been notified for more than one application the results for the emission rates to wastewater ($Elocal_{3,water}$) of the individual scenarios (that are applicable) have to be summed.

2.6 Disinfection of air conditioning systems

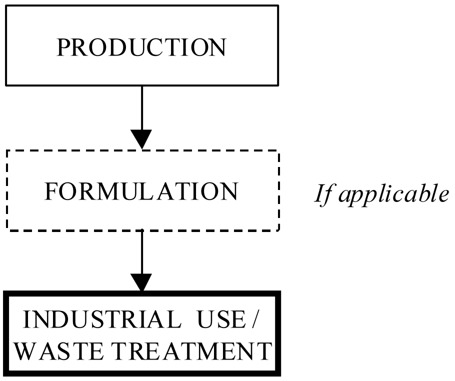
There is no information available on the type of biocides that are used (Van Dokkum, 1998). An emission scenario document has not been developed yet.

2.7 Disinfection of industrial areas

This type of disinfection seems to be covered completely by product type 4 (Food and feed area disinfectants). So, no emission scenario document has been developed.

2.8 Disinfectants for sewage and wastewater

Literature cited in Van Dokkum (1998) mainly concerns wastewater disinfection with ozone in the United States. The scheme of the life cycle stages is presented below.



A simple emission scenario for disinfection of the effluent of the standard STP of EUSES is presented in Table 2.18.

Table 2.18 Emission scenario for calculating the concentration in receiving surface water of disinfectants used for disinfection of effluent from the standard STP of EUSES

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Working concentration of the active substance in effluent (mg.l^{-1})	$Clocal_{eff}$		S
Dilution factor receiving surface water (-)	DILUTION	10	D
Output:			
$Clocal_{water}$ = Concentration in receiving surface water (mg.l^{-1})			
Model calculation:			

$$Clocal_{water} = Clocal_{eff} / DILUTION \tag{2.28}$$

2.9 Soil and other disinfectants, e.g. children playgrounds, horticulture

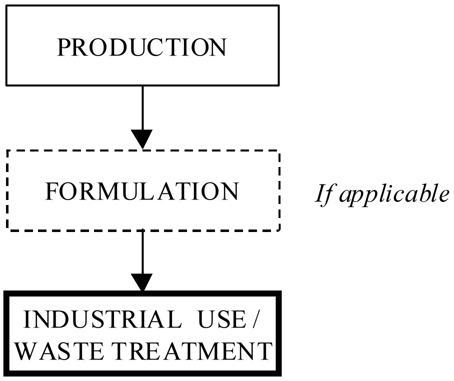
From both Van Dokkum (1998) and Baumann (2000) it appears that there is little information on this item. Horticulture has been covered specifically in section 2.3 of this report.

2.10 Disinfection of chemical toilets

No emission scenario document has been developed for this topic yet. As far as can be seen right now chemical toilets will be emptied at special sites where it is discharged to an STP (e.g. at harbours and campings).

3. Product type 3: Veterinary hygiene biocidal products

The scheme of the life cycle stages is presented below.



For this product type an RIVM report has been published already some time ago (Montfoort *et al.*, 1996). The following topics are treated:

3.1 Disinfection of animal housing
3.2 Disinfection of footwear and animals' feet
3.3 Disinfection of milk extraction systems
3.4 Disinfection of means of transport
3.5 Disinfection of hatcheries
3.6 Disinfection of fish-farms

Disinfection may be carried out at a low frequency, such as disinfection of a housing at replacement of the animals, whereas other disinfections occur at a very high frequency, e.g., disinfection of milk extraction systems. In the examples mentioned above the disinfectant will be released into the manure storage. The manure will be applied to grassland or arable land in due time. For each EU country different rules may exist for the periods during which land application may be occur, and for the maximum amounts of phosphate and/or nitrogen to be applied per ha per year. For the situations that a biocidal product is applied infrequently the approach as implemented for product type 18 (insecticides for animal housings and manure storage systems) is used (for a description see Chapter 18). For frequent biocide applications where the active substance ends up in the manure storage degradation in the manure storage in the way as proposed by van der Linden and Post (2000) is calculated. This means that an average situation is considered for a certain manure storage period. The concentration in soil is calculated after one year since the beginning of the first manure storage period in which the biocide application started. This is presented with an arbitrary example in Figure 3.1.

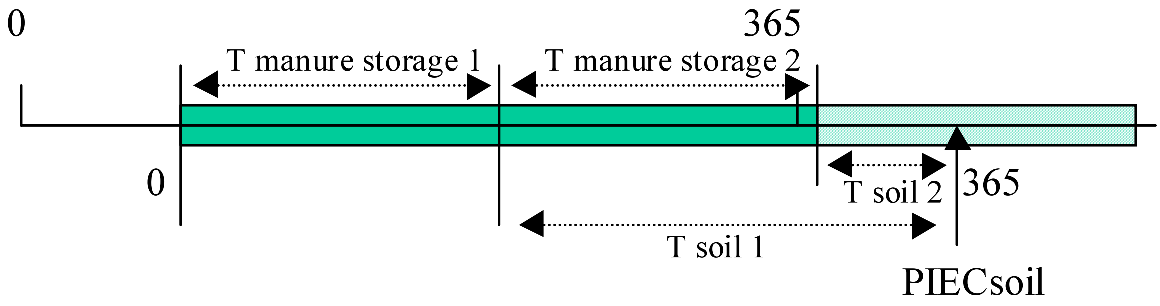


Figure 3.1 Scheme of calculation of the predicted initial concentration in soil (PIECsoil) since application during the 1st manure storage period

Appendix 4 presents concentrations for types of disinfectants commonly applied for disinfection in various situations in livestock farming.

3.1 Disinfection of animal housing

Cleaning of housing is common practices in both poultry and pig farming. In these so called "all in, all out" systems, disinfection of a unit takes place either at the beginning or at the end of a period. Disinfection of the system includes disinfection of cages or residences, floors and walls of the housing and if applicable disinfection of conveyor belts or other machinery.

Poultry is most commonly kept in one of the following three main categories of indoor systems: 1) Battery system with various types of manure collection, see Table 3.1 (in analogy to product type 18), 2) Pen system with litter floor and 3) Pen system with grating floor.

The manure and the wastewater might be kept separate in systems one and two. In general the manure and wastewater with disinfection solution are completely mixed (slurry) in system three. If the wastewater with the disinfection solution can be kept separated from the (dry) manure, it can be disposed of through a sewage water treatment plant or spread over agricultural soil. Most pig houses are equipped with slatted, partly slatted or concrete floors, with or without straw. Generally there is no separated collection system so mostly the manure is handled as slurry.

In this section an emission scenario – for infrequent biocide applications as described in Chapter 18 – is presented, based on local average consumption figures (see Table 3.2). The scenario calculates the emissions to air, wastewater and emissions to soil through the manure storage and application route.

The specification of parameters is done by using subscripts in their symbols. To maintain oversight, these specifications in the subscripts of the symbols have been replaced by indices:

Index	Subscript name

i1	cat-subcat
i2	appway
i3	stream

Table 3.1 presents the pick list with the values of the indices with the description of the content of the subscript name.

Table 3.1 Pick list for the subscript names based on the users instructions; the names are representing indices in various parameters involved in the model

Value	Description of content
Subscript name: cat-subcat, Index: i1	
1	Dairy cows
2	Beef cattle
3	Veal calves
4	Sows
5	Fattening pigs
6	Laying hens in battery cages without treatment
7	Laying hens in battery cages with aeration (belt drying)
8	Laying hens in battery cages with forced drying (deep pit, high rise
9	Laying hens in compact battery cages
10	Laying hen in free range with litter floor
11	Broilers in free range with litter floor
12	Parent broilers in free range with litter floor
13	Parent broilers in rearing with grating floor
Subscript name: appway, Index: i2	
1	Spraying
2	Fogging
3	Spraying and fogging
4	Others
Subscript name: stream, Index: i3	
1	Manure
2	Wastewater
3	Slurry

The amount of biocide used for disinfection depends on the concentration of biocide in the applied solution. Appendix 3 presents the amount of solution used per unit of area, the treated surface area (floors, walls) of the housing and the application frequency. As new information on application rates became available (Health Service Institute, 2001), application rates as presented in Montfoort *et al.* (1996)have been changed accordingly. Because poultry and pig housing is based on "all in, all out" systems, the application frequency depends on the life cycle of broiler and fattening pigs and the laying cycle of laying hens. Default values for the scenario parameters for each housing type and animal subcategory are taken from Tables 3.3 and 3.4.

On one hand the fraction of disinfectant ending up in the manure storage system (dry or slurry) or released to wastewater, depends on the way the waste streams are handled or stored in each housing type for each animal subcategory. But the emission factor also depends on the way the disinfectant is applied. The disinfectant can either be applied through spraying or fogging. The emission factors for each animal subcategory, housing type and way of application are presented in Appendix 3.
The emission factors haven been derived, pro rata, from general emission factors and the specific emission factors for product type 18, Table 18.7. The overall emission factors for the waste streams and the emission factors for air are presented in Table 3.4.
It should be noted that the moments of replacement of the stock might occur at any moment during the year. Therefore, a starting date/day ($Tappl\_d_1$ and $Tappl\_n_1$ respectively) has been arbitrary determined for any biocide application interval Nappl-bioc between 1 and 12 times per year (see Table 3.5).
For the calculation of the realistic quantities of disinfectant reaching agricultural soil upon field application of manure degradation of the disinfectant in the manure storage system is taken into account. In contrast to Montfoort *et al.* (1996) distinction is made between grassland and arable land. In estimating the disintegration in the manure storage system it is important to know the biocide application time interval which can be calculated from application frequency and the average manure storage period. The application frequency for breeding pigs is not based on a real number of emission days. It is calculated from the applied amounts and application frequencies for each breeding stage, taken from Van der Linden and Post (2000).
Information on degradation of chemical substances in manure is still limited. Decomposition of most disinfectants is stated to be rather fast with the exception of quaternary ammonium compounds (Cuperus and Straathof, 1994). However in this section it is assumed that the entire amount of disinfectant used is available for emission, degradation of the active ingredient does not occur on application and during disinfection.

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors

Variable/parameter (unit)	Symbol	S/D/O/P	[table]
Input:			
Type of housing/manure storage (for application *m* of the notification) (-)	cat-subcat (i1)	S/P	[3.1]
Type of application *n* (-)	appway (i2)	S/P	[3.1]
. . . .			
Start date of first disinfection	Tappl_d_1	D/P	[3.5]
Or:			
Day of first disinfection (d)	Tappl_n_1	D	[3.5]
. . . .			
Concentration of active substance in disinfectant solution (g.l^{-1})	Cform	S	
[A] spraying			
Quantity of disinfectant used for spraying (l.m^{-2})	$\text{Vform\_area}_{i1,i2}$	S	
Treated floor area of the housing (m^2)	AREAhousing_{i1}	D/P	[3.3]
[B] fogging			
Quantity of disinfectant used for fogging (l.100 m^{-3})	$\text{Vform\_vol}_{i1,i2}$	S	
Treated volume of the housing (m^3)	Vhousing_{i1}	D/P	[3.3]
[A] + [B]			
Fraction of active ingredient released to air (-)	$F_{3,air,i1,i2}$	D/P	[3.4]
Fraction of active ingredient released to wastewater (-)	$F_{3,water,i1,i2,i3}$	D/P	[3.4]
Fraction of active ingredient released to manure storage (-)	$F_{3,waste,i1,i2,i3}$	D/P	[3.4]
Number of disinfections per year (-)	Nappl_bioc	D/P	[3.3]
. . . .			
Start date land application period grassland 1) [18.8/18.7] 1)	Tgr_start	D/P	
Or:			
Start day of land application grassland (d)	Tgrs	D	[18.7]
. . . .			
End date period land application grassland 1)	Tgr_end	D/P	[18.8/18.7] 1)
Or:			
Last day of land application grassland (d)	Tgre	D	[18.7]
. . . .			

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

Variable/parameter (unit)	Symbol	S/D/O/P	[table]
Start date land application period arable land 1)	Tar_start	D/P	[18.8/18.7] 1)
Or:			
Start day of land application arable land (d)	Tars	D	[18.7]
End date period land application arable land 1)	Tar_end	D/P	[18.8/18.7] 1)
Or:			
Last day of land application arable land (d)	Tare	D	[18.7]
Number of land applications for grassland (yr^{-1})	Nlap_grass	D	[18.9] 2)
If Nlap_grass > 0:			
Day of 1st land application (grassland):			
a) by date 1)	Tgr_app_1	D/P	[18.6/18.7]
b) by day number	$Tgrap_1$	D	[18.6]
If Nlap_grass >1:			
Land application interval for grassland (d)	Tint_gr	D	[18.6] 3)
Days of other land applications grassland:			
a) by date (j = 2··· Nlap_grass) 1)	Tgr_app_j	D/P	[18.6/18.7]
b) by day number (j = 2··· Nlap_grass)	$Tgrap_j$	D	[18.6]
c) by application interval (Tint_gr)	***see intermediate calculations: <u>Subroutine 2</u>***		
Number of land applications for arable land (yr^{-1})	Nlap_arab	D	[18.9] 2)
If Nlap_arab > 0:			
Day of 1st land application (arable land):			
a) by date 1)	Tar_app_1	D/P	[18.6/18.7]
b) by day number	$Tarap_1$	D	[18.6]
If Nlap_arab >1:			
Land application interval for arable land (d)	Tint_ar	D	[18.6] 2)
Days of other land applications arable land:			
a) by date (j = 2··· Nlap_arab) 1)	Tar_app_j	D/P	[18.6/18.7]
b) by day number (j = 2··· Nlap_arab)	$Tarap_j$	D	[18.6]
c) by application interval (Tint_ar)	***see intermediate calculations: <u>Subroutine 3</u>***		
Number of animals in housing for every relevant category/subcategory *i1* (-)	$Nanimal_{i1}$	D/P	[3.3]
Amount of phosphate per animal for every	$Qphosph\_excr_{i1}$	D/P	[3.3]

relevant category/subcategory *i1* (kg.d^{-1})

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

Variable/parameter (unit)	Symbol	S/D/O/P	[table]
Amount of nitrogen per animal for every relevant category/subcategory *i1* (kg.d^{-1})	Qnitrog_excr$_{i1}$	D/P	[3.3]
Fraction of biocide added in the case of a combination of application in both poultry batteries without treatment and free range with litter floor (-)	Fadd	D	[18.10]
If phosphate immission standards are applied: 7)			
Phosphate immission standard for grassland (kg.ha^{-1}.yr^{-1})	Qphosph_is$_{grass}$	D	[18.9]
Phosphate immission standard for arable land (kg.ha^{-1}.yr^{-1})	Qphosph_is$_{arable}$	D	[18.9]
. . . .			
If nitrogen immission standards are applied: 7)			
Nitrogen immission standard for grassland (kg.ha^{-1}.yr^{-1})	Qnitrog_is$_{grass}$	D	[18.9]
Nitrogen immission standard for arable land (kg.ha^{-1}.yr^{-1})	Qnitrog_is$_{arable}$	D	[18.9]
. . . .			
Half-life time for biodegradation in slurry (d)	DT50bio$_{slurry}$	1e^{6}	D
Half-life time for biodegradation in soil (d)	DT50bio$_{soil}$	1e^{6}	D
Mixing depth with soil (m)	DEPTHmix$_{grass}$	D	[18.9]
Mixing depth with soil (m)	DEPTHmix$_{arable}$	D	[18.9]
Density of bulk soil (kg.m^{-3})	RHOsoil	D	[18.2]

Output:

Elocal$_{3,air}$ = Local emission of the active ingredient to air from disinfection of animal housing by spraying or fogging (kg·d^{-1})

PIECgrs_P2O5$_{i1,i2,i3}$ = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on grassland (mg.kg^{-1}) according to phosphate immission standard

PIECars_P2O5$_{i1,i2,i3}$ = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on arable land (mg.kg^{-1}) according to phosphate immission standard

PIECgrs_N$_{i1,i2,i3}$ = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on grassland (mg.kg^{-1}) according to nitrogen immission standard

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

$PIECars\_N_{i1,i2,i3}$ = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on arable land ($mg.kg^{-1}$)) according to nitrogen immission standard

$Elocal_{3,water}$ = Amount of the active ingredient (disinfectant) (kg.d-1) reaching the standard STP of EUSES/USES for the relevant cases of i1 = 6, 7, 10 and 11

Intermediate calculations:

First-order degradation rate constant in manure (d^{-1})

$$kdeg_{slurry} = \frac{\ln 2}{DT50bio_{slurry}} \qquad (3.1.1)$$

First-order degradation rate constant in soil (d^{-1})

$$kdeg_{soil} = \frac{\ln 2}{DT50bio_{soil}} \qquad (3.1.2)$$

IF Nappl_bioc <2 GO_TO @1

Application interval between two consecutive disinfections

Tint_bioc = Integer[365 / Nappl_bioc]

Subroutine 1: Days of disinfection by application interval; help variables (Nd_shift and $Thelp_x$) for days exceeding end of year (365 days)

```
        IF Nappl_bioc = 1 GO_TO End of Subroutine 1
        Nd_shift = 0
        i = 1
#1      i = i + 1
        $Tappl\_n_i = Tappl\_n_{ni-1} + Tint\_bioc$
        IF $Tappl\_n_i \leq 365$ GO_TO #2
        Nd_shift = Nd_shift + 1
#2      IF i < Nappl_bioc GO_TO #1
        IF Nd_shift = 0 GO_TO #5
(Correction for application days exceeding the year)
        FOR j = 1 ▪▪▪▪ Nappl_bioc
        $Thelp_j = Tappl\_n_j$
        ic = 0
#3      ic = ic + 1
```

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

```
        $Tappl\_n_{ic} = Thelp_{Nappl\_bioc-Nd\_shift+ic}$
        IF ic < Nd_shift GO_TO #3
#4      ic = ic +1
        $Tappl\_n_{ic} = Thelp_{ic-Nd\_shift}$
        IF ic < Nappl_bioc GO_TO #4
#5      End of subroutine 1

@1 IF Nlap_grass = 0 GO_TO @2
Subroutine 2: Days of land application grassland by application interval
        IF Nlap_grass = 1 GO_TO End of Subroutine 2
        IF Tgrs > Tgre GO_TO #7   ("Split" interval correction, see Appendix 6)

        Nlap_grass = Integer[(Tgre – Tgrap1) / Tint_gr] + 1                (3.1.3)
        m = 1
#6      m = m + 1
        $Tgrap_m = Tgrap_{m-1} + Tint\_gr$                                  (3.1.4)
        IF m < Nlap_grass GO_TO #6
        GO_TO End of Subroutine 2

#7      Tgre = Tgre + 365   ("Split" interval correction, see Appendix 6)
        $Nlap\_grass = Integer[(Tgre – Tgrap_1) / Tint\_gr] + 1$            (3.1.5)

        i = 1
        ih = 0
        $Thelp_1 = Tgrap_1$
#8      i = i + 1
        $Thelp_i = Thelp_{i-1} + Tint\_gr$
        IF $Thelp_i$ = <365 GO_TO #9
        ih = ih + 1
#9      IF i < Nlap_grass GO_TO #8
        j = 0
#10     j = j + 1
        k = Nlap_grass + 1 – j
        $Tgrap_j = Thelp_k – 365$                                           (3.1.6)
        IF j < ih GO_TO #10
#11     j = j + 1
```

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

```
        $Tgrap_j = Thelp_{j-ih}$
        IF j < Nlap_grass GO_TO #11
End of Subroutine 2

@2 IF Nlap_arab = 0 GO_TO @3
Subroutine 3: Days of land application arable land by application interval
        IF Nlap_arab = 0 GO_TO End of Subroutine 3
        IF Tars > Tare GO_TO #13   ("Split" interval correction, see Appendix 6)

        $Nlap\_arab = Integer[(Tare - Tarap_1) / Tint\_gr] + 1$                    (3.1.7)
        m = 1
#12     m = m + 1
        $Tarap_m = Tarap_{m-1} + Tint\_gr$                                          (3.1.8)
        IF m < Nlap-arab GO_TO #12
        GO_TO End of Subroutine 3

#13     Tare = Tare + 365   ("Split" interval correction, see Appendix 6)
        $Nlap\_arab = Integer[(Tare - Tarap_1) / Tint\_gr] + 1$                    (3.1.9)
        i = 1
        ih = 0
        $Thelp_1 = Tarap_1$
#14     i = i + 1
        $Thelp_i = Thelp_{i-1} + Tint\_ar$

        IF $Thelp_i$ = <365 GO_TO #15
        ih = ih + 1
#15     IF i < Nlap_arab GO_TO #14
        j = 0
#16     j = j + 1
        $k = Nlap\_arab + 1 - j$
        $Tarap_j = Thelp_k - 365$                                                  (3.1.10)
        IF j < ih GO_TO #16
#17     j = j + 1
        $Tarap_j = Thelp_{j-ih}$
        IF j < Nlap_arab GO_TO #17
End of Subroutine 3
```

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

```
@3 IF Nlap_grass = 0 GO_TO @4
```

Subroutine 4: Number of degradation days in manure (Tddmgrp) and soil (Tddgrp) for the grassland situation; help variables for calculations over the year (Tcalc and T2grap$_j$) and a numerator for the number of calculations to carry out for degradation periods (Ncalgr).

```
        $j = 0$
        $Tcalc = 365 + Tappl\_n_1$                                        (3.1.11)
#18     $j = j + 1$
        $T2grapj = 365 + T2grapj$                                         (3.1.12)
        IF $Tcalc \leq T2grapj$ GO_TO #19
        $TgrapNlap\_grass+1 = T2grapj$                                    (3.1.13)
        $Nlap\_grass = Nlap\_grass + 1$                                   (3.1.14)
        GO_TO #18
#19     $p = 0$          (p is numerator for number of insecticide applications)
        $q = 1$          (q is numerator for number of land applications)
        $Ncalgr = 0$
#20     $p = p + 1$
        IF $p > Nlap\_grass$ GO_TO Subroutine 7
#21     IF $Tgrapq \geq Tappl\_np$ GO_TO #22
        $q = q + 1$
        GO_TO #21
```

Appendix 5 gives an overview of some theoretically possible insecticide applications and land applications over the year; this applies also to disinfections.

```
#22     $Tddmgr_p = $ IF $Tgrap_q - Tappl\_n_p$                           (3.1.15)
        $Tddgr_p = 365 - Tgrap_q + Tappl\_n_p$                            (3.1.16)
        $Ncalgr = Ncalgr + 1$                                             (3.1.17)
        GO_TO #20
End of Subroutine 4
```

@4 IF Nlap_arab = 0 GO_TO @5

Subroutine 5: Number of degradation days in manure (Tddmarp) and soil (Tddarp) for the arable land situation; help variables for calculations over the year (Tcalc and T2arap$_{j6}$) and a numerator for the number of calculations to carry out for degradation periods (Ncalar).

```
        $j6 = 0$
        $Tcalc = 365 + Tappl\_n_1$                                        (3.1.18)
```

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

```
#23  j6 = j6 + 1
     $T2arap_{j6} = 365 + T2arap_{j6}$                                   (3.1.19)
     IF $Tcalc \leq T2arap_{j6}$ GO_TO #24
     $Tarap_{Nlap\_grass+1} = T2arap_{j6}$                               (3.1.20)
     Nlap_arab = Nlap_arab + 1                                           (3.1.21)
     GO_TO #23
#24  p = 0              (p is numerator for number of insecticide applications)
     q = 1              (q is numerator for number of land applications)
     Ncalar = 0
#25  p = p + 1
     IF p > Nlap_arab GO_TO End of Subroutine 7
#26  IF $Tarap_q \geq Tappl\_n_p$ GO_TO #27
     q = q + 1
     GO_TO #26
#27  $Tddmar_p$ = IF $Tarap_q - Tappl\_n_p$                             (3.1.22)
     $Tddar_p = 365 - Tarap_q + Tappl\_n_p$                              (3.1.23)
     Ncalar = Ncalar + 1                                                 (3.1.24)
     GO_TO #25
End of Subroutine 5
```

@5 Continue

[A] + [B]

Amount of active ingredient at one application (kg)

For i2 = 1, 4, and i2 = 3 for waste

$$Qsubst\_appl_{i1,i2} = Cform * Vform\_area_{i1,i2} * AREAhousing_{i1} * 10^{-3} \qquad (3.1.25)$$

For i2 = 2 and i2 = 3 for air

$$Qsubst\_appl_{i1,i2} = Cform * Vform\_vol_{i1,i2} * Vhousing_{i1} * 10^{-5} \qquad (3.1.26)$$

Amount of active ingredient in relevant stream *i3* after one application (kg)

$$Qsubst\_stream_{i1,i2,i3} = Qsubst\_appl_{i1,i2} * F_{3,waste,i1,i2,i3} \qquad (3.1.27)$$

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

Soil

[I] For all relevant applications *i1* (When there is for poultry a combination of application in both batteries without treatment and free range with litter floor: i1 = 6 and i1 = 10 see [II]) and relevant waste streams *i4*

Amount of active ingredient in soil (kg) after the last land application of manure/slurry on grassland after one year since the 1st insecticide application for the maximum number of relevant biocide applications

If Nlap_grass > 0:

$$\mathrm{Qsubst\_grass}_{i1,i2,i3,i4} = \sum_{j=1}^{Ncalgr} \mathrm{Qsubst\_stream}_{i1,i2,i3,i4} * e^{-(kdeg_{slurry}*Tddmgr_j + kdeg_{soil}*Tddgr_j)} \qquad (3.1.28)$$

If Nlap_arab > 0:

$$\mathrm{Qsubst\_arab}_{i1,i2,i3,i4} = \sum_{j=1}^{Ncalar} \mathrm{Qsubst\_streami}_{i1,i2,i3,i4} * e^{-(kdeg_{slurry}*Tddmar_j + kdeg_{soil}*Tddar_j)} \qquad (3.1.29)$$

Amount of phosphate applied in one year for every relevant (sub)category of animal/housing *i1* ($kg.yr^{-1}$)

$$\mathrm{Qphosph\_total}_{i1,i4} = \mathrm{Nanimal}_{i1} * \mathrm{Qphosph\_excr}_{i1} \qquad (3.1.30)$$

Amount of nitrogen applied in one year for every relevant (sub)category of animal/housing *i1* ($kg.yr^{-1}$)

$$\mathrm{Qnitrog\_total}_{i1,i4} = \mathrm{Nanimal}_{i1} * \mathrm{Qnitrog\_excr}_{i1} \qquad (3.1.31)$$

[II] For poultry, if there is a combination of application in both batteries without treatment and free range with litter floor: (*i1* = 6 and *i1* = 10)

Amounts of active ingredient in soil ($kg.yr^{-1}$) after the last land application on grassland after one year since the 1st insecticide application for the maximum number of relevant biocide applications when liquid waste from {1} free range with laying hens or {2} free range with broilers is used

If Nlap_grass > 0:

$$\mathrm{Qsubst\_grass} - \{1\} = \mathrm{Qsubst\_grass}_{6,i2,i3,i4} + \mathrm{Fadd} * \mathrm{Qsubst\_grass}_{10,i2,i3,i4} \qquad (3.1.32)$$

$$\mathrm{Qsubst\_grass} - \{2\} = \mathrm{Qsubst\_grass}_{6,i2,i3,i4} + \mathrm{Fadd} * \mathrm{Qsubst\_grass}_{11,i2,i3,i4} \qquad (3.1.33)$$

IF Qai-grass-{1} ≥ Qai-grass-{1} GO_TO #28

$$\mathrm{Qsubst\_grass}_{6,i2,i3,i4} = \mathrm{Qsubst\_grass}\text{-}\{2\} \qquad (3.1.34)$$

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

```
    GO_TO #29 Continue
#28 $Qsubst\_grass_{6,i2,i3,i4} = Qsubst\_grass\text{-}\{1\}$    (3.1.35)
#29 Continue
```

Amounts of active ingredient in soil ($kg.yr^{-1}$) after the last land application on arable land after one year since the 1st insecticide application for the maximum number of relevant biocide applications when liquid waste from {1} free range with laying hens or {2} free range with broilers is used

If Nlap_arab > 0:

```
    $Qsubst\_arab-\{1\} = Qsubst\_arab_{6,i2,i3,i4} + Fadd * Qsubst\_arab_{10,i2,i3,i4}$    (3.1.36)
    $Qsubst\_arab-\{2\} = Qsubst\_arab_{6,i2,i3,i4} + Fadd * Qsubst\_arab_{11,i2,i3,i4}$    (3.1.37)
    IF $Qsubst\_\text{-}grass\text{-}\{1\} \geq Qsubst\_grass\text{-}\{1\}$ GO_TO #30
    $Qsubst\_arab_{6,i2,i3,i4} = Qsubst\_arab\text{-}\{2\}$    (3.1.38)
    GO_TO #31 Continue
#30 $Qsubst\_arab_{6,i2,i3,i4} = Qsubst\_arab\text{-}\{1\}$    (3.1.39)
#31 Continue
```

Amounts of phosphate applied in one year ($kg.yr^{-1}$) when liquid waste from {1} free range with laying hens and {2} free range with broilers is used

```
    $Qphosph\_total\text{-}\{1\} = Qphosph\_total_{6,i4} + Fadd * Qphosph\_total_{10,i4}$    (3.1.40)
    $Qphosph\_total\text{-}\{2\} = Qphosph\_total_{6,i4} + Fadd * Qphosph\_total_{11,i4}$    (3.1.41)
    IF $Qphosph\_total\text{-}\{1\} \geq Qphosph\_total\text{-}\{2\}$ GO_TO #32
    $Qphosph\_total_{6,i4} = Qphosph\_total\text{-}\{2\}$
    GO_TO #33 Continue

#32 $Qphosph\_total_{6,i4} = Qphosph\_total\text{-}\{1\}$
#33 Continue
```

Amounts of nitrogen applied in one year ($kg.yr^{-1}$) when liquid waste from {1} free range with laying hens and {2} free range with broilers is used

```
    $Qnitrog\_total\text{-}\{1\} = Qnitrog\_total_{6,i4} + Fadd * Qnitrog\_total_{10,i4}$    (3.1.42)
    $Qnitrog\_total\text{-}\{2\} = Qnitrog\_total_{6,i4} + Fadd * Qnitrog\_total_{11,i4}$    (3.1.43)
    IF $Qnitrog\_total\text{-}\{1\} \geq Qnitrog\text{-}total\text{-}\{2\}$ GO_TO #34
    $Qnitrog\_total_{6,i4} = Qnitrog\_total\text{-}\{2\}$    (3.1.44)
```

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

```
    GO_TO #35 Continue
#34 $Qnitrog\_total_{6,i4} = Qnitrog\_total\text{-}\{1\}$    (3.1.45)
```

#35 Continue

End calculations

Air

$$\mathrm{Elocal}_{3,\mathrm{air}} = \mathrm{F}_{3,\mathrm{air},\mathrm{i1},\mathrm{i2}} * \mathrm{Qsubst\_appl}_{\mathrm{i1},\mathrm{i2}} \tag{3.1.46}$$

Soil

For all relevant applications i1 and the waste stream i3:

If the phosphate immission standard is applicable $^{4)}$:

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the phosphate immission standard for grassland PIECgrs-P2O5$_{\mathrm{i1,i2,i3,i4}}$ =

$$\mathrm{PIECgrs\_P2O5}_{\mathrm{i1,i2,i3,i4}} = \frac{100 * \mathrm{Qsubst\_grass}_{\mathrm{i1,i2,i3,i4}} * \mathrm{Qphosph\_is}_{\mathrm{grass}}}{\mathrm{Qphosph\_total}_{\mathrm{i1,i4}} * \mathrm{DEPTHmix}_{\mathrm{grass}} * \mathrm{RHOsoil}} \tag{3.1.47}$$

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the phosphate immission standard for arable land

$$\mathrm{PIECars\_P2O5}_{\mathrm{i1,i2,i3,i4}} = \frac{100 * \mathrm{Qsubst\_arab}_{\mathrm{i1,i2,i3,i4}} * \mathrm{Qphosph\_is}_{\mathrm{arable}}}{\mathrm{Qphosph\_total}_{\mathrm{i1,i4}} * \mathrm{DEPTHmix}_{\mathrm{arable}} * \mathrm{RHOsoil}} \tag{3.1.48}$$

If the nitrogen immission standard is applicable $^{4)}$:

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the nitrogen immission standard for grassland

$$\mathrm{PIECgrs\_N}_{\mathrm{i1,i2,i3,i4}} = \frac{100 * \mathrm{Qsubst\_grass}_{\mathrm{i1,i2,i3,i4}} * \mathrm{Qnitrog\_is}_{\mathrm{grass}}}{\mathrm{Qnitrog\_total}_{\mathrm{i1,i4}} * \mathrm{DEPTHmix}_{\mathrm{grass}} * \mathrm{RHOsoil}} \tag{3.1.49}$$

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the phosphate immission standard for arable land

$$\mathrm{PIECars\_N}_{\mathrm{i1,i2,i3,i4}} = \frac{100 * \mathrm{Qsubst\_arab}_{\mathrm{i1,i2,i3,i4}} * \mathrm{Qnitrog}_{\mathrm{arable}}}{\mathrm{Qnitrog\_total}_{\mathrm{i1,i4}} * \mathrm{DEPTHmix}_{\mathrm{arable}} * \mathrm{RHOsoil}} \tag{3.1.50}$$

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

STP

Amount of active ingredient reaching the standard STP ($kg.d^{-1}$) (for the relevant cases of *i1* = 6, 7, 10 and 11)

$$Elocal_{3,water} = F_{3,water,i1,i2,i3} * Qsubst\_appl_{i1,i2} \qquad (3.1.51)$$

---

1) The date is automatically converted into the corresponding day number via Table 18.9

2) If Nlap_grass is set to zero the set of input data till the next dotted line are skipped; for the calculations Subroutine 2 is by-passed.

3) If Nlap_arab is set to zero the set of input data till the next dotted line are skipped; for the calculations Subroutine 3 is by-passed.

4) At least one of the immission standards should be applied; if none is specified the phosphate immission standard is used with the default values of Table 18.9

Table 3.4 Defaults for the emission factors for air, $F_{3,air,i1,i2}$, manure storage, $F_{3,waste,i1,i2,i3}$, and wastewater, $F_{3,water,i1,i2}$, for various animal species and application methods, and for the application rates of the biocidal product are presented for both the area, $Vform\_area_{i1,i2}$ ($l.m^{-2}$), and volume, $Vform\_vol_{i1,i2}$ ($l.100m^{-3}$) of a housing

Application	$Vform\_vol_{i1,i2}$	$Vform\_area_{i1,i2}$	$F_{3,waste,i1,i2,i3}$	$F_{3,air,i1,i2}$	$F_{3,water,i1,i2}$
Spraying (i2=1)			0.65	0.10	0.2
General1)		0.3-.05			
Pigs		0.1-0.2			
Fogging(i2=2)	1.1-1.7		0.50	0.25	0.2
Spraying & Fogging (i2=3)2)					0.2
Spray1)		0.2-0.3	**0.65**	0.10	
Fog	1.1-1.7		0.50	**0.25**	
Unknown (i2=4) 1)		0.3-0.5	0.65	0.25	0.2

1) Application rate includes other treated surfaces than floors like walls, pens and cages, but is expressed as unit floor area

2) In this case the worst case values are chosen (**bold** in table)

Table 3.3 Pick-list for the emission model parameters for calculating the releases of disinfectant used in disinfection of housings, for various types of animals: treated surface area (floor area for poultry and unknown), $AREA_{i1}$, for an average housing (m^2), treated volume, $Vhousing_{i1}$ (m^3), for an average housing, number of animals, $Nanimal_{i1}$, in a housing (-), phosphate generation per animal, $Qphosph\_excr_{i1}$, ($kg.d^{-1}$) and nitrogen generation per animal, $Qnitrog\_excr_{i1}$, ($kg.d^{-1}$), and number of disinfection events per year, Nappl_bioc (-)

Animal type	$AREAhousing_{i1}$	$Vhousing_{i1}$	$Nanimal_{i1}$
Cattle			
Dairy cows	4,000	28,500	40
Beef cattle	4,000	28,500	40
Veal calves	4,000	28,500	40
Pigs			
Fattening	552	3,950	260
Breeding	472	3,350	100
Poultry			
Battery, Laying hens			
- belt drying	4,000	19,000	27,000
- deep pit, high-rise	4,000	19,000	27,000
- compact	4,000	19,000	27,000
- no treatment	4,000	19,000	27,000
Free range, litter floor			
- Laying hens	4,000	19,000	27,000
- Broilers	4,000	19,000	27,000
Free range, grating floor			
- Parent broilers	2,000	9,500	9,000
- Parent broilers in rearing	2,000	9,500	12,000

Table 3.3 Pick-list for the emission model parameters for calculating the releases of disinfectant used in disinfection of housings, for various types of animals: treated surface area (floor area for poultry and unknown), $AREA_{i1}$, for an average housing (m^2), treated volume, $Vhousing_{i1}$ (m^3), for an average housing, number of animals, $Nanimal_{i1}$, in a housing (-), phosphate generation per animal, $Qphosph\_excr_{i1}$, ($kg.d^{-1}$) and nitrogen generation per animal, $Qnitrog\_excr_{i1}$, ($kg.d^{-1}$), and number of disinfection events per year, Nappl_bioc (-) (continued)

Animal type	$Qphosph\_excr_{i1}$	$Qnitrog\_excr_{i1}$	Nappl_bioc
Cattle			
Dairy cows	0.0177	0.0745	0
Beef cattle	0.367	0.1670	0
Veal calves	0.0142	0.0238	0
Pigs			
Fattening	0.0203	0.0304	6
Breeding	0.0556	0.0710	12
Poultry			
Battery, Laying hens			
- belt drying	0.00111	0.000181	1
- deep pit, high-rise	0.00111	0.000181	1
- compact	0.00111	0.000181	1
- no treatment	0.00122	0.00202	1
Free range, litter floor			
- Laying hens	0.00111	0.00171	1
- Broilers	0.00066	0.00156	6
Free range, grating floor			
- Parent broilers	0.00077	0.00137	6
- Parent broilers in rearing	0.00188	0.00298	6

Table 3.5 Defaults for date (Tappl_d$_1$) and day number (Tappl_n$_1$) of first disinfection depending on the number of applications per year (Nappl_bioc)

Nappl_bioc	Tappl_d$_1$	Tappl_n$_1$	Nappl_bioc	Tappl_d$_1$	Tappl_n$_1$
1	1 July	182	7	26 January	26
2	1 April	91	8	23 January	23
3	1 March	60	9	20 January	20
4	15 February	46	10	18 January	18
5	6 February	37	11	16 January	16
6	30 January	30	12	15 January	15

3.2 Disinfection of footwear and animals' feet

Disinfection of footwear and animal's feet are usual procedures in Dutch livestock farming. Footwear is usually disinfected upon entering housing facilities for poultry and pigs. Animal's feet are only disinfected at cattle farms. To bring about disinfection, persons and animals move through a dip or tub with a solution of the disinfectant. The solution should preferably be replaced twice a week, especially when the solution contains dirt, which reduces the effectiveness of the disinfectant. So, the biocide application occurs quite frequently.

It is assumed that the remainder of the solution is poured into the manure storage system. The amount of disinfectant reaching the manure storage system equals the applied amount because this method is described to be rather inefficient (Montfoort *et al.*, 1996), although one should not rule out the possibility that the solution is poured directly onto the ground.

The emission scenario for frequent biocide applications is presented in Table 3.6. It is based on local average consumption figures, and an average (fixed) manure storage period. The scenario calculates the emissions to air and emissions to soil through the manure storage and land application route. For each full manure storage period (within the year from the start of the first manure storage period with disinfection) the average amount of disinfectant degraded in the manure storage is considered. The remaining amounts of disinfectant applied to land with manure is considered for degradation in soil for the respective period since land application till the moment of calculation of the PIECsoil.
Table 3.7 gives default values for several parameters of the emission scenario based on average consumption figures. Default values for the concentration of active substance in the disinfectant can be derived from Appendix 4.

Table 3.6 Emission scenario for calculating the release of disinfectants used in disinfection of footwear and animals' feet

Variable/parameter (unit)	Symbol	Default	S/D/O/P	[table]
Input:				
Concentration of active substance in disinfectant (g.l^{-1})	Cform		S	
Quantity of disinfectant in one reservoir (l)	Vreserv$_{i1}$		P	[3.7]
Number of reservoirs (-)	Nreserv$_{i1}$		P	[3.7]
Emission fraction to air (-)	$F_{3,air,i1,i2,i3}$ [1]		P	[3.7]
Emission fraction to wastewater (-)	$F_{3,water,i1,i2,i3}$ [1]		P	[3.7]
Emission fraction to manure storage (-)	$F_{3,waste,i1,i2,i3}$ [1]		P	[3.7]
Number of disinfection events per year (-)	Nappl_bioc		P	[3.7]
Phosphate immission standard for grassland (kg.ha^{-1}.yr^{-1})	Qphosph_is$_{grass}$		P	[3.5]
Phosphate immission standard for arable land (kg.ha^{-1}.yr^{-1})	Qphosph_is$_{arable}$		P	[18.9]
Nitrogen immission standard for grassland (kg.ha^{-1}.yr^{-1})	Qnitrog_is$_{grass}$		P	[18.9]
Nitrogen immission standard for arable land (kg.ha^{-1}.yr^{-1})	Qnitrog_is$_{arable}$		P	[18.9]
Half-life time for biodegradation in slurry (d)	DT50bio$_{slurry}$	1e^{6}	D	
Half-life time for biodegradation in soil (d)	DT50bio$_{soil}$	1e^{6}	D	
Manure storage period (d)	Tstorage	180	D	
Number of animals in housing for every relevant category/subcategory *i1* (-)	Nanimal$_{i1}$		D/P	[3.3]
Amount of phosphate per animal for every relevant category/subcategory *i1* (kg.d^{-1})	Qphosph_excr$_{i1}$		D	[3.3]
Amount of nitrogen per animal for every relevant category/subcategory *i1* (kg.d^{-1})	Qnitrog_excr$_{i1}$		D	[3.3]
Fraction of biocide added in the case of a combination of application in both poultry batteries without treatment and free range with litter floor (-)	Fadd		D	[18.10]
Mixing depth with bulk soil grassland (m)	DEPTHmix$_{grass}$		P	[18.9]
Mixing depth with bulk soil arable land (m)	DEPTHmix$_{arable}$		P	[18.9]
Bulk density of soil (kg.m^{-3})	RHOsoil	1500	D	[18.2]

[1] The subscript "3" refers to the stage of processing in conformance with EUSES 1.0 and USES 3.0

Table 3.6 Emission scenario for calculating the release of disinfectants used in disinfection of footwear and animals' feet (continued)

Output:

$Elocal_{3,air}$ = Local emission to air from disinfection of animal housing by spraying or fogging ($kg \cdot d^{-1}$)

$Elocal_{3,water}$ = Local emission to wastewater from disinfection of animal housing by spraying or fogging ($kg \cdot d^{-1}$)

$PIECgrs\_P2O5_{i1,i2,i3}$ = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on grassland ($mg.kg^{-1}$) according to phosphate immission standard

$PIECars\_P2O5_{i1,i2,i3}$ = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on arable land ($mg.kg^{-1}$) according to phosphate immission standard

$PIECgrs\_N_{i1,i2,i3}$ = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on grassland ($mg.kg^{-1}$) according to nitrogen immission standard

$PIECars\_N_{i1,i2,i3}$ = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on arable land ($mg.kg^{-1}$)) according to nitrogen immission standard

Intermediate calculations

First-order degradation rate constant in manure (d^{-1})

$$kdeg_{slurry} = \frac{\ln 2}{DT50bio_{slurry}} \tag{3.2.1}$$

First-order degradation rate constant in soil (d^{-1})

$$kdeg_{soil} = \frac{\ln 2}{DT50bio_{soil}} \tag{3.2.2}$$

Number of disinfections per storage period (-)

$$Nappl\_storage = Integer[365/Nappl\_bioc + 0.5] \tag{3.2.3}$$

Time interval between the single treatments (d)

$$Tint\_bioc = \frac{Tstorage}{Nappl\_bioc} \tag{3.2.4}$$

Table 3.6 Emission scenario for calculating the release of disinfectants used in disinfection of footwear and animals' feet (continued)

Fraction of the amount of disinfectant applied at one treatment remaining after one application interval (-)

$$\mathrm{Fdeg_{int}} = \mathrm{e}^{-\mathrm{kdeg_{slurry}} * \mathrm{Tint\_bioc}} \tag{3.2.5}$$

Average amount of disinfectant in manure after one storage period (kg)

$$\mathrm{Qsubst\_stream_{i1,i2,i3}} = \mathrm{Cform} * \mathrm{Vreserv_{i1}} * 10^{-3} * \mathrm{Nreserv_{i1}} * \mathrm{F_{3,waste,i1,i2,i3}} * \frac{\left\{1 - (\mathrm{Fdeg_{int}})^{\mathrm{Nappl\_storage}}\right\} * (\mathrm{Fdeg_{int}} + 1)}{2 * (1 - \mathrm{Fdeg_{int}})} \tag{3.2.6}$$

Maximum number of land applications (manure storage periods) in one year (-)

$$\mathrm{Nmsp} = \mathrm{Integer}[365/\mathrm{Tstorage}] \tag{3.2.7}$$

Number of degradation days in soil after land application till determination of PIECsoil (d)

╓▶ For i = 1 ▪▪▪▪ Nmsp

╙═ $\mathrm{Nd\_soil_i} = 365 - \mathrm{i} * \mathrm{Tstorage}$

For grassland land applications:

$$\mathrm{Qsubst\_grass_{i1,i2,i3}} = \sum_{i=1}^{\mathrm{Nmsp}} (\mathrm{Qsubst\_stream_{i1,i2,i3}} * \mathrm{e}^{-\mathrm{kdegsoil} * \mathrm{Nd\_soil_i}}) \tag{3.2.8}$$

For grassland land applications:

$$\mathrm{Qsubst\_arab_{i1,i2,i3}} = \sum_{i=1}^{\mathrm{Nmsp}} (\mathrm{Qsubst\_stream_{i1,i2,i3}} * \mathrm{e}^{-\mathrm{kdegsoil} * \mathrm{Nd\_soil_i}}) \tag{3.2.9}$$

Amount of phosphate applied in one year for every relevant (sub)category of animal/housing *i1* (kg.yr^{-1})

$$\mathrm{Qphosph\_total_{i1,i3}} = \mathrm{Nanimal_{i1}} * \mathrm{Qphosph\_excr_{i1}} \tag{3.2.10}$$

Amount of nitrogen applied in one year for every relevant (sub)category of animal/housing *i1* (kg.yr^{-1})

$$\mathrm{Qnitrog\_total_{i1,i3}} = \mathrm{Nanimal_{i1}} * \mathrm{Qnitrog\_excr_{i1}} \tag{3.2.11}$$

Table 3.6 Emission scenario for calculating the release of disinfectants used in disinfection of footwear and animals' feet (continued)

End calculations:

Air

$$\mathrm{Elocal}_{3,\mathrm{air}} = \mathrm{F}_{3,\mathrm{air},\mathrm{i1},\mathrm{i2},\mathrm{i3}} * \mathrm{Cform} * \mathrm{Vreserv}_{\mathrm{i1}} * \mathrm{Nreserv}_{\mathrm{i1}} * 10^{-3} \quad (3.2.12)$$

Soil

For all relevant applications i1 and the waste stream i3:

If the phosphate immission standard is applicable $^{4)}$***:***

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the phosphate immission standard for grassland $\mathrm{PIECgrs\text{-}P2O5}_{\mathrm{i1,i2,i3,i4}}$ =

$$\mathrm{PIECgrs\_P2O5}_{\mathrm{i1,i2,i3,i4}} = \frac{100 * \mathrm{Qsubst\_grass}_{\mathrm{i1,i2,i3,i4}} * \mathrm{Qphosph\_is}_{\mathrm{grass}}}{\mathrm{Qphosph\_total}_{\mathrm{i1,i4}} * \mathrm{DEPTHmix}_{\mathrm{grass}} * \mathrm{RHOsoil}} \quad (3.2.13)$$

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the phosphate immission standard for arable land

$$\mathrm{PIECars\_P2O5}_{\mathrm{i1,i2,i3,i4}} = \frac{100 * \mathrm{Qsubst\_arab}_{\mathrm{i1,i2,i3,i4}} * \mathrm{Qphosph\_is}_{\mathrm{arable}}}{\mathrm{Qphosph\_total}_{\mathrm{i1,i4}} * \mathrm{DEPTHmix}_{\mathrm{arable}} * \mathrm{RHOsoil}} \quad (3.2.14)$$

If the nitrogen immission standard is applicable $^{4)}$***:***

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the nitrogen immission standard for grassland

$$\mathrm{PIECgrs\_N}_{\mathrm{i1,i2,i3,i4}} = \frac{100 * \mathrm{Qsubst\_grass}_{\mathrm{i1,i2,i3,i4}} * \mathrm{Qnitrog\_is}_{\mathrm{grass}}}{\mathrm{Qnitrog\_total}_{\mathrm{i1,i4}} * \mathrm{DEPTHmix}_{\mathrm{grass}} * \mathrm{RHOsoil}} \quad (3.2.15)$$

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the phosphate immission standard for arable land

$$\mathrm{PIECars\_N}_{\mathrm{i1,i2,i3,i4}} = \frac{100 * \mathrm{Qsubst\_arab}_{\mathrm{i1,i2,i3,i4}} * \mathrm{Qnitrog}_{\mathrm{arable}}}{\mathrm{Qnitrog\_total}_{\mathrm{i1,i4}} * \mathrm{DEPTHmix}_{\mathrm{arable}} * \mathrm{RHOsoil}} \quad (3.2.16)$$

STP

Amount of active ingredient reaching the standard STP (kg.d^{-1}) (for the relevant cases of *i1* = 6, 7, 10 and 11)

$$\mathrm{Elocal}_{3,\mathrm{water}} = \mathrm{F}_{3,\mathrm{water},\mathrm{i1},\mathrm{i2},\mathrm{i3}} * \mathrm{Cform} * \mathrm{Vreserv}_{\mathrm{i1}} * \mathrm{Nreserv}_{\mathrm{i1}} * 10^{-3} \quad (3.2.17)$$

Table 3.7 *Pick-list of emission model parameters for calculating the release of disinfectants used in disinfection of footwear and animals' feet: Number of disinfections per year, Nappl_bioc (-), number of reservoirs,* $Nreserv_{i1}$ *(-), volume of disinfectant in one reservoir,* $Vreserv_{i1}$ *(l), emission factor to air,* $F_{3,air,i1,i2,i3}$ *(-), emission factor to wastewater,* $F_{3,water,i1,i2,i3}$ *(-), and emission factor to manure,* $F_{3,waste,i1}$ *(-)*

Animal type	Nappl_bioc	$Nreserv_{i1}$	$Vreserv_{i1}$	$F_{3,air,i1,i2,i3}$	$F_{3,water,i1,i2,i3}$	$F_{3,waste,i1,i2,i3}$
Cows	12	1	1000	0.5	0	0.25
Dairy cow						
Beef cattle						
Veal calf						
Pigs	104	3	10	0	0	0.75
Fattening						
Breeding						
Poultry	104	2	10	0		
Battery, Laying hens						
- belt drying					0 / 1 1)	0.75 / 0 2)
- deep pit, high-rise					0 / 1 1)	0.75 / 0 2)
- compact					0	0.75
- no treatment					0	0.75
Free range, litter floor						
- laying hens					0 / 1 1)	0.75 / 0 2)
- broilers					0 / 1 1)	0.75 / 0 2)
Free range, grating floor						
- Parent broilers					0	0.75
- Parent broilers in rearing					0	0.75

1) In case of connection to STP

2) Zero in case of connection to STP

3.3 Disinfection of milk extraction systems

Milk extraction systems are cleaned and disinfected immediately after finishing milking, usually twice a day. The milk storage tanks are emptied once in 2 or 3 days and are disinfected directly afterwards. For this emission scenario it is supposed that the entire amount of active ingredient is available for emission and discharged into the manure storage system.

The number of disinfection events is not equal to a real number of days but is derived from a combination, i.e., weighted to the amount of disinfectant used, and the number of days the milk installation and milk storage tank are cleaned. For the daily average amount of disinfectant used the application interval, Tint_bioc, equals 1 day; so, the number of applications during a storage period equals the number of days of the storage period Tstorage. In principle distinction should be made between the stalling period in winter (175 days) and the grazing period in summer. In summer the cows come only to the milking parlour during milking and hence the amounts of phosphate and nitrogen excreted and discharged into the manure storage are lower. This worst case situation has been assumed for the model. Through this, the final concentration of biocides in manure can be estimated straight away instead of calculating it in separately for both cleaning milk extraction systems and storage tanks.

This section presents one emission scenario presented in Table 3.8 based on local average consumption figures. The scenario calculates the emissions to soil through the manure storage and application route.

Table 3.8 Emission scenario for calculating the release of disinfectants used for disinfection of milk extraction systems

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Concentration of active substance in disinfectant ($g.l^{-1}$)	Cform		S
Quantity of disinfectant used for disinfection (milk installation) ($l.d^{-1}$)	$Vform_{inst}$	130	D
Quantity of disinfectant used for disinfection (storage tank) ($l.d^{-1}$)	$Vform_{tank}$	45	D
Emission fraction to manure storage (-)	$F_{3,waste}$	0.75	D
Number of disinfections per day (installation) (-)	Nappl_inst	2	D
Number of disinfections per day (storage tank) (-)	Nappl_tank	0.33	D
Number of cows in milking parlor (-)	Nanimal	40	D
Amount of phosphate per dairy cow ($kg.d^{-1}$)	Qphosph_excr	0.0177	D
Amount of nitrogen per dairy cow ($kg.d^{-1}$)	Qnitrog_excr	0.0745	D
Phosphate immission standard for grassland ($kg.ha^{-1}.yr^{-1}$)	$Qphosph\_is_{grass}$		P [18.9]
Phosphate immission standard for arable land ($kg.ha^{-1}.yr^{-1}$)	$Qphosph\_is_{arable}$		P [18.9]
Nitrogen immission standard for grassland ($kg.ha^{-1}.yr^{-1}$)	$Qnitrog\_is_{grass}$		P [18.9]
Nitrogen immission standard for arable land ($kg.ha^{-1}.yr^{-1}$)	$Qnitrog\_is_{arable}$		P [18.9]
Manure storage period (d)	Tstorage	180	D
Mixing depth with bulk soil grassland (m)	$DEPTHmix_{grass}$		P [18.9]
Mixing depth with bulk soil arable land (m)	$DEPTHmix_{arable}$		P [18.9]
Bulk density of soil ($kg.m^{-3}$)	RHOsoil	1500	D [18.2]
Half-life time for degradation in manure (d)	$DT50bio_{slurry}$		D [18.2]
Half-life time for degradation in soil (d)	$DT50bio_{soil}$		D [18.2]

Table 3.8 Emission scenario for calculating the release of disinfectants used for disinfection of milk extraction systems (continued)

Output:

PIECgrs_P2O5 = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on grassland ($mg.kg^{-1}$) according to phosphate immission standard

PIECars_P2O5 = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on arable land ($mg.kg^{-1}$) according to phosphate immission standard

PIECgrs_N = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on grassland ($mg.kg^{-1}$) according to nitrogen immission standard

PIECars_N = Concentration of the active ingredient (disinfectant) in soil after the first year that the biocide is applied on arable land ($mg.kg^{-1}$) according to nitrogen immission standard

Intermediate calculations

First-order degradation rate constant in manure (d^{-1})

$$kdeg_{slurry} = \frac{\ln 2}{DT50bio_{slurry}} \qquad (3.3.1)$$

First-order degradation rate constant in soil (d^{-1})

$$kdeg_{soil} = \frac{\ln 2}{DT50bio_{soil}} \qquad (3.3.2)$$

Number of disinfections per storage period (-)

$$Nappl\_storage = Tstorage \qquad (3.3.3)$$

Time interval between the single treatments (d)

$$Tint\_bioc = 1 \qquad (3.3.4)$$

Fraction of the amount of disinfectant applied at one treatment remaining after one application interval (-)

$$Fdeg_{int} = e^{-kdeg_{slurry} * Tint\_bioc} \qquad (3.3.5)$$

Table 3.8 Emission scenario for calculating the release of disinfectants used for disinfection of milk extraction systems (continued)

Average amount of disinfectant applied per day (kg)

$$\mathrm{Qsubst_{day}} = \mathrm{Cform} * (\mathrm{Vform_{inst}} * \mathrm{Nappl\_inst} + \mathrm{Vform_{tank}} * \mathrm{Nappl\_tank}) * 10^{-3} \quad (3.3.6)$$

Average amount of disinfectant in manure after one storage period (kg)

$$\mathrm{Qsubst\_stream} = \mathrm{Qsubst_{day}} * \mathrm{F_{3,waste}} * \frac{\left\{1 - (\mathrm{Fdeg_{int}})^{\mathrm{Nappl\_storage}}\right\} * (\mathrm{Fdeg_{int}} + 1)}{2 * (1 - \mathrm{Fdeg_{int}})} \quad (3.3.7)$$

Maximum number of land applications (manure storage periods) in one year (-)

Nmsp = Integer[365/Tstorage]

Number of degradation days in soil after land application till determination of PIECsoil (d)

╔▶ For i = 1 ▪▪▪▪ Nmsp

╚═ $\mathrm{Nd\_soil_i} = 365 - i * \mathrm{Tstorage}$

For grassland land applications:

$$\mathrm{Qsubst\_grass} = \sum_{i=1}^{\mathrm{Nmsp}} (\mathrm{Qsubst\_stream} * e^{-\mathrm{kdegsoil} * \mathrm{Nd\_soil_i}}) \quad (3.3.8)$$

For grassland land applications:

$$\mathrm{Qsubst\_arab} = \sum_{i=1}^{\mathrm{Nmsp}} (\mathrm{Qsubst\_stream} * e^{-\mathrm{kdegsoil} * \mathrm{Nd\_soil_i}}) \quad (3.3.9)$$

Amount of phosphate applied in one year for every relevant (sub)category of animal/housing *i1* ($\mathrm{kg.yr^{-1}}$)

$$\mathrm{Qphosph\_total} = \mathrm{Nanimal} * \mathrm{Qphosph\_excr} \quad (3.3.10)$$

Amount of nitrogen applied in one year for every relevant (sub)category of animal/housing *i1* ($\mathrm{kg.yr^{-1}}$)

$$\mathrm{Qnitrog\_total} = \mathrm{Nanimal} * \mathrm{Qnitrog\_excr} \quad (3.3.11)$$

Table 3.8 Emission scenario for calculating the release of disinfectants used for disinfection of milk extraction systems (continued)

End calculations:

Soil

For all relevant applications i1 and the waste stream i3:

If the phosphate immission standard is applicable $^{4)}$:

Concentration of the active ingredient in soil after the first year that the biocide is applied ($mg.kg^{-1}$) based on the phosphate immission standard for grassland

$$PIECgrs\_P2O5 = \frac{100 * Qsubst\_grass * Qphosph\_is_{grass}}{Qphosph\_total * DEPTHmix_{grass} * RHOsoil} \tag{3.2.12}$$

Concentration of the active ingredient in soil after the first year that the biocide is applied ($mg.kg^{-1}$) based on the phosphate immission standard for arable land

$$PIECars\_P2O5 = \frac{100 * Qsubst\_arab * Qphosph\_is_{arable}}{Qphosph\_total * DEPTHmix_{arable} * RHOsoil} \tag{3.2.13}$$

If the nitrogen immission standard is applicable $^{4)}$:

Concentration of the active ingredient in soil after the first year that the biocide is applied ($mg.kg^{-1}$) based on the nitrogen immission standard for grassland

$$PIECgrs\_N = \frac{100 * Qsubst\_grass * Qnitrog\_is_{grass}}{Qnitrog\_total * DEPTHmix_{grass} * RHOsoil} \tag{3.2.14}$$

Concentration of the active ingredient in soil after the first year that the biocide is applied ($mg.kg^{-1}$) based on the phosphate immission standard for arable land

$$PIECars\_N = \frac{100 * Qsubst\_arab * Qnitrog_{arable}}{Qnitrog\_total * DEPTHmix_{arable} * RHOsoil} \tag{3.2.15}$$

3.4 Disinfection of means of transport

Disinfection of means of transport is relevant for pigs and poultry. Pigs are transported in transport vehicles only, poultry is transported in special boxes on the transport vehicle. Although there is legislation which prescribes disinfection of means of transport at pig farms there is usually no disinfection of transport vehicles at farms at all. Disinfection of the whole vehicle occurs only at slaughterhouse or export places for pigs. At these locations there is severe risk of infection and cleaning and disinfection is required. For the emission scenario this situation has been taken as a guide.

This means that only the most important aspect of disinfection, i.e., disinfection at the slaughterhouse is described. In most cases surplus of disinfectant is discharged into the sewer ending up in the local sewage treatment plant. For this emission scenario the "worst case" assumption has been made that the total available amount of active ingredient is discharged into the local sewage treatment plant, see Table 3.9.

The quantity of active ingredient depends on the applied concentration of disinfectant, the amount of solution used for disinfection of a square meter or a box and the total area or number of boxes to be cleaned. Further more it is assumed that disinfection occurs at 260 days, 25,000 pigs are transported each day and for poultry 51,000 animals are transported each day, resembling 2,550 boxes, see Table 3.10.

Table 3.9 Emission scenario for calculating the release of disinfectants used in animal transport

Variable/parameter (unit)	Symbol	Default	S/D/O/P	[table]
Input:				
Concentration of active substance in disinfectant ($g.l^{-1}$)	Cform		S	
[A]				
Quantity of disinfectant used per square meter ($l.m^{-2}$)	$Vform\_area_{i1}$		P	[3.11]
[B]				
Quantity of disinfectant used per box (l)	$Vform\_box_{i1}$		P	[3.11]
Treated surface area in transportation (m^2)	AREAtransp		P	[3.11]
Treated number of boxes in transportation (-)	Nbox		P	[3.11]
Emission fraction to water (-)	$F_{3,water}$	0.75	D	
Number of disinfection per year (-)	Nappl_transp	260	D	

Table 3.9 Emission scenario for calculating the release of disinfectants used in animal transport (continued)

Output:

$Elocal_{3,water}$ = Local emission to wastewater ($kg.d^{-1}$) [1]

Model calculations:

[A]

$$Elocal_{3,water} = Cform * Vform\_area_{i1} * AREAtransp * 10^{-3} * F_{3,water} * Ndisinf \qquad (3.4.1)$$

[B]

$$Elocal_{3,water} = Cform * Vform\_box_{i1} * Nbox * 10^{-3} * F_{3,water} * Ndisinf \qquad (3.4.2)$$

---

[1] The subscript "3" refers to the stage of processing in conformance with EUSES 1.0 and USES 3.0

Table 3.10 Pick-list for the amount of disinfectant used for cleaning a square meter, $Vform\_area_{i1}$ ($l.m^{-2}$), and a box, $Vform\_box_{i1}$ (l), and the total surface area, AREAtransp (m^2), and number of boxes, Nbox (-), to be cleaned

Animal type	$Vform\_area_{i1}$	AREAtransp	$Vform\_box_{i1}$	Nbox
Pigs	0.2	12,500	.	.
Poultry	.	.	2.0	2,550
Others	.	.	2.0	2,500

3.5 Disinfection of hatcheries

In most cases formaldehyde is used for disinfection of hatcheries. Disinfection is applied at the rooms of the hatchery, chicks and eggs before and during brooding. Emissions occur to air and wastewater. Wastewater is drained to the sewer or surface water. For the emission scenario it is assumed that all disinfectant which reaches the wastewater is emitted to the local wastewater treatment plant.

The amount of disinfectant used for the four disinfection steps depends on the concentration of disinfectant, the quantity of disinfectant solution used per cubic meter hatchery space, total number of eggs and amount of eggs per cubic meter. The default number of disinfection days is estimated at 260 days. The emission scenario is presented in Table 3.11 and a pick-list with defaults for concentrations of active ingredients in Table 3.13.

Table 3.11 Emission scenario for calculating the release of disinfectants used in hatcheries

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of disinfectant used per cubic meter ($g.m^{-3}$)	Qsubst		S/P [3.13]
Total number of eggs disinfected (-)	$Negg_{total}$	37,000	D
Number of eggs per cubic meter (m^{-3}) for stage:	$Negg_{stage}$		D
1 Eggs before brooding		1,160	
2 Eggs during brooding		1,410	
3 Chicks and eggshells		1,410	
4 Rooms		1,410	
Emission factor to air (-)	$F_{3,air}$	0.25	D
Emission factor to water (-)	$F_{3,water}$	0.50	D

Output:

$Elocal_{3,air}$ = Local emission rate to air ($kg \cdot d^{-1}$) [1]

$Elocal_{3,water}$ = Local emission rate to water ($kg \cdot d^{-1}$) [1]

Model calculations:

$$Elocal_{3,air} = \sum_{stage=1}^{4} \frac{Qsubst * 10^{-3} * Negg_{total} * F_{3,air}}{Neggs_{stage}} \tag{3.5.1}$$

$$Elocal_{3,waterr} = \sum_{stage=1}^{4} \frac{Qsubst * 10^{-3} * Negg_{total} * F_{3,water}}{Neggs_{stage}} \tag{3.5.2}$$

---

[1] The subscript "3" refers to the stage of processing in conformance with EUSES 1.0 and USES 3.0

Table 3.12 Pick-list for the amount of active ingredient Qsubst ($g.m^{-3}$) used for disinfection of hatcheries used as defaults for various types of disinfectants

Active ingredient	Qsubst
Formalin	1.2
Paraformaldehyde	6.3
Others	6.3

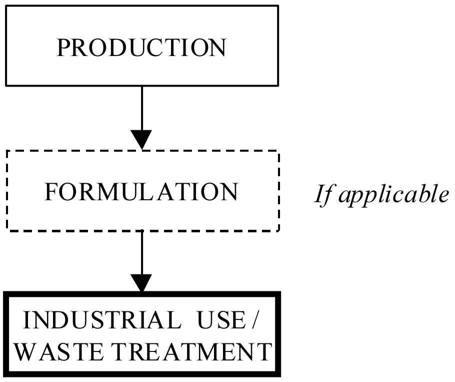
3.6 Disinfection of fish-farms

This topic has not been covered yet.

4. Product type 4: Food and feed area disinfectants

A start has been made with an emission scenario document producing a general document on the scope of this product type. This document has been discussed during one of the meetings. It was agreed that industry – by the way of CEFIC representation – an emission scenario document would be written at RIVM for all relevant categories in food industry (e.g. meat processing, fruit and vegetable, dairy, etc.).

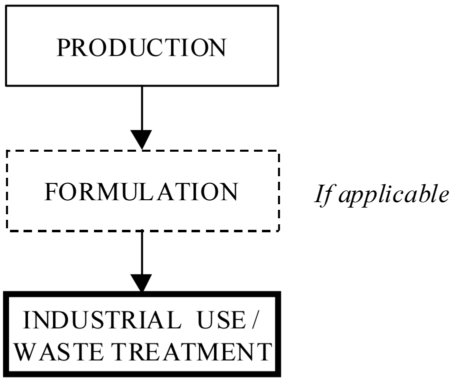
The scheme of the life cycle stages is presented below.



5. Product type 5: Drinking water disinfectants

No emission scenario document exists for this product type. Some data on practice in the Netherlands have been collected. As far as can be seen right now this is not a priority in the development of emission scenarios. Recently a provisional draft on this product type has been produced by the Umweltbundesamt (Hermann, 2001). No emission scenario has been produced yet.

The scheme of the life cycle stages is presented below.



6. Product type 6: In-can preservatives

In-can preservatives are added to a variety of products to prolong shelf life of the product. The products concerned according to Van Dokkum *et al.* (1998) and Baumann *et al.* (2000) are listed below, where 'P' means professional use and 'N' non-professional use:

6.1 Washing and cleaning fluids, human hygienic products and cosmetics (P, N)
6.2 Detergents (P, N)
6.3 Paints and coatings (P, N)
6.4 Fluids used in paper, textile and leather production (P)
6.5 Lubricants (P)
6.6 Machine oils (P)
6.7 Fuels (P, N)

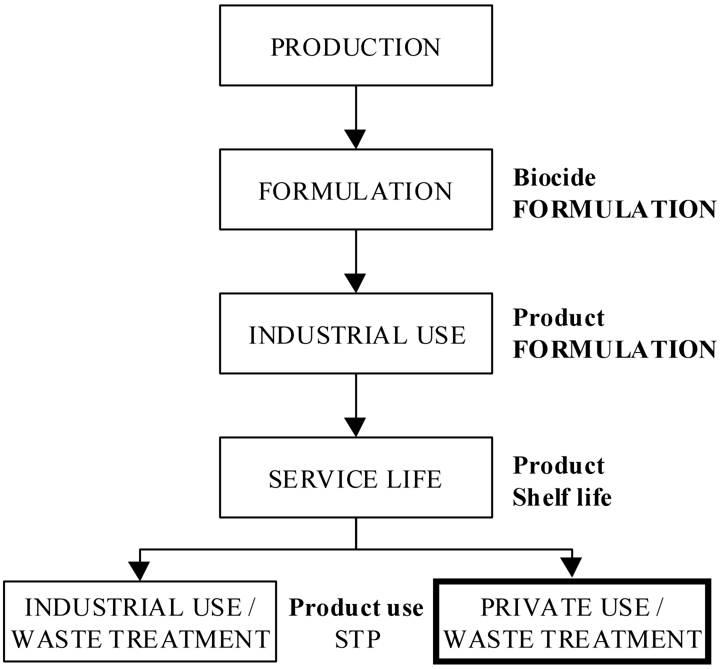
It should be noted that professional and non-professional use refers to the application of the product (life cycle stages 3 and 4 respectively). In-can preservatives for 6.3 and 6.4 end up in a product/article to a large extent. During the service life diffuse emissions will occur. For these preservatives the stage of waste treatment is of interest and in the case of paper also recycling.
The topics mentioned above are discussed separately below.

6.1 Washing and cleaning fluids, human hygienic products and cosmetics

The preservatives used in washing and cleaning fluids as well in shampoos, soaps and similar products will be released to wastewater at the stage of private use or – in the case of washing and cleaning fluids for professional use at the stage of industrial use ("processing"). It is doubtful whether the notifier will (and can) distinguish between professional and non-professional use. However, for special washing and cleaning purposes, e.g. for breweries and dairy industry, such notifications may exist. This has to be looked into in a future study. For the dimensioning of such industries that belong to the food and feed area data from the scenarios to be developed for product type 4 may be used then.
For diffuse releases from households the standard STP of EUSES is regarded as the point source for the releases. The same emission scenarios as for product type 1 (human hygiene biocidal products) can be used, presented in Tables 1.1 and 1.2. For the scenario based on the consumption the pick-list presented in Table 6.1 can be used for some products identified here. The data for average consumption are derived from Bremmer and Van Veen (2000) and from the emission scenario document for industrial categories 5 (Personal/domestic) and 6 (Public domain) in the TGD. The defaults for the fraction of the inhabitants have been generated by expert judgement.

The scheme for 6.1 (Washing and cleaning fluids, human hygienic products and cosmetics) is split in two parts. The 1st is for washing and cleaning fluids and the 2nd for human hygienic products and cosmetics:

I. Washing and cleaning fluids



II. Human hygienic products and cosmetics

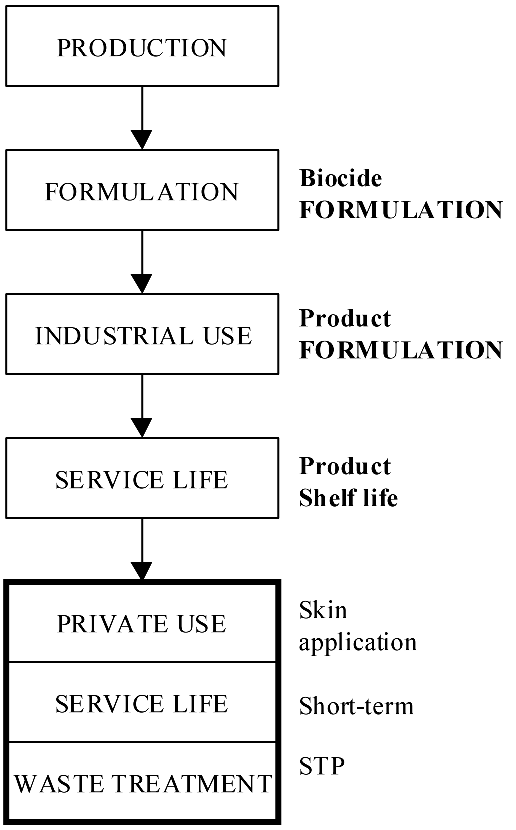


Table 6.1 Pick-list for average consumption per inhabitant per day, $Vform_{inh}$ *(*$ml.d^{-1}$*) &* $Qform_{inh}$ *(*$g.d^{-1}$*), and per application (*$Vform_{appl}$ *(ml) &* $Qform_{appl}$ *(g), number of applications, Nappl (*d^{-1}*) and the fraction of inhabitants using the product, Finh (-)*

Product	Vform_{inh} Qform_{inh}	Vform_{appl} Qform_{appl}	Nappl	Finh
Fabric washing				
Washing liquids	4.0			
Auxiliary products	0.6			
Fabric rinsing products	7.0			
Washing-up liquid				
Hand wash	7.0			
Machine wash	1.6			
Surface cleaning				
General purpose	5.0			
Lavatory cleaners	2.0			
Special purpose	0.8			
Scourers	1.5			
Human hygiene products				
Toilet soaps	1.6			
Shampoo	2.3			
Shower products	.	5.0	0.9	0.95
Bath products	.	17	0.2	0.15
Anti-perspirants/Deodorants:				
- aerosol	.	3.0	2	0.2
- stick, roll-on	.	0.5	1	0.8
Creams:				
General creams	.	1 $^{1)}$	1.5	0.2
Facial creams	.	0.8	2	0.1
Body lotion	.	7.5	1.5	0.2
Hand cream $^{1)}$	.	0.3	2	0.5
Suntan products:				
- creams	.	8.0	2	0.4
- lotions	.	10	2	0.4

$^{1)}$ Expert judgement

Table 6.1 Pick-list for average consumption per inhabitant per day, $Vform_{inh}$ (ml.d^{-1}) & $Qform_{inh}$ (g.d^{-1}), and per application ($Vform_{appl}$ (ml) & $Qform_{appl}$ (g), number of applications, Nappl (d^{-1}) and the fraction of inhabitants using the product, Finh (-) (continued)

Product	$Vform_{inh}$ $Qform_{inh}$	$Vform_{appl}$ $Qform_{appl}$	Nappl	Finh
Cosmetics				
Hair conditioner ("cream rinse")	.	14	0.2	0.3
Hair conditioner	.	2.7	0.75	0.3
Hair gel	.	2.9	1	0.2
Permanent wave fluid:				
- curling liquid	.	80	0.01	0.1
- fixing liquid	.	80	0.01	0.1
Eye shadow	.	0.01	2	0.3
Mascara	.	0.025	1	0.2
Eye liner	.	0.005	1	0.1
Lipstick, lip ointment	.	0.1 [2)]	4	0.3

[1)] Expert judgement

6.2 Detergents

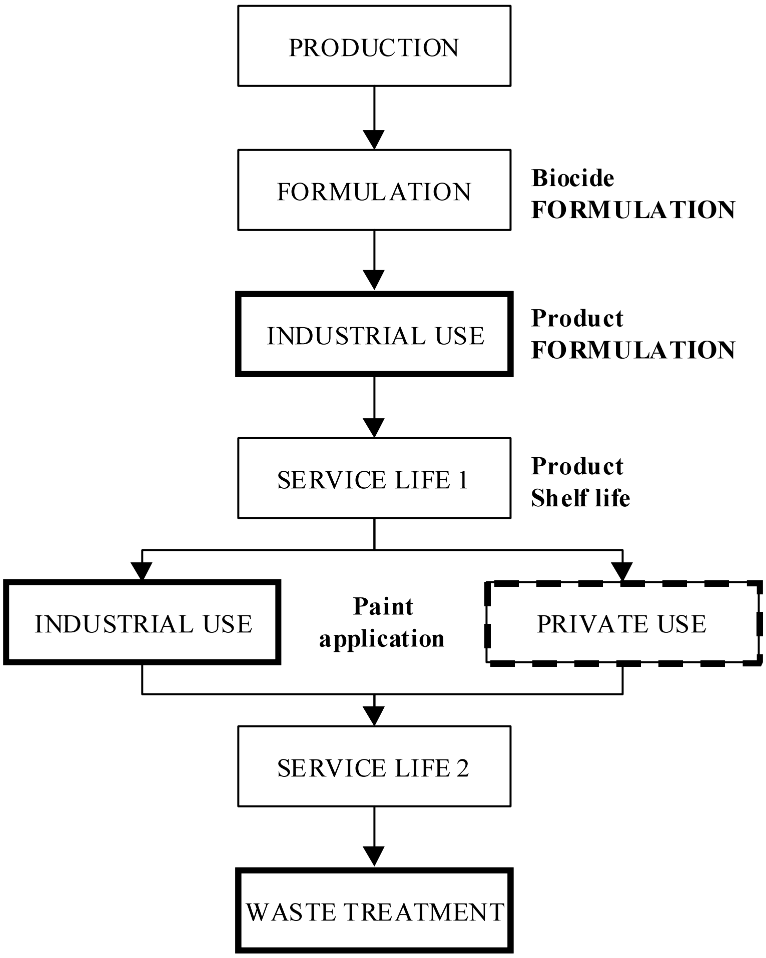
A detergent can be defined as 1) any of numerous synthetic water-soluble or liquid organic preparations that are chemically different from soaps but are able to emulsify oils, hold dirt in suspension, and act as wetting agents and 2) an oil-soluble substance that holds insoluble foreign matter in suspension and is used in lubricating oils and dry-cleaning solvents (Britannica, 2001)

Detergents belonging to the 1st definition have already been treated in section 6.1. Detergents used in lubricating oils of the 2nd definition belong to sections 6.5 and 6.6. Dry-cleaning solvents contain detergents but do not have to be preserved, as they do not contain water.

The scheme for the life cycle stages is not presented here, as it is the same as for 6.1 (Washing and cleaning).

6.3 Paints and coatings

In-can preservatives serve another goal than film preservatives in paints and coatings but the emission pattern will be exactly the same. However, in-can preservatives will only be added to water-based coating products whereas film preservatives may be added to solvent based coating products as well. For the fraction of the preservative in the product before application, $Fsubst\_prod_i$, the default value of 0.02 is used (Van der Poel, 1999b). The stages of the life cycle of interest in this report are the application stages 2 (formulation), 3 (industrial use) and 4 (private use), service life, and life cycle stages 5a (waste treatment), and 5b (recycling). Service life has not been investigated; so, no specific attention is given to this stage in this report. Recycling may be a potential stage for some painted articles (e.g. steel or aluminium) but has not been investigated yet.
The scheme for the life cycle stages is presented below. Though private use is discussed in a separate paragraph no emission scenario is presented.



6.3.1 Formulation

The TGD includes an emission scenario document for industrial category 14 (Paints, lacquers and varnishes industry). This emission scenario document gives emission factors for several types of industrial paint formulations. The general scenario approach of EUSES of EUSES can be applied; the emission scenario of the TGD is presented in Table 6.2. The relevant information from the emission scenario document is presented in Table 6.3. Volatile substances are defined as having a vapour pressure >10 Pa at 23 °C and a water-soluble substances as having a water solubility >1000 $mg.l^{-1}$. However, this emission scenario document does not supply default values to establish the size of a point source for emission estimations at the local scale. For that purpose the B-tables for industrial category 14 of the TGD may be used presented here in Table 6.4. The tonnage in the table, $TONNAGEreg_{form}$, can be considered the tonnage formulated in the Netherlands. It should be noted that the regional tonnage, TONNAGEreg, is corrected for the calculation of the fraction of the main source and the number of emission days by the concentration of the substance in the formulation $Fchem_{form}$. The concentration in the paint or coating product has to be supplied by the notifier. The correction occurs according to the formula:

$$\text{TONNAGEreg}_{\text{form}} = \frac{1}{\text{Fchem}_{\text{form}}} * \text{TONNAGEreg} \qquad (6.1)$$

Table 6.3 Emission factors to air ($F_{2,air}$) and (waste)water ($F_{2,water}$) for the formulation of some types of paint and coating products that are likely to contain in-can preservatives. I = volatile, II = non-volatile & water soluble and III = non-volatile & non-water soluble

Type of product/application	I		II		III	
	$F_{2,air}$	$F_{2,water}$	$F_{2,air}$	$F_{2,water}$	$F_{2,air}$	$F_{2,water}$
Furniture (general)	0.01	0.01	0	0.01	0	0.01
Wood lacquer	0.01	0.02	0	0.02	0	0.02
Coil coating	0.01	0	0	0.01	0	0.01
Can coatings general	0.03	0	0	0	0	0
2 piece can external white enamel	0.015	0	0	0	0	0
OEM car manufacturing	0.03	0	0	0	0	0
Car refinish	0.03	0	0	0	0	0

Table 6.2 Emission scenario for new and existing substances that is used for calculating the releases of preservatives used in paints at the stage of (paint) formulation based on the annual tonnage applied

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
A)			
Relevant tonnage in the region for this application (tonnes.yr^{-1})	TONNAGEreg 1)		O
B)			
Relevant tonnage in the EU for this application (tonnes.yr^{-1})	TONNAGE 1)		O
Fraction for the region (-)	$Fprodvol_{reg}$	0.1	D
A + B)			
Fraction of the tonnage released to compartment *j* during formulation (-)	$F_{2,j}$ 2)		D [2.4]
Code for high production volume chemical (yes/no)	HPVC	no	D
Fraction of the main local source (-)	$Fmainsource_i$ 2)		D [2.5]
Number of emission days per year (d.yr^{-1})	$Temission_i$ 2)		D [2.5]

Output:

$Elocal_{2,air}$ = Emission rate to air (kg.d^{-1}) 2)

$Elocal_{2,water}$ = Emission rate to wastewater (kg.d^{-1}) 2)

Intermediate calculation:

B)

Relevant tonnage in the region for this application (tonnes.yr^{-1})

$$TONNAGEreg = Fprodvol_{reg} * TONNAGE \qquad (6.2)$$

End calculations:

A + B)

$$Elocal_{2,air} = TONNAGEreg * 10^3 * Fmainsource_2 * F_{2,air} / Temission \qquad (6.3)$$

$$Elocal_{2,water} = TONNAGEreg * 10^3 * Fmainsource_2 * F_{2,water} / Temission \qquad (6.4)$$

---

1) In principle this should be TONNAGE, or respectively TONNAGEreg, to identify usage in product *k* but this is not shown just as in the EUSES documentation.

2) The subscript "i" refers to the stage of the life cycle, i.e. "2" for formulation and "3" for industrial use (processing) in conformity with EUSES 1.0 and USES 3.0.

Table 6.4 Fraction of the main source, Fmainsource$_2$ (-), and number of emission days, Temission$_2$ (d), for the formulation stage of paints and coatings with in-can preservatives based on the corrected regional tonnage, TONNAGEreg$_{form}$ (tonnes.yr^{-1}), of the biocide

TONNAGEreg$_{form}$	Fmainsource$_2$	Temission$_2$
HPVC[1] = yes	1	300
< 3,500		
3,500 – 10,000	0.8	300
10,000 – 25,000	0.7	300
25,000 – 50,000	0.6	300
≥ 50,000	0.4	300
HPVC[1] = no		
< 5	1	20
5 – 50	1	60
50 – 100	1	2 * Fmainsource$_2$ * TONNAGEreg$_{form}$
100 – 500	0.8	Fmainsource$_2$ * TONNAGEreg$_{form}$
500 – 1000	0.6	0.5 * Fmainsource$_2$ * TONNAGEreg$_{form}$
≥ 1000	0.4	300

[1] HPVC is the code to specify if the substance is a so-called high production volume chemical

o

6.3.2 Industrial use

Industrial paint application may be carried out by professionals at a relatively small scale and in industries at a variable scale (from small to very large). Paints may be applied, for example, by brush, rollers or spraying. Emissions will vary depending on the way of application and – especially at techniques such as spraying – the abatement techniques applied. As paint application is not a typical biocide application no emission scenarios have been developed specifically. For emission estimation the scenarios for new and existing substances may be applied as presented in Table 6.2 (subscript $i = 3$). In the TGD an emission scenario document is found for industrial category 14 (Paints, lacquers and varnishes industry). The emission factors for the relevant paint types are presented in Table 6.5 analogous to the stage of formulation. For the fraction of the main source and number of emission days the generic B-table of the TGD may be used, which is presented in Table 6.6.

Table 6.5 Emission factors to air, $F_{3,air}$ (-), and (waste)water, $F_{3,water}$ (-), for the application of some types of paint and coating products that are likely to contain in-can preservatives. I = volatile, II = non-volatile & water soluble and III = non-volatile & non-water soluble

Type of product/application	I		II		III	
	$F_{3,air}$	$F_{3,water}$	$F_{3,air}$	$F_{3,water}$	$F_{3,air}$	$F_{3,water}$
Furniture (general)	0.97	0.01	0	0.03	0	0.03
Wood lacquer	0.92	0.05	0	0.05	0	0.05
Coil coating	0.01 [1)]	0.01	0	0.01	0	0.01
Can coatings (general)	0.94	0	0	0	0	0
2 piece can external white enamel	0.965	0	0	0	0	0
OEM car manufacturing	0.97	0	0	0	0	0
Car refinish	0.97	0	0	0	0	0.01

[1)] Assuming treatment of flue gases (0.98 if no treatment)

Table 6.6 Fraction of the main source, $Fmainsource_3$ (-), and number of number of emission days, $Temission_3$ (d), for paints and coatings with in-can preservatives based on the corrected regional tonnage, $TONNAGEreg_{form}$ (tonnes.yr^{-1}), of the biocide at the stage of industrial use

$TONNAGEreg_{form}$	$Fmainsource_3$	$Temission_3$
< 10	0.9	20 * $Fmainsource_3$ * $TONNAGEreg_{form}$
10 – 50	0.6	6.66 * $Fmainsource_3$ * $TONNAGEreg_{form}$
50 – 300	0.3	3.33 * $Fmainsource_3$ * $TONNAGEreg_{form}$
300 – 5,000	0.15	300
5,000 – 25,000	0.1	300
≥ 25,000	0.05	300

6.3.3 Private use

For this stage no emission scenario document is available. The release tables of the TGD do not contain use category 39 (Biocides, non-agricultural) at all. There is also no information on the amount of (water-based) coating products that is released with wastewater at cleaning of brushes and other tools and materials used.

6.3.4 Waste treatment

For the emission scenario of the model landfill the required defaults for the input data of Table 24.2 are derived from Van der Poel (1996b) and presented in Table 6.7.

Table 6.7 Default settings for the input parameters of the model for preservatives applied in waterborne coatings at landfilling

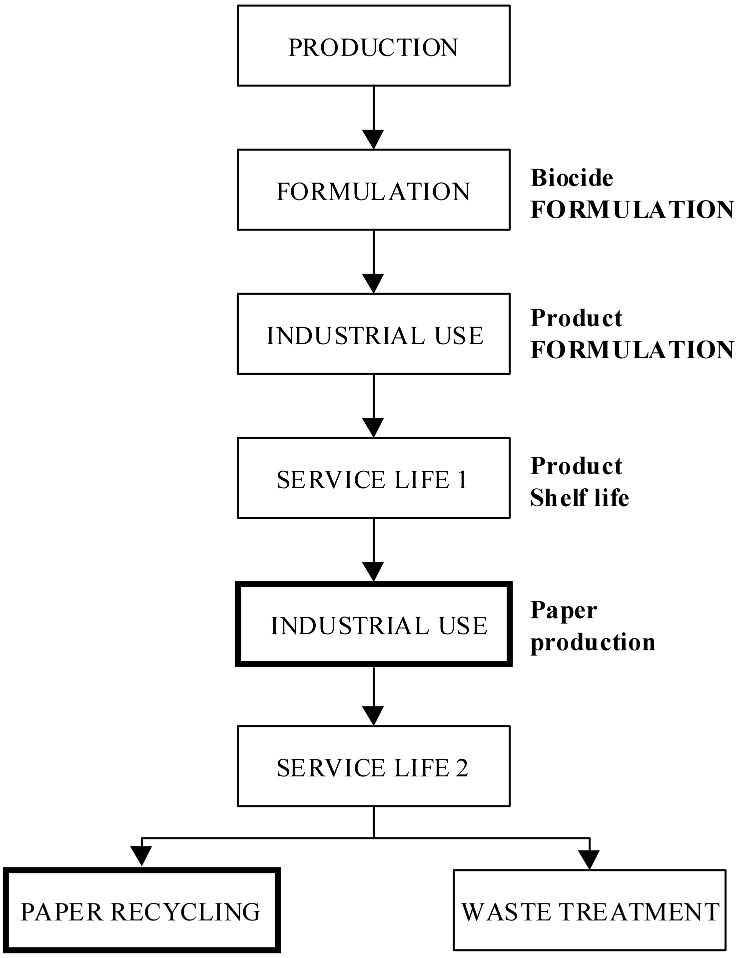
Variable/parameter (unit)	Symbol	Default
Fraction of preservative (by weight) in product before application (-)	$Fsubst\_prod_i$	0.02
Quantity of product i in the region (ktonnes.yr^{-1})	$Qreg\_prod_i$	210
Fraction of product with a preservative added (-)	$Fpres\_prod_i$	0.8
Penetration factor (-)	$Fpenetr_i$	0.25
Fraction lost due to diffuse releases (-)	$Fdiff_i$	0.25
Fraction lost due to degradation (-)	$Fdeg_i$	0
Fraction of product waste landfilled (-)	$Flandf_i$	0.75
Fraction of total waste landfilled (-)	$Flandf_{total}$	0.6

6.4 Fluids used in paper, textile and leather production

For the use of in-can preservatives in fluids used in paper, textile and leather production a separate emission scenario document has been prepared for the EUBEES working group (Tissier and Migné, 2001; Tissier, Chesnais and Migné, 2001; Tissier and Chesnais, 2001). The three application fields are treated in the next three subsections.

6.4.1 Fluids used in paper production

The scheme of the life cycle stages is presented below.



The emission scenarios in the emission scenario document on paper coating and finishing (Tissier and Migné, 2001a) comprise life cycle stages 3 ("processing", industrial use) and 5 (paper) recycling. For life cycle stage 3 the emission scenario for air releases from the drying sections after size-pressing is presented in Table 6.8 and the accompanying pick-list for the daily production volumes in Table 6.9. This pick-list is also used for the emission scenario for the releases to wastewater from "broke" in the paper machine at stock preparation; this emission scenario is presented in Table 6.10. Table 6.11 presents the pick-list for the degree of closure of the water system. For life cycle stage 5b, paper recycling, the emission scenario is presented in Table 6.12. The accompanying pick-list for the paper-recycling rate for various types of paper is presented in Table 6.13. It should be noted that for product type 6 no default values are present yet. A pick-list for the various products used might be developed in future. The emission scenarios of Tissier and Migné (2001) have been modified somewhat.

Table 6.9 Pick-list for the daily production volumes, Qpaper (tonnes.d^{-1}), used as defaults for the model site for various types of paper (Böhm et al., 1997)

Type of paper		Qpaper
Newsprint		449
Printing and writing paper		66
Paper and cardboard for packaging		237
Paper for sanitary and domestic use (tissue paper)		222
Special and industrial paper (all types)		102
Cardboard	- flat cardboard	329
	- corrugated cardboard	329

Table 6.8 Emission scenario for calculating the releases from drying sections after size-pressing and coating for product type 6 biocides

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of paper produced per day (tonnes.d^{-1})	Qpaper		P [6.9]
[A]			
Quantity of active substance applied per tonne of paper (kg.tonne^{-1}) 1)	Qsubst		S
[B]			
Quantity of product with preservative applied per tonne of paper for each application step (l.tonne^{-1}) 1)	Vform		S 1)
Concentration of active substance in the biocidal product (g.l^{-1}) 1)	Cform		S 1)
[A + B]			
Fraction evaporated (-) if volatility (Pa at 100 ºC):	Fevap		D
≥ 133		0.0025	
13.3 – 133		0.0005	
1.3 – 13.3		0.0001	
< 1.3		0	
Fraction decomposed during drying (-)	Fdecomp	0	D

Output:

$Elocal_{3,air}$ = Local emission of active substance to air for one treatment step (kg.d^{-1})

Intermediate calculation:

[B]

Quantity of active substance applied per tonne of paper (kg.tonne^{-1})

$$Qsubst = Vform * Cform * 10^{-3} \tag{6.5}$$

End calculation:

$$Elocal_{3,air} = Qpaper * Qsubst * Fevap * (1-Fdecomp) \tag{6.6}$$

---

1) The notifier of an in-can preservative only has to specify the quantity to be used in the biocidal formulation it sells to paper industry. The formulator will prescribe how much of the fluid should be used per tonne of paper. No defaults (for a pick-list for instance) have been generated yet.

Table 6.10 Emission scenario for calculating the releases from "broke" for product type 6 biocides

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]

Input:			
Quantity of coated paper produced per day (tonnes.d^{-1})	Qpaper		P [6.9]
[A]			
Quantity of active substance applied per tonne of paper for each application step (kg.tonne^{-1})	Qsubst		S
[B]			
Quantity of product with preservative applied per tonne of paper for each application step (l.tonne^{-1})	Vform		S [1)]
Concentration of active substance in the product (g.l^{-1})	Cform		S [1)]
[A + B]			
Degree of closure of the water system (-)	Fclosure		P [6.11] [2)]
Fraction of coated broke produced compared to overall production (-)	Fbroke	0.2	D
Fixation fraction (-)	Ffix	0	D

Output:

$Elocal_{3,water}$ = Local emission of active substance to wastewater (kg.d^{-1})

Intermediate calculations:

[B]

Quantity of active substance applied per tonne of paper (kg.tonne^{-1})

$$Qsubst = Vform * Cform * 10^{-3} \qquad (6.7)$$

End calculations:

$$Elocal_{3,water} = Qpaper * Qsubst * Fbroke * (1 - Ffix) * (1 - Fclosure) \qquad (6.8)$$

[1)] The notifier of an in-can preservative only has to specify the quantity to be used in the biocidal formulation it sells to paper industry. The formulator will prescribe how much of the fluid should be used per tonne of paper. No defaults (for a pick-list for instance) have been generated yet.

[2)] The default values are the averages of the ranges presented in Tissier and Migné (2001)

Table 6.12 Emission scenario for calculating the releases from paper recycling

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Relevant tonnage in EU for this application (tonnes.yr^{-1})	TONNAGE		S

Relevant tonnage in the region for this application (tonnes.yr^{-1})	TONNAGEreg		O
Fraction of the region (-)	$Fprodvol_{reg}$	0.1	D [1]
Fraction of main source (-)	$Fmainsource_5$	0.1	D
Fraction of paper recycled (-)	$Frec_{paper}$	0.5	P [6.13]
Fraction of preservatives released at deinking (-)	Fdeink	1	D
Fraction decomposed during deinking (-)	Fdecomp	0	D
Fraction removed from wastewater (-)	Fprelim		D
during preliminary on-site treatment:			
- easily soluble (> 1000 mg.l^{-1})		0.1	
- poorly soluble($\leq$ 1000 mg.l^{-1})		0.8	
Number of working days (d.y^{-1})	Nwdays	320	D

Output:

$Elocal_{5,water}$ = Local emission of active substance to wastewater (kg.d^{-1})

Model calculations:

$$TONNAGEreg = Fprodvol_{reg} * TONNAGE \tag{6.9}$$

$$Elocal_{5,water} = TONNAGEreg * Frec * Fmainsource_5 * Fdeink * (1 - Fprelim) * (1 - Fdecomp) * 1\,000 / Nwdays \tag{6.10}$$

---

[1] For new substances or existing substances produced at low volumes and which are not used homogeneously through out the EU, it can be assumed in a first approach that $Fprodvol_{reg}$ = 1.

Table 6.11 Pick-list for the degree of closure of the water system, Fclosure, (-) used as defaults for various types of paper [1)]

Type of paper		Fclosure
Newsprint		0.75
Printing and writing paper		0.55
Paper and cardboard for packaging		0.95
Paper for sanitary purposes (tissue paper)		0.55
Special and industrial paper (all types)		0.55
Cardboard	- flat cardboard	0.95
	- corrugated cardboard	0.95

[1)] The default values are the averages of the ranges presented in Tissier and Migné (2001)

Table 6.13 Pick-list for the fraction of recycled paper, $Frec_{paper}$, (-), used as defaults for various types of paper

Type of paper		$Frec_{paper}$
Newsprint		0.58
Printing and writing paper		0.11
Paper and cardboard for packaging		0.33
Paper for sanitary purposes (tissue paper)		0.46
Special and industrial paper (all types)		0.34
Cardboard	- flat cardboard	0.90
	- corrugated cardboard	0.92

6.4.2 Fluids used in textile production

The scheme of the life cycle stages is presented on the next page. The stage of waste treatment is directly connected to the industrial use of products with the biocide assessed (as an in-can preservative); this is caused by the fact that it is expected that almost the whole amount of the biocide will be emitted into the wastewater (default for fixation fraction is zero).

Tissier, Chesnais and Migné (2001) do not mention the use of in-can preservatives in fluids for textile production. This is not surprising as most aqueous fluids used will not have organic chemicals in them. One of the exceptions is the use of detergents but the application of in-can preservatives in this kind of products belongs to section 6.2. However, no specific emission scenario is presented in that section. Therefore, a simple scenario is presented here in Table 6.14. The scenario assumes that an average amount of fluid per tonne of product can be established in some way. For the fixation fraction 0 (zero) has been assumed. It should be noted that the user's instructions only have to contain the prescription of the in-can preservative in the product (fluid); it will not have to prescribe the quantity of product in textile processing.

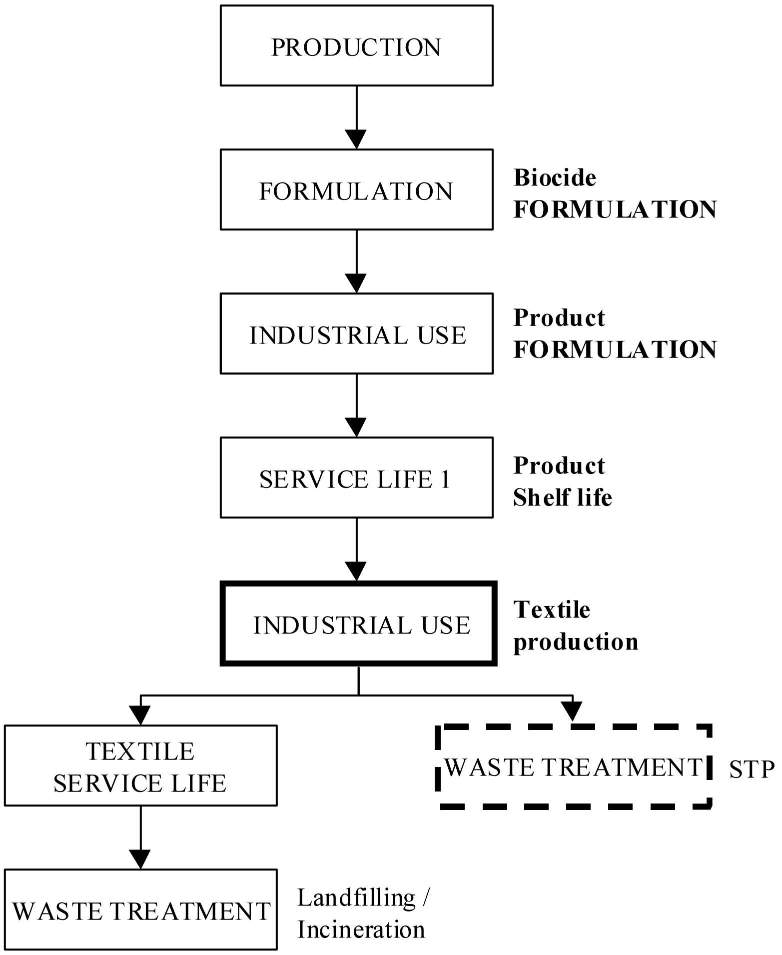


Table 6.14 Emission scenario for calculating releases from fluids with in-can preservatives used in textile production

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of fibres / fabrics treated per day (tonnes.d^{-1})	Qfibres		P [9.3]
[A]			
Quantity of active substance applied per tonne of fibres / fabrics for treatment step *i* (kg.tonne^{-1}) [1]	$Qsubst_i$		S
[B]			
Concentration of the preservative in the fluid (g.l^{-1})	$Cform_i$		S
Quantity of fluid used per tonne of fibres / fabric (l.tonne^{-1})	$Vform_i$	- [2]	D/P
[A + B]			
Fixation fraction (-)	Ffix	0	D

Output:

$Elocal_{3,water}$ = Local emission of active substance to wastewater (kg.d^{-1})

Intermediate calculations:

[B]

Quantity of active substance applied per tonne of fibres / fabrics for treatment step *i* (kg.tonne^{-1})

$$Qsubst_i = Vform_i * Cform_i * 10^{-3} \quad (6.11)$$

[A + B]

Local emission of active substance to wastewater for treatment step *i* (kg.d^{-1})

$$Elocal\_water_i = Qfibres * Qsubst_i * (1 - Ffix) \quad (6.12)$$

End calculation:

$$Elocal_{3,water} = \sum_{i=1}^{n} Elocal\_water_i \quad (6.13)$$

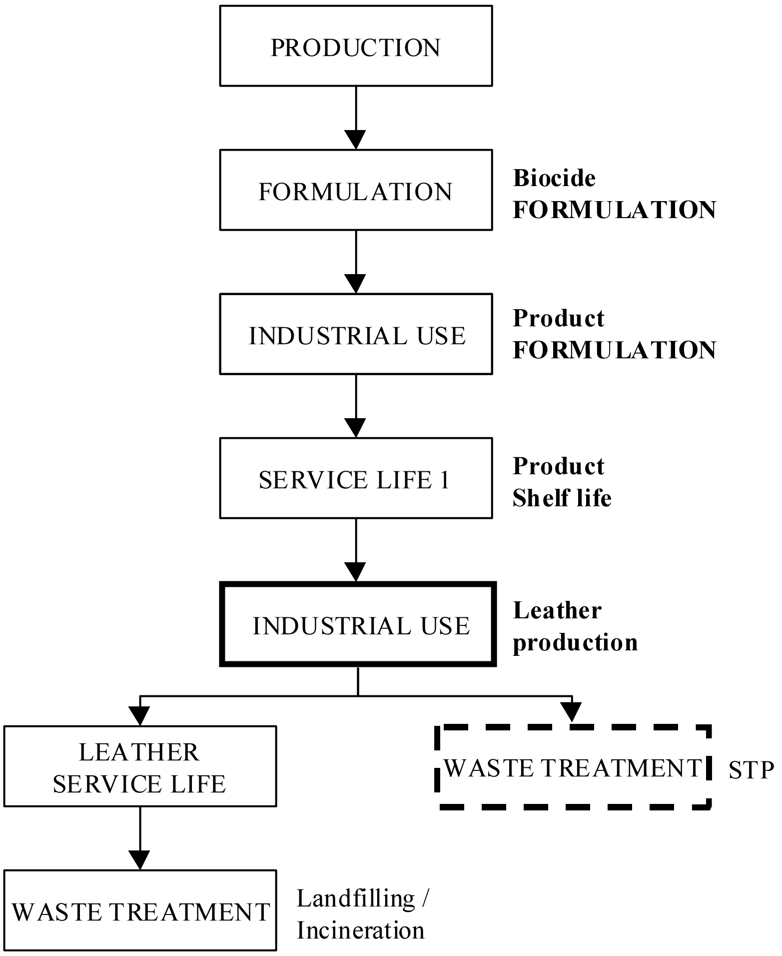
---

[1] *i* represents a treatment step (desizing/scouring, dyeing, finishing)

[2] The default value will depend on the function of preserved product used. A pick list might be developed for common products in textile processing in future.

6.4.3 Fluids used in leather production

The scheme of the life cycle stages is presented below. The stage of waste treatment connected directly to the industrial use of products with the biocide assessed (as an in-can preservative); this is caused by the fact that it is expected that almost the whole amount of the biocide will be emitted into the wastewater (default for fixation fraction is zero).



Tissier and Chesnais (2001) do not mention the use of in-can preservatives in fluids for leather production either. It is not likely that fluids with in-can preservatives will be used at all. However, as for textile production an emission scenario is presented in Table 6.15. For the fixation fraction 0 (zero) has been assumed. The default values for the quantities of biocide used per tonne of leather are also derived from Tissier and Chesnais (2001) and presented in Table 6.16.

Table 6.15 Emission scenario for calculating releases from fluids with in-can preservatives used in leather production

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of treated raw hides per day (tonnes.d^{-1})	Qleather	15	D
[A]			
Quantity of active substance applied per tonne of leather for treatment step *i* (kg.$tonne^{-1}$) [1]	$Qsubst_i$		P [6.15]
[B]			
Quantity of fluid used per tonne of raw hides (l.$tonne^{-1}$)	$Vform_i$	- [2]	S/P
Concentration of the preservative in the fluid (mg.l^{-1})	$Cform_i$		S
[A + B]			
Fixation fraction (-)	Ffix	0	D

Output:
$Elocal_{3,water}$ = Local emission of active substance to wastewater (kg.d^{-1})

Intermediate calculations:
[B]
Quantity of active substance applied per tonne of leather for treatment step *i* (kg.$tonne^{-1}$)

$$Qsubst_i = Vform_i * Cform_i * 10^{-6} \tag{6.14}$$

Local emission of active substance to wastewater for treatment step *i* (kg.d^{-1})

$$Elocal\_water_i = Qleather * Qsubst_i * (1 - Ffix) \tag{6.15}$$

End calculation:

$$Elocal_{3,water} = \sum_{i=1}^{n} Elocal\_water_i \tag{6.16}$$

---

[1] *i* represents a treatment step (curing, soaking, pickling, tanning, finishing)

[2] The default value will depend on the function of preserved product used. A pick list might be developed for common products in leather production in future.

Table 6.16 Pick-list for the quantity of biocide used per tonne of leather, Qsubst$_i$ (kg.tonne^{-1}) for relevant process steps in leather production

Process step		Qsubst$_i$
Curing (salting)		5
Soaking		5
Pickling		5
Tanning	large hides	3
	small hides	5
Finishing		3

6.5 Lubricants

This application concerns the application in cooling-lubricants used in metalworking. For the preservation of the fluid to extend the shelf life the same biocide will work as the active ingredient to preserve the diluted fluid used at metalworking. The specific topic of is discussed at product type 13 (Metalworking-fluid preservatives) in Chapter 13.

6.6 Machine oils

Only Van Dokkum *et al.* (1998) mentions the application of in-can preservatives in machine oils. No information could be obtained on (water-based) machine oils containing preservatives and use of such oils. So, no emission scenario has been developed.

6.7 Fuels

Many cases of microbial fouling and spoilage of fuels have been recorded for about 65 years (Hill, 1995). The common factor in all problems is the presence of water which, because of its higher density and immiscibility, will lie below the fuel as a discrete phase (Hill, 1995) a description of this topic was found. If biocides are used the solubility ratio in fuel and water is a critical parameter and an agent must be selected which has the correct solubility characteristics for the planned use (Hill, 1995). The same author specifies properties for antimicrobial agents for both water phase preservatives and fuel phase preservatives. The most important properties of these for emission scenarios are:

Fuel phase:
- combustible, leaving no ash or corrosive residues
- preferably contain no metal or halogen compounds

Water phase:
- an acceptable health impact toward the staff operating water drains and the public

Emissions into wastewater occur when the water phase of a storage is discharged into the sewer. No information was readily available on source sizes, preservatives used, etc. So, no emission scenario document has been produced yet.

7. Product type 7: Film preservatives

Film preservatives are used to preserve layers of materials such as paints and adhesives on a substrate during service life of these materials. The topics to be considered are:

7.1 Paints and coatings
7.2 Plastics
7.3 Glues and adhesives

Film preservatives for textile, leather, paper and plastics are treated in Chapter 9 at product type 9 (Fibre, leather, rubber and polymerised materials preservatives). The topics stated above are discussed in the following sections. In section 7.4 Paper and cardboard will be covered.

7.1 Paints and coatings

Product types 6 and 7 overlap as stated in Chapter 6 for paints and coatings. Therefore, the same emission scenarios as presented in subsections 6.3.1 (formulation), 6.3.2 (industrial use), and 6.3.4 (waste treatment) can be used. The default value for the fraction of product with preservative added in Table 6.9 is then: $Fprs\_prod_i = 0.6$.

7.2 Plastics

Plastics are polymerised materials and, therefore, overlaps with product type 9 (Fibre, leather, rubber and polymerised materials preservatives). So, this topic will be discussed into more detail in Chapter 9, section 9.3.

7.3 Glues and adhesives

Glues and adhesives are produced in a variety of types and for a variety of purposes. Large amounts are used for short-term applications and/or dry conditions (no microbial attack), for example cardboard packaging materials. In those adhesive products no or little preservatives will be used. For long term applications and/or moist conditions preservatives are required, for example plywood for outdoors use. Emissions may occur at application of the adhesives (life cycle stage 3), private use (life cycle stage 4), service life of the product with the adhesive, waste treatment (life cycle stage 5a) and recycling (life cycle stage 5b). The scheme of the life cycle stages is presented below. As can be seen from the scheme only the waste treatment stage has been covered by an emission scenario. This is the general emission scenario for a landfill. For the emission scenario of the model landfill the required defaults for the input data of Table 24.2 are presented in Table 7.1.

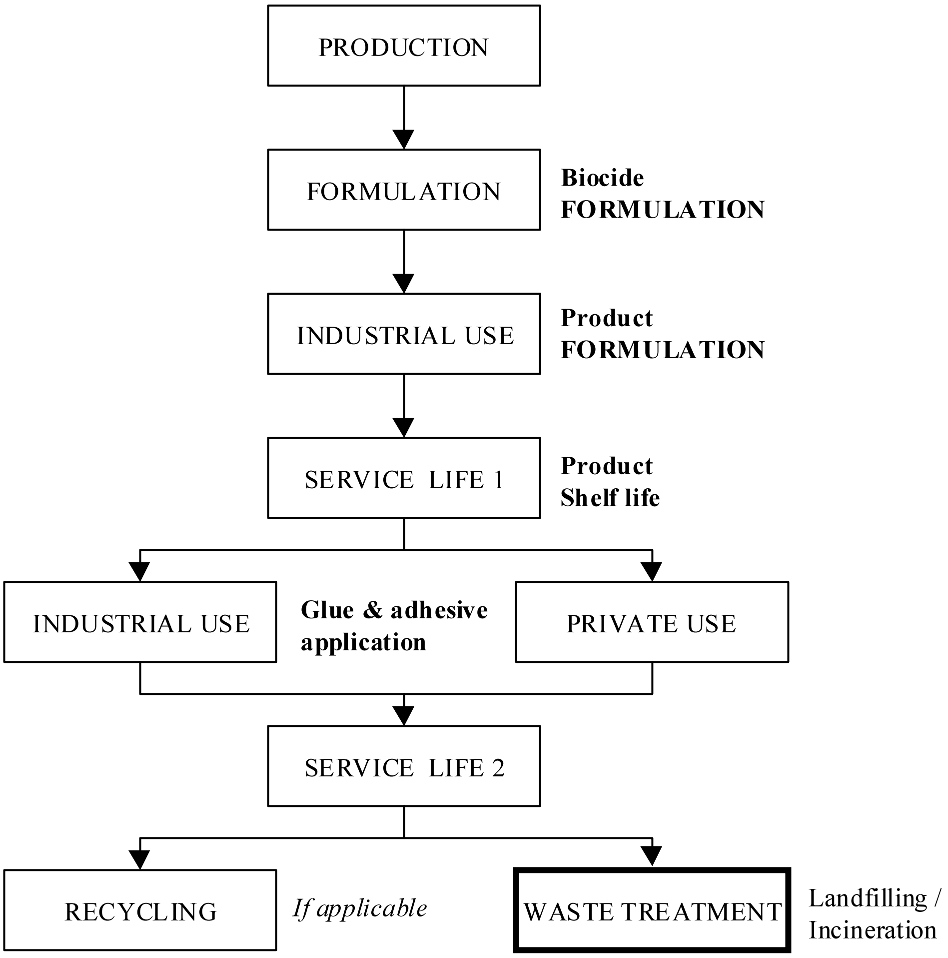

PRODUCTION
FORMULATION
Biocide FORMULATION
INDUSTRIAL USE
Product FORMULATION
SERVICE LIFE 1
Product Shelf life
INDUSTRIAL USE
Glue & adhesive application
PRIVATE USE
SERVICE LIFE 2
RECYCLING
If applicable
WASTE TREATMENT
Landfilling / Incineration

Table 7.1 Default settings for the input parameters of the model for preservatives applied in adhesives (I = water-based adhesives, II = dispersion adhesives) at landfilling

Variable/parameter (unit)	Symbol	Defaults:	
		I	II
Fraction of preservative (by weight) in product before application (-)	$Fsubst\_prod_i$	0.003	0.003
Quantity of product i in the region (ktonnes.yr^{-1})	$Qreg\_prod_i$	25	60
Fraction of product with a preservative added (-)	$Fpres\_prod_i$	0.8	0.8
Penetration factor (-)	$Fpenetr_i$	0.25	0.25
Fraction lost due to diffuse releases (-)	$Fdiff_i$	0.15	0.4
Fraction lost due to degradation (-)	$Fdeg_i$	0	0
Fraction of product waste landfilled (-)	$Flandf_i$	0.26	0.54
Fraction of total waste landfilled (-)	$Flandf_{total}$	0.6	0.6

7.4 Paper and cardboard

It is questionable whether film preservatives are used for paper (and cardboard). However it seems possible that coatings on paper have to be preserved. Anyway, the emission scenarios presented in Tissier and Migné (2001) provide a possibility for the evaluation of this product type. They follow the emission scenarios of Tables 6.8 up to and including 6.13. Only Tables 6.8 and 6.10 are different for the calculation of the quantity of active substance (active ingredient) per tonne of paper. Therefore, Tables 7.2 and 7.3 presented below replace them respectively. The scheme for the life cycle stages is the same as for product type 6 and is reproduced below.

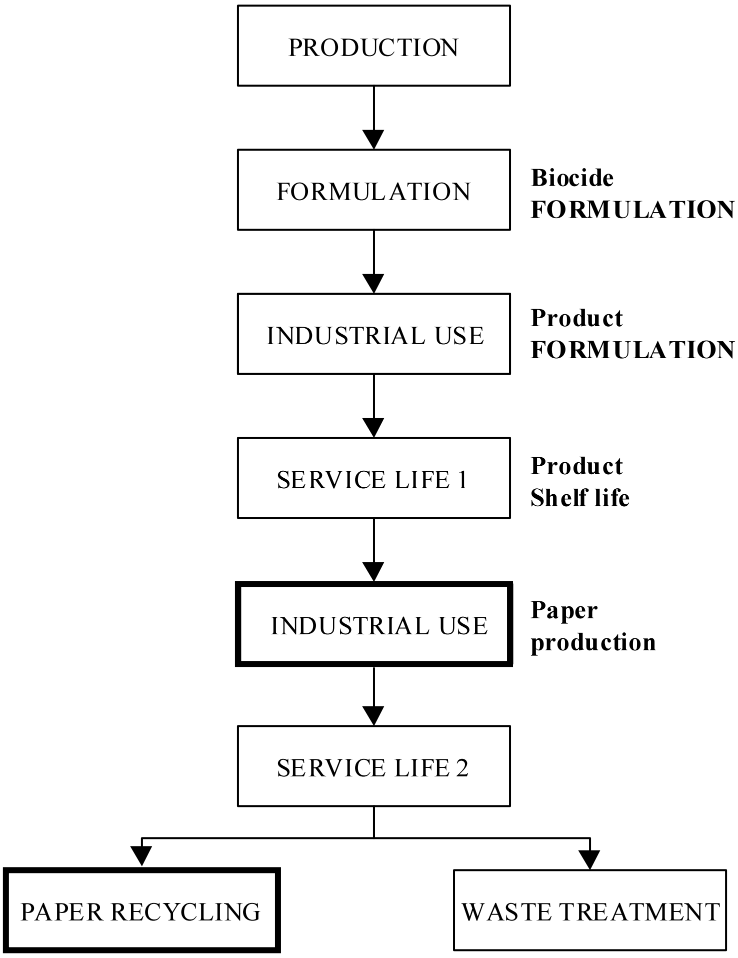


Table 7.2 Emission scenario for calculating the releases from drying sections after size-pressing and coating for product type 7 biocides

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of coated paper produced per day (tonnes.d^{-1})	Qpaper		P [6.9]
[A]			
Quantity of active substance applied per tonne of paper (kg.tonne^{-1})	Qsubst		S
[B]			
Quantity of product with preservative applied per tonne of paper (kg.tonne^{-1})	Qform		S
Concentration of active substance in the product (g.kg^{-1})	$Cform_{solid}$		S
[C]			
Quantity of product with preservative applied per tonne of paper (l.tonne^{-1})	Vform		S
Concentration of active substance in the product (g.l^{-1})	$Cform_{liquid}$		S
[A + B + C]			
Evaporation rate (-) if volatility (Pa at 100 ºC):	Fevap		D
≥ 133		0.0025	
13.3 – 133		0.0005	
1.3 – 13.3		0.0001	
< 1.3		0	
Decomposition rate during drying (-)	Fdecomp	0	S
Output:			
$Elocal_{3,air}$ = Local emission of active substance to air (kg.d^{-1})			

Table 7.2 Emission scenario for calculating the releases from drying sections after size-pressing and coating for product type 7 biocides (continued)

Intermediate calculations:

Quantity of active substance applied per tonne of paper ($kg.tonne^{-1}$)

[B]

$Qsubst = Qform * Cform_{solid} * 10^{-3}$ (7.1)

[C]

$Qsubst = Vform * Cform_{liquid} * 10^{-3}$ (7.2)

End calculation:

[A + B + C]

$Elocal_{3,water} = Qpaper * Qsubst * Fevap * (1-Fdecomp)$ (7.3)

Table 7.3 Emission scenario for calculating the releases from "broke" for product type 9 biocides

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of coated paper produced per day (tonnes.d^{-1})	Qpaper		P [Table 6.9]
[A]			
Quantity of active substance applied per tonne of paper (kg.tonne^{-1})	Qsubst		S
[B]			
Quantity of product with preservative applied per tonne of paper (kg.tonne^{-1})	Qform		S
Concentration of active substance in the product (g.kg^{-1})	Cform$_{solid}$		S
[C]			
Quantity of product with preservative applied per tonne of paper (l.tonne^{-1})	Vform		S
Concentration of active substance in the product (g.l^{-1})	Cform$_{liquid.}$		S
[A + B + C]			
Degree of closure of the water system (-)	Fclosure		P 1) [6.11]
Fraction of coated broke produced compared to overall production (-)	Fbroke	0.2	D
Fixation fraction (-) (cf. section 3)	Ffix	0	D
Output:			
Elocal$_{3,water}$ = Local emission of active substance to wastewater (kg.d^{-1})			

1) The default values are the averages of the ranges presented in Tissier and Migné (2001)

Table 7.3 Emission scenario for calculating the releases from "broke" for product type 9 biocides (continued)

Intermediate calculations:

Quantity of active substance applied per tonne of paper (kg.tonne^{-1})

[B]

$Qsubst = Qform * Cform_{solid} * 10^{-3}$ (7.4)

[C]

$Qsubst = Vform * Cform_{liquid} * 10^{-3}$ (7.5)

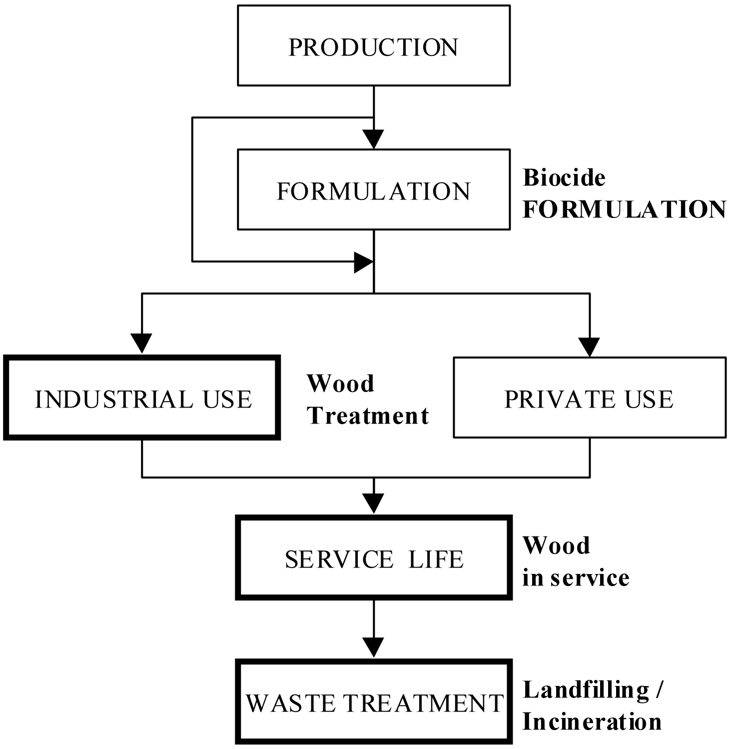
End calculation:

[A + B + C]

$Elocal_{3,water} = Qpaper * Qsubst * Fbroke * (1-Fclosure) * (1-Ffix)$ (7.6)

8. Product type 8: Wood preservatives

Wood preservatives may be applied preventive or curative. Preventive wood treatment may be carried out by impregnation, drenching/dipping or application with brush/roller/spray-gun. Curative treatment may consist of fumigation, brushing/spraying, pills or injection. A joint EU – OECD effort will produce an emission scenario document for all stages of the life cycle. This process started in 2000 and is expected to finish by the end of 2000. The scheme of the life cycle stages is presented below. As can be seen in the scheme formulation is not always an applicable stage of the life cycle. In this report the emission scenarios published in Luttik *et al.* (1993; 1995) and incorporated in USES 3.0 are presented in sections 8.1 up to and including 8.3 for the stage of the life cycles treated (bold boxes in the scheme).



At the moment an OECD Expert Group has reviewed two draft versions of the emission scenario document on wood preservatives. The second version is revised at this moment and will be sent to the Expert Group mid November 2001. If they approve the draft version 3 will be sent to the Biocides Steering Group and Task Force on Environmental Exposure Assessment of the OECD. If these groups give the green light the documents will be circulated to the OECD countries for review and comments (personal communication with M. Paneli at OECD (October 2001). The Emission scenario document includes:

Life cycle stage: Industrial use (preventive applications)

Automated spraying processes

Dipping/immersion processes
Vacuum-Pressure and Double-Vacuum/Low Pressure processes

Life cycle stage: Service life

Wood not covered, not in contact with ground, exposed to the weather or subject to frequent wetting:
- Fence
- Noise barrier
- House

Wood in contact with ground or fresh water and permanently exposed to wetting:
- Transmission pole
- Fence post
- Jetty in lake
- Sheet piling in waterway

Wood permanently exposed to salt water:
- Wharf

Life cycle stages: Industrial and private use (preventive and curative applications)

Fumigation indoors

Outdoor treatments:
- Brushing
- Injection
- Wrapping
- Termite control

8.1 Industrial use

The largest quantities of wood preservatives are used by industry in impregnation plants. The second largest use of wood preservatives is by the skilled trades, for example joineries with dipping installations. Private use of wood preservatives occurs widely spread with a comparatively small quantity.

The industrial application of wood preservatives may be divided in (Baumann et al., 2000):

Preventive application:

- Automated spraying
- Automated immersion
- Vacuum pressure
- Double vacuum
- Joinery: large-scale dipping

Curative application:

- Spraying indoors
- Brushing indoors
- Brushing outdoors
- Fumigation
- Injection indoors
- Injection outdoors

Luttik *et al.* (1993) presented emission scenarios for preventive applications (impregnation and drenching and dipping). For curative applications Luttik *et al.* (1993) presented one emission scenario for remedial timber treatment in buildings. These emission scenarios have been modified somewhat to bring them in-line with the other scenarios in this report.

8.1.1 Preventive application: Creosote impregnation

The scenarios for impregnation with creosote are presented in Tables 8.1 and 8.2. In Table 8.2 the defaults for parameters used by the distribution module of USES 3.0.

Table 8.1 Emission scenario for calculating the releases at wood impregnation with creosote (Luttik et al., 1993)

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Quantity of wood impregnated ($m^3.d^{-1}$)	Qwood	50	D
Quantity of creosote per m^3 of wood ($kg.m^{-3}$)	Qform	80	D
Fraction of substance in creosote (-)	Fcreos	0.05	D
Fraction released to water/soil (-) if the water solubility is ($mg.m^{-3}$):	Fwater/soil		D
< 0.25		0.000 1	
0.25 – 1		0.001 5	
1 – 50		0.003	
50 – 100		0.015	
≥ 100		0.03	
Fraction released to wastewater (-)	$F_{3,water}$	0.99	D
Fraction released to air (-) if the vapour pressure is (Pa):	$F_{3,air}$		S/D
< 0.005		0.000 5	
0.005 – 0.05		0.005	
0.05 – 0.5		0.01	
0.5 – 1.25		0.05	
1.25 – 2.5		0.1	
2.5 – 15		0.2	
≥ 15		0.25	
Storage density of treated wood per m^2 ($m^3.m^{-2}$)	Dstorage	0.76	D

Output:

$Elocal_{3,water}$ = Local emission of active substance to wastewater ($kg.d^{-1}$)
$Elocal_{3,air}$ = Local emission of active substance to air ($kg.d^{-1}$)
$DOSE_{pest}$ = Dosage of active substance per m^2 soil surface for 1 storage period (mg/m^2)

Table 8.1 Emission scenario for calculating the releases at wood impregnation with creosote (Luttik et al., 1993) (continued)

Intermediate calculations:

Fraction of the total fraction emitted to water/soil to soil (-)

$$F_{3,soil} = 1 - F_{3,water} \quad (8.1)$$

End calculations:

$$Elocal_{3,water} = Qwood_{creos} * Qform * Fcreos * Fwater/soil * F_{3,water} \quad (8.2)$$

$$Elocal_{3,air} = Qwood_{creos} * Qform * Fcreos * F_{3.air} \quad (8.3)$$

$$DOSE_{pest} = Dstorage * Qform * Fcreos * Fwater/soil * F_{3,soil} \quad (8.4)$$

Table 8.2 Default values of parameters required for distribution models of USES 3.0

Parameters required (unit)	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Number of emission days (d)	Temission	$Temission_{creos}$	$Temission_3$	250
Fraction of dosage that reaches the soil (-)	F_{soil}	-	Fsoil	1 [1)]
Application interval (d)	$T_{interval}$	$T_{interval,creos}$	Tint	70
Number of applications in one year (-)	N_{appl}	$N_{appl,creos}$	Nappl	5
Mixing with soil (yes/no)	MIX	-	MIX	no

[1)] This fraction to soil is set to one since this is the fraction of the calculated dose. In $DOSE_{pest}$ the fraction of the total release directed to soil is already accounted for by $Fwater/soil * F_{3,soil}$.

8.1.2 Preventive application: Salt impregnation

The emission scenarios for impregnation with salts are presented in Tables 8.3 and 8.4. In Table 8.4 the defaults are presented for parameters used by the distribution module of USES 3.0

Table 8.3 Emission scenario for calculating the releases at wood impregnation with salts (Luttik et al., 1993)

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Quantity of wood impregnated ($m^3.d^{-1}$)	Qwood	50	D
Quantity of salt per m^3 of wood ($kg.m^{-3}$)	Qsubst	2	D
Fraction released to wastewater/soil (-)	Fwater/soil	0.0001	D
Fraction released to wastewater (-)	$F_{3,water}$	0.99	
Storage density of treated wood per m^2 ($m^3.m^{-2}$)	Dstorage	0.76	D

Output:

$Elocal_{3,water}$ = Local emission of active substance to wastewater ($kg.d^{-1}$)

$DOSE_{pest}$ = Dosage of active substance per m^2 soil surface for 1 storage period ($kg.m^{-2}$)

Intermediate calculations:

Fraction of the total fraction emitted to water/soil to soil (-)

$$F_{3,soil} = 1 - F_{3,water} \quad (8.5)$$

End calculations:

$$Elocal_{3,water} = Qwood_{salt} * Qsubst * Fwater/soil * F_{3,water} \quad (8.6)$$

$$DOSE_{pest} = Qwood_{salt} * Qsubst * Fwater/soil * F_{3,soil} \quad (8.7)$$

Table 8.4 Default values of parameters required for distribution models of USES 3.0

Parameters required (unit)	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Number of emission days (d)	Temission	$Temission_{salt}$	$Temission_3$	250
Fraction of dosage that reaches the soil (-)	F_{soil}	-	Fsoil	1 [1)]
Application interval (d)	$T_{interval}$	$T_{interval,salt}$	Tint	36
Number of applications in one year (-)	N_{appl}	$N_{events,salt}$	Nappl	10
Mixing with soil (yes/no)	MIX	-	MIX	no

[1)] This fraction to soil is set to one since this is the fraction of the calculated dose. In $DOSE_{pest}$ the fraction of the total release directed to soil is already accounted for by $F_{ws,salt} * F_{s,salt}$.

8.1.3 Preventive application: Drenching and dipping

The emission scenarios for drenching and dipping are presented in Tables 8.5 and 8.6. In Table 8.6 the defaults for parameters used by the distribution module of USES 3.0

Table 8.5 Emission scenario for calculating the releases at drenching and dipping (Luttik et al., 1993)

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Quantity of wood impregnated ($m^3.d^{-1}$)	Qwood	2	D
Quantity of active ingredient per m^3 of wood ($kg.m^{-3}$)	Qsubst	1	D
Fraction released to wastewater/soil (-)	Fwater/soil	0.000 5	D
Fraction released to wastewater (-)	$F_{3,water}$	0.9	D
Fraction released to air (-) if vapour pressure at 20 °C is:	$F_{3,air}$		D
< 0.005		0.001	
0.005 – 0.05		0.01	
0.05 – 0.5		0.02	
0.5 – 1.25		0.075	
1.25 – 2.5		0.15	
≥ 2.5		0.25	
If no organic solvent		0	
Storage density of treated wood per m^2 ($m^3.m^{-2}$)	Dstorage	0.76	D

Output:

$Elocal_{3,air}$ = Local emission of active substance to air ($kg.d^{-1}$)

$Elocal_{3,water}$ = Local emission of active substance to wastewater ($kg.d^{-1}$)

$DOSE_{pest}$ = Dosage of active substance per m^2 soil surface for 1 storage period ($kg.m^{-2}$)

Intermediate calculations:

Fraction of the total fraction emitted to water/soil to soil (-)

$$F_{3,soil} = 1 - F_{3,water} \tag{8.8}$$

End calculations:

$$Elocal_{3,water} = Qwood_{drench} * Qsubst * Fwater/soil * (F_{3,water} - F_{3,air}) \tag{8.9}$$

$$Elocal_{3,air} = Qwood_{drench} * Qsubst * F_{3,air} \tag{8.10}$$

$$DOSE_{pest} = Dstorage * Qsubst * Fwater/soil * F_{3,soil} \tag{8.11}$$

Table 8.6 Default values of parameters required for distribution models of USES 3.0

Parameters required	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Number of emission days (d)	Temission	$\text{Temission}_{\text{drench}}$	Temission_3	50
Fraction of dosage that reaches the soil (-)	F_{soil}	-	Fsoil	1 [1)]
Application interval (d)	T_{interval}	$T_{\text{interval,drench}}$	Tint	35
Number of applications in one year (-)	N_{appl}	$N_{\text{appl,drench}}$	Nappl	10
Mixing with soil (yes/no)	MIX	-	MIX	no

[1)] This fraction to soil is set to one since this is the fraction of the calculated dose. In $DOSE_{pest}$ the fraction of the total release directed to soil is already accounted for by $Fwater/soil * F_{3,water}$.

8.1.4 Curative application: Remedial timber treatment in buildings

For curative applications Luttik *et al.* (1993) presented one emission scenario for remedial timber treatment in buildings. The calculated dose is used in a specific risk-characterisation ratio: the Relative Toxicity Index (RTI) for bats. The emission scenario is presented here in Table 8.7.

Table 8.7 Emission scenario for calculating the releases at remedial timber treatment in buildings (Luttik et al., 1993)

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Fraction of active ingredient in formulation (-)	Fform		S
A)			
Solid application rate of formulation ($kg.m^{-2}$)	Qform		S
B)			
Fluid application rate of formulation ($m^3.m^{-2}$)	Vform		S
Density of formulation ($kg.m^{-3}$)	RHOform		S

Table 8.7 Emission scenario for calculating the releases at remedial timber treatment in buildings (Luttik et al., 1993) (continued)

Output:

Qsubst = Dosage of active ingredient per m^2 wood ($kg.m^{-2}$)

Model calculations:

A)

Qsubst = Qform* Fform (8.12)

B)

Qsubst = Qform* RHOform * Fform (8.13)

8.2 Service life

The treated wood – either impregnated or drenched/dipped – is used for all kinds of outdoor applications, ranging from embankments for streams to fences and playground equipment. In USES 3.0 the following emission scenarios are present:

- Leaching from impregnated wood used as sheet piling of waterways to surface water (Luttik *et al.*, 1993)
- Leaching from impregnated wood used as poles in sand soils to groundwater (Luttik *et al.*, 1995)
- Leaching from impregnated wood used as planks for fences to soil (Luttik *et al.*, 1995)

8.2.1 Leaching from impregnated wood to surface water

The emission scenario of Luttik *et al.* (1993) for leaching to surface water from poles used as sheet piling of waterways to surface water is presented in Table 8.8.

Table 8.8 Emission scenario for calculating the releases at leaching from poles to surface water

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Waterway depth (m)	DEPTHwway	1.5	D
Waterway width (m)	WIDTHwway	5	D
Residence time of waterway water (d)	TAUwway	20	D
Diameter of poles (m)	DIAMpole	0.1	D
Number of poles per meter (both sides) (m^{-1})	Npole	5	D
Suspended solids concentration ($mg.l^{-1}$)	SUSPwater	15	D [1]
Solids-water partitioning coefficient in suspended matter ($m^3.kg^{-1}$)	Kp_{susp}		O [2]
Test duration for bird toxicity test (d)	T_{bird}		S
Test duration for mammalian toxicity test (d)	T_{mammal}		S
A) *Curve fitting possible*			
Regression constant a (-)	a		S
Regression constant e^b (-)	e^b		S
B) *Curve fitting not possible*			
Mean flux of compound over a certain period ($kg.m^{-2}.d^{-1}$)	FLUXsubst		S

Output:

$Cwater_{pest-0}$ = Peak concentration in surface water ($kg.m^{-3}$)

$Cwater_{pest-T}$ = Average concentration in surface water over T days ($kg.m^{-3}$)

---

[1] Default for the regional system (default for the continental system: 0.025)

[2] Calculated in USES

Table 8.8 Emission scenario for calculating the releases at leaching from poles to surface water (continued)

Intermediate calculations:

Leaching surface of impregnated wood per meter model waterway ($m^{-2}.m^{-1}$)

$AREAleach = 2 * N * DIAMpole * \pi * DEPTHwway$ (8.14)

A) Curve fitting possible

Concentration of active ingredient in the waterway as a function of time ($kg.m^{-3}$):

If $t \leq TAU_{wway}$ and ($-12 < a < 0$)

$$Cwway(t) = \frac{AREAleach * e^{b}}{DEPTHwway * WIDTHwway * (a+1)} * t^{a+1} \qquad (8.15)$$

If $t > TAU_{wway}$ and ($-2 < a < 0$ and $a \neq -1$)

$$Cwway(t) = \frac{AREAleach * e^{b}}{DEPTHwway * WIDTHwway * (a+1)} * [t^{a+1} - (t - TAUwway)^{a+1}] \qquad (8.16)$$

The maximum concentration is reached at t = TAUditch, the average concentration over an interval T is calculated started from t = TAUditch:

$$Cwway(t) = Fdiss_{ditch} * \frac{1}{T} * \int_{TAUditch}^{TAUditch + T} Cwway(t) \quad dt \qquad (8.17)$$

The integral can be solved analytically and yields the following equations:

$$Fdiss_{ditch} = \frac{1}{1 + Kp_{susp} * SUSP_{water}} \qquad (8.18)$$

B) *Curve fitting not possible*

Estimation for C_{wway} ($kg.m^{-3}$)

$$Cwater_{pest,eq} = \frac{AREA_{leach} * FLUXavg}{DEPTH_{wway} * \frac{WIDTH_{wway}}{TAU_{wway}}} \qquad (8.19)$$

End calculations:

A) *Curve fitting possible*

$$Cwater_{pest-T} = \frac{AREA_{leach} * e^{b}}{DEPTH_{wway} * WIDTH_{wway} * (a+1)} * Fdiss_{ditch} * \frac{(T + TAU_{wway})^{a+2} - T^{a+2} - TAU_{wway}^{a+2}}{(a+2) * T}$$

$$T \in \{1,4,7,21,28,T_{bird},T_{mammal},365\} \qquad (8.20)$$

Table 8.8 Emission scenario for calculating the releases at leaching from poles to surface water (continued)

$$Cwater_{pest\text{-}0} = Cwater_{pest\text{-}1} \tag{8.21}$$

B) <u>*Curve fitting not possible*</u>

$$Cwater_{pest-T} = \frac{Cwater_{pest,eq}}{1 + Kp_{susp} * SUSP_{water}} \tag{8.22}$$

$$T \in \{0,4,7,14,21,28,T_{bird},T_{mammal},365\}$$

8.2.2 Leaching from impregnated wood to sandy soil and groundwater

The emission scenario for leaching to soil and groundwater from poles used for fences and suchlike according to Luttik *et al.* (1995) and as present in USES 3.0 is presented in Table 8.9.

Table 8.9 Emission scenario for calculating the releases at leaching from poles to sandy soils and groundwater

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Mean flux of compound ($kg.m^{-2}.d^{-1}$)	FLUXsubst		S
Part of pole in saturated zone (m)	DEPTHpole	0.1	D
Radius of pole (m)	RADpole	0.05	D
Radius of soil area (m)	RADsoil	0.1	D
Bulk density of soil ($kg_{wwt}.m^{-3}$)	RHOsatsoil		$O^{c\ 1)}$
Conversion factor wet weight-dry weight soil ($kg_{wwt}.kg_{dwt}^{-1}$)	CONVsatsoil		$O^{c\ 1)}$
Fraction influenced area per ha (-)	Finfluence		$O^{c\ 1)}$
Fraction water in saturated soil ($m^3.m^{-3}$)	$Fwater_{satsoil}$	0.4	D
Solids-water partition coefficient in soil ($m^3.kg_{dwt}^{-1}$)	Kp_{pest}		$O^{\ 1)}$

1) Value coming from another module of USES

Table 8.9 Emission scenario for calculating the releases at leaching from poles to groundwater (continued)

Output:

Cporew = Concentration of leached substance in soil pore water ($kg.m^{-3}$)
Cgrw = Concentration in groundwater for drinking water ($kg.m^{-3}$)
$Csoil_{pest\text{-}0}$ = Concentration of leached substance in soil ($kg.kg_{wwt}^{-1}$)

Intermediate calculations:

Leaching area (m^{-2})

$$AREAleach = 2 * DEPTHpole * \pi * RADpole \tag{8.23}$$

Amount of substance leached over 1 year (kg)

$$Qsubst_{leach} = 365 * AREAleach * FLUXsubst \tag{8.24}$$

Soil volume around pole (m^3)

$$Vsoil = DEPTHpole * (\pi * RADsoil^2 * RADpole^2) \tag{8.25}$$

Fraction influenced soil per ha (-)

$$Finfluence = \frac{200}{1000} * (\pi * RADsoil^2 - RADpole^2) \tag{8.26}$$

Soil mass around pole (kg_{dwt})

$$Qsoil = Vsoil * \frac{RHOsatsoil}{CONVsatsoil} \tag{8.27}$$

Pore water volume around pole (m^3)

$$Vporew = Vsoil * Fwater_{satsoil} \tag{8.28}$$

End calculations:

$$Cporew = \frac{Qsubst_{leach}}{Vporew + Qsoil + Kp_{pest}} \tag{8.29}$$

$$Cgrw = Cporew * Finfluence \tag{8.30}$$

$$Csoil_{pest-0} = \frac{Cporew * Kppest}{CONVsatsoil} \tag{8.31}$$

8.2.3 Leaching from impregnated wood to soil

The emission scenario for leaching to soil from treated wood used for fences to soil according to Luttik *et al.* (1995) and as present in USES 3.0 is presented in Table 8.10.

Table 8.10 Emission scenario for calculating the releases at leaching from poles to soil

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Depth of soil layer (m)	DEPTHfence	0.05	D
Width of the fence (m)	WIDTHfence	0.025	D
Height of the fence (m)	HEIGHTfence	2	D
Length of the fence (m)	LENGTHfence	1	D
Mean flux of compound over 1 year ($kg.m^{-2}.d^{-1}$)	FLUXsubst		S
Number of days with leaching (d)	Train	35	D
Bulk density of soil ($kg_{wwt}.m^{-3}$)	RHOpest		$O^{c\ 1)}$
Conversion factor wet weight-dry weight soil ($kg_{wwt}.kg_{dwt}^{-1}$)	CONVpest		$O^{c\ 1)}$
Volume fraction water in soil ($m^3.m^{-3}$)	$Fwater_{pest}$	0.2	$D^{\ 2)}$
Solids-water partition coefficient in soil ($m^3.kg_{dwt}^{-1}$)	Kp_{pest}		$O^{\ 1)}$

Output:

Cporew = Peak concentration of leached substance in soil pore water ($kg.m^{-3}$)

$Csoil_{pest-0}$ = Concentration of leached substance in soil ($kg.kg_{wwt}^{-1}$)

Intermediate calculations:

Leaching area (m^{-2})

$$AREAleach = HEIGHTfence * LENGTHfence \quad ^{3)} \tag{8.32}$$

Amount of leached substance over one year (kg)

$$Qsubst_{leach} = Train * AREAleach * FLUXsubst \tag{8.33}$$

Soil volume beneath fence (m^3)

$$Vsoil = DEPTHfence * WIDTHfence * LENGTHfence \tag{8.34}$$

---

1) Value coming from another module of USES

2) As defined in and provided with the same default in the USES module on characteristics of compartments

3) In Luttik *et al.* (1995) a factor of 2 is used to express leaching at both sides of the fence

Table 8.10 Emission scenario for calculating the releases at leaching from poles to soil (Luttik et al., 1993) (continued)

Intermediate calculations:

Soil mass beneath fence (kg_{dwt})

$$Qsoil = Vsoil * \frac{RHOpest}{CONVpest} \tag{8.35}$$

Pore water volume beneath fence (m^3)

$$Vporew = Vsoil * Fwater_{pest} \tag{8.36}$$

End calculations:

$$Cporew = \frac{Qsubst_{leach}}{Vporew + Qsoil * Kp_{pest}} \tag{8.37}$$

$$Csoil_{pest-0} = \frac{Cporew * Kp_{pest}}{CONVpest} \tag{8.38}$$

8.3 Waste treatment

Table 8.11 presents the required defaults for the input data of Table 24.2. It should be noted that the calculation of the quantity of biocide for application in product *i* in total waste is not according to formula L-37;. this formula has been replaced for wood preservatives by formula 8.39 (Van der Poel, 1999b).

Table 8.11 Default settings for the input parameters of the model for wood preservatives at landfilling

Variable/parameter (unit)	Symbol	Defaults:
Quantity of biocide for application in preparation *i* in total waste (ktonnes.yr^{-1}):	$Qsubst\_prep_i$	
- Salts		1.6
- Coal tar		2.75
- Others		2.0
Penetration factor (-)	$Fpenetr_i$	0.25
Fraction of component in wood preservative (-):	Fsubst	
- Salts		0.35
- Coal tar		0.05
- Others		0.8
Fraction of product waste landfilled (-)	$Flandf_i$	0.6
Fraction lost due to degradation (-)	$Fdeg_i$	0
Fraction lost due to diffuse releases (-)	$Fdiff_i$	0
Fraction of total waste landfilled (-)	$Flandf_{total}$	0.6

Extra calculations:

Quantity of biocide for application in product i in total waste

$$Qsubst\_reg_i = Qsubst\_prep_i * 10^6 * Fpenetr_i * Fsubst * (1-Fdiff_i) \qquad (8.39)$$

For wood preservatives Van der Poel (1999b) also gives a table with defaults for the waste module for products applied for surface protection. This table is presented here as Table 8.12.

Table 8.12 Default settings for the input parameters of the model for wood preservatives in products for general-use surface protection at landfilling

Variable/parameter (unit)	Symbol	Defaults: I
Quantity of product i in total waste (ktonnes.yr^{-1})	$Qreg\_prod_i$	4.5
Penetration factor (-)	$Fpenetr_i$	0.4
Fraction of preservative (by weight) in product before application (-)	$Fsubst\_prod_i$	0.1
Fraction lost due to diffuse releases (-)	$Fdiff_i$	0
Fraction of product waste landfilled (-)	$Flandf_i$	0.6
Fraction of total waste landfilled (-)	$Flandf_{total}$	0.6

9. Fibre, leather, rubber and polymerised materials preservatives

This product type includes all kinds of macromolecules and polymerous materials. The product groups that may be considered are:

9.1 Textile and fabrics
9.2 Leather and hides
9.3 Rubber, plastics and other polymerised materials
9.4 Paper and cardboard

These four topics are described in the following sections.

9.1 Textile and fabrics

The scheme of the life cycle stages for textile production is presented on the next page. The box with the broken lines represents the case that the biocide assessed is already present on the fabric. This has been incorporated in the textile production stage where the biocide may be emitted.

USES 3.0 already contains an emission module for biocides used in textile industry based on the emission scenario present in Luttik *et al.* (1993). However, a more extended emission scenario is present in the emission scenario document produced in the framework of the EUBEES project (Tissier, Chesnais and Migné, 2001). So, this emission scenario is presented here. For the stage of the service life an emission scenario is already present in advance of the update of the TGD. The emission scenarios are presented in Tables 9.1 up to and including 9.5 (Table 9.3 is a pick-list also used in section 6.4.2.) It should be noted that the names and symbols for several parameters have been adapted a little.

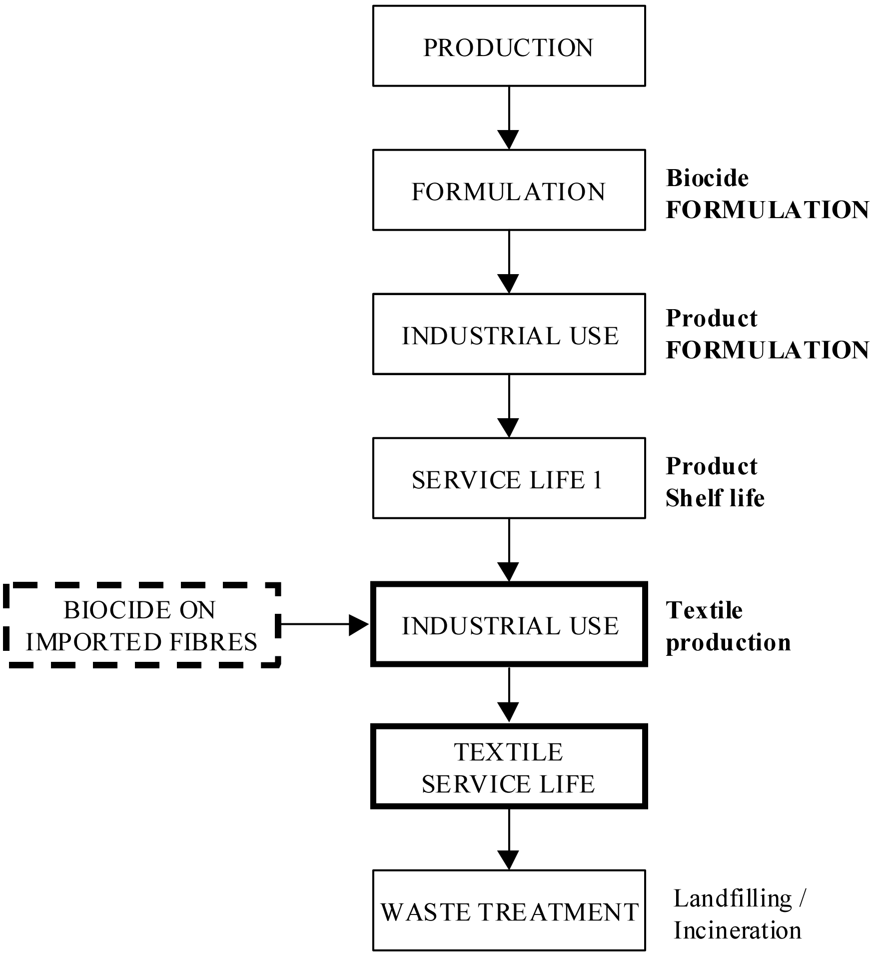


Table 9.1 Emission scenario for calculating the releases from the biocide that is present in imported material

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of fibres / fabrics treated per day (tonnes.d^{-1})	Qfibres		D/P [9.3]
Estimated content of active substance present in imported material (mg.kg^{-1}):	Cmat		D
- wool		0.004	
- cotton		0.01	

Table 9.1 Emission scenario for calculating the releases from the biocide that is present in imported material (continued)

Output:

$Eimport_{water}$ = Local emission of active substance to wastewater due to imported material ($kg.d^{-1}$)

$Elocal_{3,water}$ = Total local emission of active substance due to imported material (same biocide is not applied in process steps) ($kg.d^{-1}$)

Model calculations:

Local emission of active substance to wastewater due to imported material ($kg.d^{-1}$)

$$Eimport_{water} = Qfibres * Cmat * 10^{-3} \tag{9.1}$$

If the same biocide is not applied during the various process steps

$$Elocal_{3,water} = Eimport_{water} \tag{9.2}$$

Table 9.2 Emission scenario for calculating the releases from the different application steps p = 1 to m of biocide

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of fibres / fabrics treated per day ($tonnes.d^{-1}$)	Qfibres		D/P [9.3]
Quantity of active substance applied per tonne of fibres / fabrics for treatment step *i* ($kg.tonne^{-1}$)	$Qsubst_i$		S
Local emission of active substance to wastewater due to imported material ($kg.d^{-1}$)	$Eimport_{water}$		O [1)]
Fixation fraction (-)	Ffix	0.7	S/D

Output:

$Elocal_{3,water}$ = Total local emission of active substance to wastewater ($kg.d^{-1}$)

Intermediate calculations:

Local emission of active substance to wastewater for one treatment step *i* ($kg.d^{-1}$)

$$Elocal\_water_i = Qfibres * Qsubst_i * (1 - Ffix) \tag{9.3}$$

End calculations:

$$Elocal_{3,water} = Eimport_{water} + \sum_{i=1}^{m} Elocal\_water_i \tag{9.4}$$

---

1) This parameter is calculated in Table 9.1

Table 9.3 Pick-list with defaults for the daily production, Qfibres (tonnes.d^{-1}), of the model textile production site (according to Tissier, Chesnais and Migné (2001))

Fabric / textile	Qfibres
Cotton spinning	7
Wool preparation	1
Wool spinning	2.5
Silk, synthetic	1
Sewing knit	4
Cotton weaving	2
Wool weaving	1
Silk weaving	0.1
Others weaving	1.5
Textile ennobling	6.5
House and furnishing fabric	0.5
Others textile goods	0.2
Cords, filets	3
Nonwoven	4
Mail fabrics	2

Table 9.4 Emission scenario for calculating the releases from articles during their service life

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Annual input of the substance in article *k* (tonnes.yr^{-1})	$Qsubst\_tot_k$		S
Fraction of the region (-)	$Fprodvol_{reg}$	0.1	D
Service life of article *k* (yr)	$Tservice_k$		P [9.5]
Fraction of tonnage released over one year during service life to compartment *j* (-)	$F_{service,j}$	- $^{1)}$	D
Emission duration per year (d.yr^{-1})	$Temission_{service}$	365	D
Fraction of the main source (STP) (-)	$Fmainsource_{service}$	0.002	D

Table 9.4 Emission scenario for calculating the releases from articles during their service life (continued)

Output:

$\mathrm{RELEASEreg}_{\mathrm{service,j}}$ = Total regional release for the stage of service life to compartment *j* for biocide for all *m* products with the biocide ($\mathrm{kg.d^{-1}}$)

$\mathrm{Elocal}_{\mathrm{service,water}}$ = Total local emissions for the stage of service life to compartment *j* from all products ($\mathrm{kg.d^{-1}}$)

Intermediate calculations:

Regional release for the stage of service life to compartment *j* for biocide for product *k* ($\mathrm{tonnes.d^{-1}}$)

$$\mathrm{RELEASEreg}_{\mathrm{k,service,j}} = (\mathrm{Fprodvol}_{\mathrm{reg}} * \mathrm{F}_{\mathrm{service,j}} * \mathrm{Qsubst\_tot}_{\mathrm{k}} * \sum_{y=1}^{\mathrm{Tservice}_k} \left(1-\mathrm{F}_{\mathrm{service,j}}\right)^{y-1}) / \mathrm{Temission}_{\mathrm{service}} \qquad (9.5)$$

End calculations:

$$\mathrm{RELEASEreg}_{\mathrm{service,j}} = 10^3 * \sum_{k=1}^{m} \mathrm{RELEASEreg}_{\mathrm{k,service,j}} \qquad (9.6)$$

$$\mathrm{Elocal}_{\mathrm{service,water}} = \mathrm{Fmainsource}_{\mathrm{service}} * \mathrm{RELEASEreg}_{\mathrm{service,water}} \qquad (9.7)$$

[1)] Tissier, Chesnais and Migné (2001) give some values; it is suggested, however, to generate more realistic ones together with industry

Table 9.5 Service life of some articles, $\mathrm{Tservice}_k$ (yr), according to (Tissier, Chesnais and Migné (2001)); some values are the averages of the ranges presented in the emission scenario document.

Articles	Service life (years)
Clothes on contact with skin	1
Others clothes and bed linen	3.5
Household linen	7.5
Bedding (mattress)	10
Carpets	14
Wall-to-wall carpet	17
Sunblind	11
Tents	12
Awning	2

9.2 Leather and hides

The scheme of the life cycle stages for leather production is presented below. The emission scenario document prepared for the EUBEES project (Tissier and Chesnais, 2001) covers the stage of leather production. The emission scenario is presented in Tables 9.6 and 9.7.

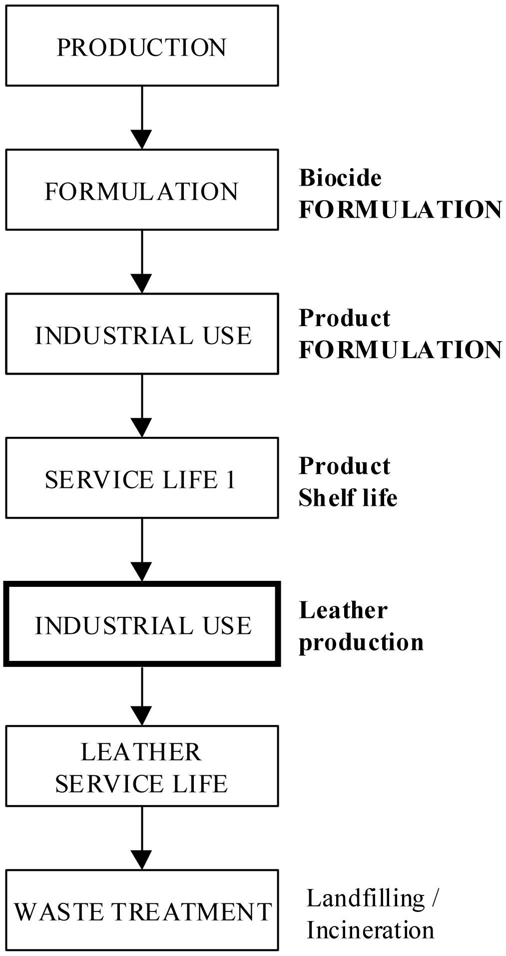


Table 9.6 Emission scenario for calculating the releases of biocides used as preservatives in the leather industry

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of treated raw hides per day ($tonnes.d^{-1}$)	Qleather	15	D
[A]			
Quantity of active substance applied per tonne of leather for treatment step *i* ($kg.tonne^{-1}$) ¹⁾	$Qsubst_i$		P [6.15]
[B]			
Quantity of fluid used per tonne of raw hides ($l.tonne^{-1}$)	$Vform_i$	- ²⁾	S/P
Concentration of the preservative in the fluid ($mg.l^{-1}$)	$Cform_i$		S
[A + B]			
Fixation fraction (-)	Ffix	0.95	D

Output:

$Elocal_{3,water}$ = Total local emission of active substance for all treatment steps i1 = 1 to m ($kg.d^{-1}$)

Intermediate calculations:

[B]

Quantity of active substance applied per tonne of leather for treatment step *i* ($kg.tonne^{-1}$)

$$Qsubst_i = Vform_i * Cform_i * 10^{-6} \qquad (9.8)$$

Local emission of active substance to wastewater for treatment step *i* ($kg.d^{-1}$)

$$Elocal\_water_i = Qleather * Qsubst_i * (1 - Ffix) \qquad (9.9)$$

End calculation:

$$Elocal_{3,water} = \sum_{i=1}^{n} Elocal\_water_i \qquad (9.10)$$

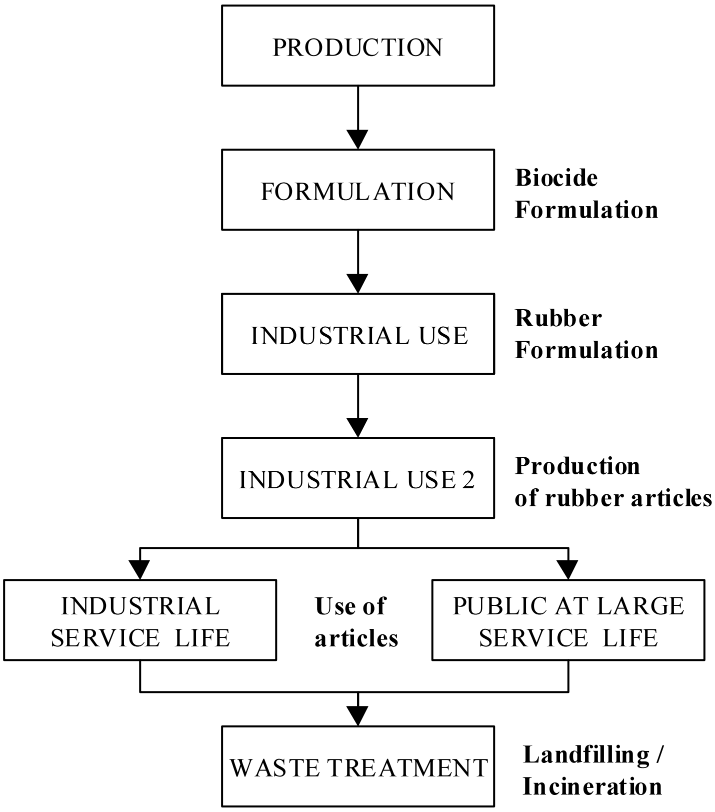
[1)] *i* represents a treatment step (curing, soaking, pickling, tanning, finishing)

[2)] The default value will depend on the function of preserved product used. A pick list might be developed for common products in leather production in future.

9.3 Rubber, plastics and other polymerised materials

9.3.1 Rubber

The scheme of the life cycle stages is shown below. As can be seen no emission scenario is presented. A draft emission scenario document on additives in the rubber industry has been produced under the authority of the German Umweltbundesamt (INFU, 2001). This document only states biocides ("microbiocides") in the table on emission factors; however for the amounts used in rubber products it is stated that there are no data. In Ullmann (2001) no data on biocides were found. According to Baumann and Ismeier (1998) biocides are added to rubber at the production of rubber (latex) shoes and gloves, and hygienic rubber articles. This, however, is not a preservative for the leather and so does not belong to one of the product types of the Directive.

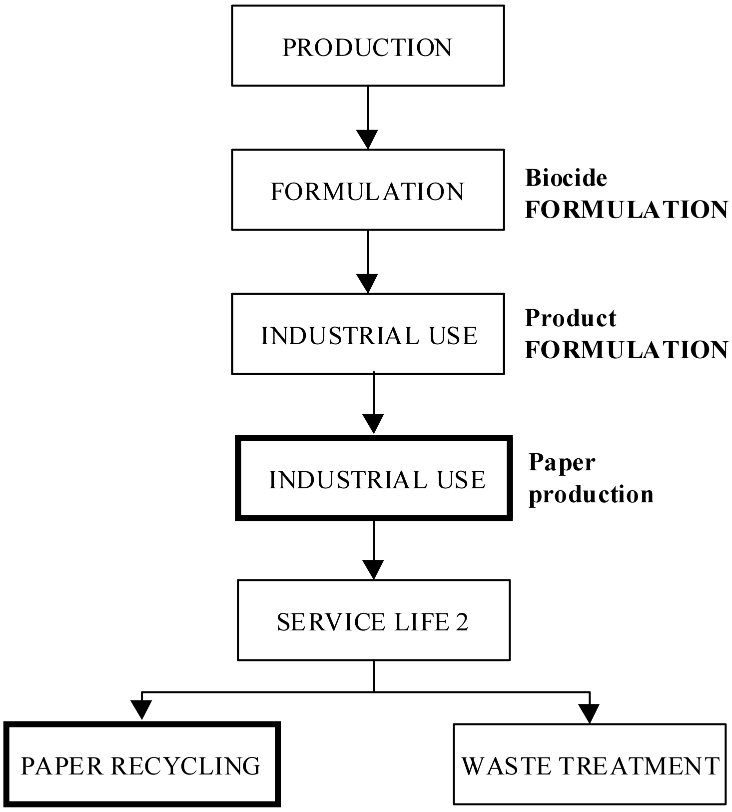


9.3.2 Plastics and other polymerised materials

So far, no data were found on the preservation of plastics and other polymerised materials. So, no emission scenario is presented here.

9.4 Paper and cardboard

Biocides may be added at paper production to preserve the fibres. The scheme of the life cycle stages is presented at the following page. It is different from the scheme for product types 6 and 7 for paper and cardboard.



The emission scenarios are derived from Tissier and Migné (2001). They are already presented in sections 6.4 and 7.4. Tables 9.7 and 9.8 replace tables 6.7 and 6.9 respectively.

Table 9.7 Emission scenario for calculating the releases from drying sections after size-pressing and coating for product type 9 biocides

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of coated paper produced per day (tonnes.d^{-1})	Qpaper		P [6.8]
[A]			
Quantity of active substance applied per tonne of paper (kg.tonne^{-1})	Qsubst		S
[B]			
Quantity of product with biocide applied per tonne of paper (l.tonne^{-1})	Vform		S
Concentration of active substance in the biocidal product (g.l^{-1})	Cform		S
[A + B]			
Evaporation rate (-) if volatility (Pa at 100 ºC):	Fevap		D
≤ 133		0.0025	
13.3 – 133		0.0005	
1.3 – 13.3		0.0001	
< 1.3		0	
Decomposition rate during drying (-)	Fdecomp	0	S

Output:

$\text{Elocal}_{3,\text{air}}$ = Local emission of active substance to air for one treatment step (kg.d^{-1})

Intermediate calculation:

[B]

$$\text{Qsubst} = \text{Vform} * \text{Cform} * 10^{-3} \quad (9.11)$$

End calculation:

$$\text{Elocal}_{3,\text{air}} = \text{Qpaper} * \text{Qsubst} * \text{Fevap} * (1\text{-Fdecomp}) \quad (9.12)$$

Table 9.8 Emission scenario for calculating the releases from "broke" for product type 9 biocides

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of coated paper produced per day (tonnes.d^{-1})	Qpaper		P [6.8]
[A]			
Quantity of active substance applied per tonne of paper (kg.tonne^{-1})	Qsubst		S
[B]			
Quantity of product with biocide applied per tonne of paper (l.tonne^{-1})	Vform		S
Concentration of active substance in the biocidal product(g.l^{-1})	Cform		S
[A + B]			
Degree of closure of the water system (-) (Table 6.11)	Fclosure		P [1)]
Fraction of coated broke produced compared to overall production (-)	Fbroke	0.2	S/D
Fixation fraction (-) (cf. section 3)	Ffix	0	S/D
Output:			
$Elocal_{3,water}$ = Local emission of active substance to wastewater (kg.d^{-1})			

Intermediate calculation:

[B]

$$Qsubst = Vform * Cform * 10^{-3} \quad (9.13)$$

End calculation:

$$Elocal_{3,water} = Qpaper * Qsubst * Fbroke * (1 - Ffix) * (1 - Fclosure) \quad (9.14)$$

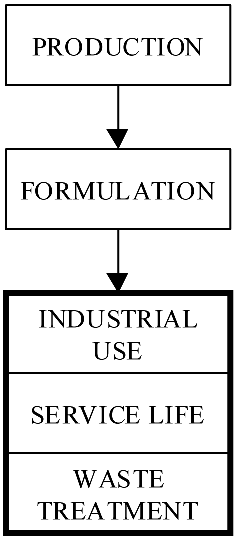
[1)] The default values are the averages of the ranges presented in Tissier and Migné (2001)

10. Product type 10: Masonry preservatives

This product type is investigated at the moment in France. A draft emission scenario document will be prepared for the follow-up of the EUBEES project.

11. Product type 11: Preservatives for liquid-cooling and processing systems

The treatment of process water is often very specific for the industrial branches concerned. The most important example is paper, pulp and cardboard industry where slimicides are applied at a large scale. For this application product type 12 (Slimicides) has been designated. So, the attention is focused on liquid cooling systems completely.
The scheme of the life cycle stages is presented below. The stages of processing (industrial use, i.e. the application), service life and waste treatment (discharge of cooling water) are completely interconnected.



The emission scenarios of Luttik *et al.* (1993) have been incorporated in USES 3.0 (RIVM, VROM, VWS, 1999) and are presented here in Table 11.1. The defaults for parameters required for the distribution models of USES are presented in Table 11.2.

Table 11.1 Emission scenario for calculating the releases from biocides used in process and cooling-water installations

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Type of cooling water system (open/cont.)	COOLTYPE		P
Concentration of active ingredient in cooling-water ($kg.m^{-3}$)	Cproc	0.000 5	D
Solids-water partition coefficient in suspended matter ($m^3.kg^{-1}$)	Kp_{susp}		O 1)
Concentration suspended matter ($kg.m^{-3}$)	SUSPwater	0.015	D 2)
Dilution factor in receiving surface water (-)	DILUTION	3	D
Test duration for bird toxicity test (d)	T_{bird}		S
Test duration for mammalian toxicity test (d)	T_{mammal}		S
Only for open circulation systems (COOLTYPE = open):			
Quantity of water in circulation ($m^3.d^{-1}$)	Qcirc	10000	D
Fraction of water lost due to spray and wind drift (-)	Fdepos	0.000 25	D
Soil surface where deposition occurs (m^2)	AREAdepos	100	D
Time period between two emission events (d)	Tint	1	D
Number of applications in one year (-)	Nappl	300	D

Output:

$Cwater_{pest\text{-}0}$ = Peak concentration of chemical in surface water ($kg.m^{-3}$)

$Cwater_{pest\text{-}T}$ = Average concentration of chemical in surface water over T days($kg.m^{-3}$)

Only for open circulation systems (COOLTYPE = open):

$DOSE_{pest}$ = Dosage for one event ($kg.m^{-2}$)

Table 11.1 Emission scenario for calculating the releases from biocides used in process and cooling-water installations (continued)

Model calculations:

$$\mathrm{Cwater}_{\mathrm{pest-0}} = \frac{\mathrm{Cproc}}{(1 + \mathrm{Kp}_{\mathrm{susp}} * \mathrm{SUSP}_{\mathrm{water}}) * \mathrm{DILUTION}} \quad (11.1)$$

$$\mathrm{Cwater}_{\mathrm{pest-}T} = \mathrm{Cwater}_{\mathrm{pest-0}} \qquad T \in \{4,7,14,21,28,\mathrm{T}_{\mathrm{bird}},\mathrm{T}_{\mathrm{mammal}},365\} \quad (11.2)$$

Only for open circulation systems (COOLTYPE = open):

$$\mathrm{DOSE}_{\mathrm{pest}} = \mathrm{Qcirc} * \mathrm{Cproc} * \frac{\mathrm{Fdepos}}{\mathrm{AREAdepos}} \quad (11.3)$$

---

1) Value coming from another module of USES

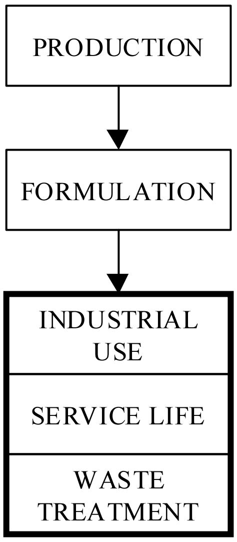
2) Default for the regional system as in USES 3.0 (default for the continental system: 0.025)

Table 11.2 Default values of parameters required for distribution models of USES 3.0

Parameters required	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Fraction of dosage that reaches the soil (-)	F_{soil}	-	Fsoil	1
Application interval (d)	$T_{interval}$	$T_{interval,cooling}$	Tint	1
Number of applications in one year (-)	N_{appl}	$N_{appl,cooling}$	Nappl	300
Mixing with soil (yes/no)	MIX	-	MIX	no

12. Slimicides

Slimicides are biocides used to control slime-producing micro-organisms in industrial processes. Especially in systems where process water is recycled with a high degree of closure of the systems, slime formation is a serious problem. Biocides applied in process cooling water systems are referred to as product type 11
The scheme of the life cycle stages is presented below. The stage of industrial use (processing), service life (the time the slimicide is in use) and the waste stage are interconnected completely.



USES 3.0 (RIVM, VROM, VWS, 1999) includes an emission scenario for slimicides used in paper and cardboard industry. The scenario has been derived from Luttik *et al.* (1993). This emission scenario uses the standard STP of (E)USES with an STP size of 5000 $m^3.d^{-1}$ (3000 $m^3.d^{-1}$ in USES 3.0). This model does not include degradation due to biodegradation, hydrolysis and photolysis. The model is presented in Table 12.2. Recently a (draft) report was finished in co-operation with the Finnish Environment Institute (Van der Poel and Braunschweiler, 2001). This report includes an update of the USES model to calculate the concentration of active ingredient in the effluent from a paper mill (an input parameter, with *Cinf*[1)] as a symbol, in the USES model) from the data supplied by the notifier in the user's instructions). This general applicable part of the emission scenarios is presented in Table 12.1. Furthermore emission scenarios are presented for pulp and paper mills with various ways of wastewater treatment and varying degrees of closure for the water cycle. These scenarios consider also the pH conditions at paper making. The various stages considered in the model are presented in Figure 12.1. The original Finnish spreadsheet calculation model with two scenarios that take also degradation due to photolysis, hydrolysis and some biodegradation into account

[1)] The abbreviation corresponds to USES 3.0 for the influent to the STP.

has been converted to the format of (E)USES. The part of the model concerning the rate constants for degradation is presented in Table 12.4. As process water temperatures may deviate from laboratory test temperatures a correction was suggested in Van der Poel and Braunschweiler (2001) according to the formula $DT50_{T2} = DT50_{T1} * e^{(0.08 * (T1 - T2)}$, where T1 is the laboratory test temperatures and T2 the process water temperature. As biodegradation tests may be carried out in the dark or in 12 hours light/12 hours dark cycles, this also has been incorporated in the model.

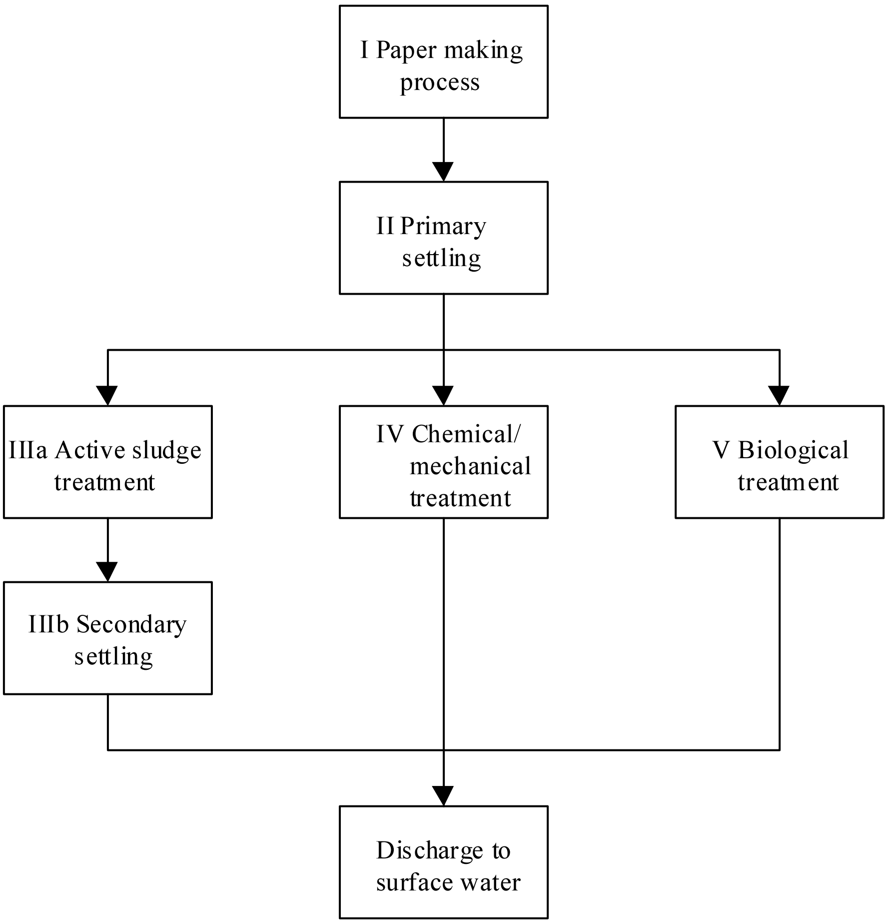


Figure 12.1 Scheme of the water flow depending on the type of wastewater treatment.

Figure 12.2 gives the scheme of the possible stage of the water flow, together with the time periods for each stage and the points where PECs have to be calculated. The values of these parameters are presented in Table 12.5 that presents the actual paper mill model.

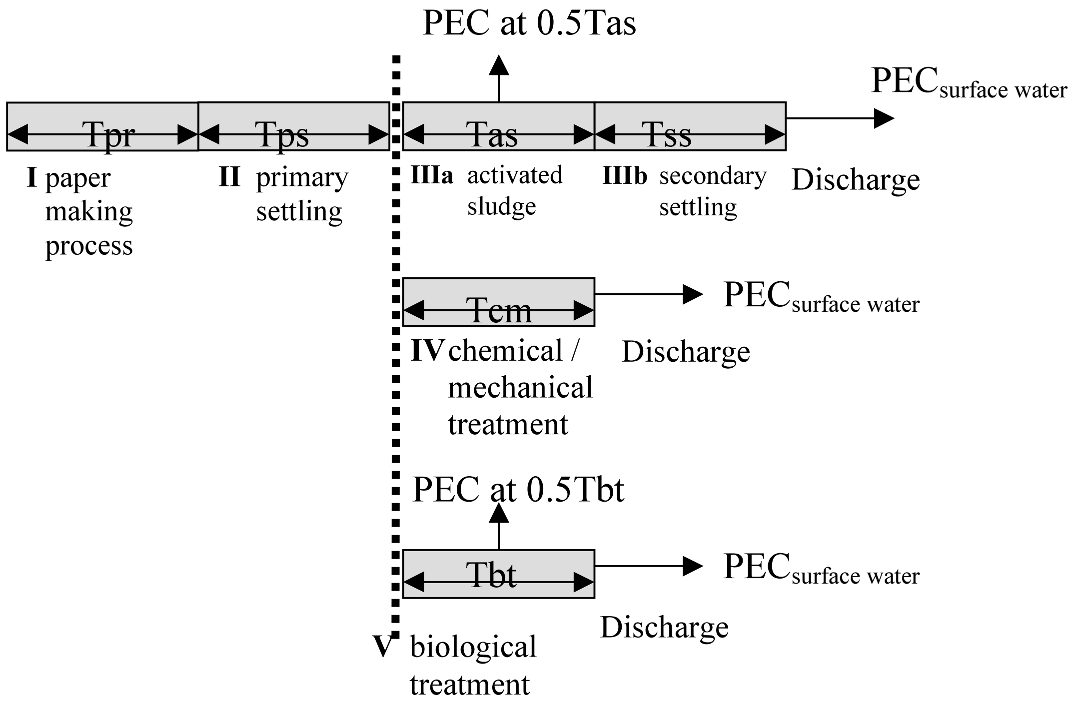


Figure 12.2 Scheme of the water flow depending on the type of wastewater treatment with the time periods and points where PECs have to be calculated (see Table 4.2 for values of these parameters).

Table 12.1 Common part of the models for the calculation of the theoretical average concentration (i.e. assuming that no degradation occurs) before wastewater treatment, depending on the way the dosage is expressed in the user's instructions; concentration reduction due to degradation in process water is presented in Tables 12.3 and 12.4

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
[A]			
Amount of wastewater for one tonne of dry paper (m^3):	Vww	15	D
Amount of biocide prescribed in user's instructions (unit [1])	Qform_uins		S
[B]			
Amount of biocide prescribed in user's instructions (unit[1].m^{-3})	Qform_uins		S
[A/B]			
Content of active ingredient in biocidal product ([1])	Cform		S
Specific density of biocide ($kg.m^{-3}$)	RHOform	1,000	D
[B/C]			
Treatment of both long and short circulation with slimicide (yes/no)	APPL	yes	P
Fraction of the total wastewater flow coming from the short circulation of the wire part (%):	Fww1		
- APPL = yes		100	O
- APPL = no		60	D
Connection to pulp mill (yes/no)	CONN	no	P
Fraction dilution of wastewater with wastewater from pulping (%)	Fww2		
- CONN = no		0	O
- CONN = yes		50	D

[1] For units see calculations

Table 12.1 Common part of the models for the calculation of the theoretical average concentration (i.e. assuming that no degradation occurs) before wastewater treatment, depending on the way the dosage is expressed in the user's instructions; concentration reduction due to degradation in process water is presented in Tables 12.3 and 12.4 (continued)

Variable/parameter (unit)	Symbol	Default	S/D/O/P
[C]			
Concentration of process water prescribed in the user's instructions ([A] & [B]) (mg.l^{-1})	Cproc		S

Output:

Cinf = Theoretical concentration of active ingredient in effluent from paper mill (mg.l^{-1}) 1)

Calculations:

[A/B]

Dose (g) of a.i., dependent on specifications for the amount of biocide preparation (Qform_uins) and content of a.i. in biocide preparation (Cform)

Equation	Units: Qform_uins	Cform	
$Qsubst = Qform\_uins * Cform * 10$	kg	%	(12.1)
$Qsubst = Qform\_uins * Cform * 10^3 / RHOform$	kg	g/l	(12.2)
$Qsubst = Qform\_uins * Cform * 10^{-2}$	g	%	(12.3)
$Qsubst = Qform\_uins * Cform / RHOform$	g	g/l	(12.4)
$Qsubst = Qform\_uins * Cform$	l	g/l	(12.5)
$Qsubst = Qform\_uins * Cform * 10^{-3}$	ml	g/l	(12.6)

[A] $C_{inf} = Qsubst / Vww$ (12.7)

[B] $C_{inf} = Qsubst * Fww1 * 0.01 * (1 - Fww2/100)$ (12.8)

[C] $C_{inf} = Cproc * Fww1 * 0.01 * (1 - Fww2/100)$ (12.9)

---

1) The abbreviation corresponds to USES 3.0 for the influent to the STP ('eff' is the abbreviation for the effluent from the STP.

Table 12.2 Model for the calculation of the daily release to the STP excluding biodegradation.

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Theoretical concentration of a.i. in process water discharged ($mg.l^{-1}$)	Cinf		O [1)]
Effluent discharge of STP for paper plant ($m^3.d^{-1}$)	$EFFLUENT_{stp}$	5000	D
Output:			
$Elocal_{3,water}$ = Local emission to wastewater during episode ($kg.d^{-1}$)			
Calculations:			
$Elocal_{3,water} = EFFLUENT_{stp} * Cinf * 10^{-3}$			(12.10)

1) Calculation according to scenario presented in Table 12.1

Table 12.3 Default values of parameters required for distribution models of USES 3.0

Parameters required	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Number of emission days paper plant (d)	Temission	$Temission_{paper}$	$Temission_3$	300
Capacity of the local STP of paper plant (eq)	Nlocal	$Nlocal_{paper}$	-	25000
Dilution factor in receiving surface water (-)	DILUTION	$DILUTION_{paper}$	DILUTION	10

Table 12.4 Common part for the emission scenarios for calculating the release of slimicides in paper mills taking biodegradation and degradation due to hydrolysis and photolysis into account

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Half-life time for hydrolysis in acid circumstances (d)	$DT50hydr_{acid}$		S
Half-life time for hydrolysis in neutral circumstances (d)	$DT50hydr_{water}$ [1)]		S
Half-life time for hydrolysis in alkaline circumstances (d)	$DT50hydr_{alkal}$		S
Half-life time for photolysis in water (d)	$DT50photo_{water}$		S
Half-life time for biodegradation in activated sludge system (d)	$DT50bio_{stp}$ [2)]	$DT50bio_{water}$ /2 [2)]	D/S
[I] Biodegradation test 12 hours light/12 hours dark			
Half-life time for biodegradation in water (d)	$DT50bioI_{water}$		S
[II] Biodegradation test in the dark			
Half-life time for biodegradation in water (d)	$DT50bioII_{water}$		S

Output:

$khydr_{acid}$ = rate constant for degradation due to hydrolysis at acid (pH≈5) conditions (d^{-1})

$khydr_{water}$ = rate constant for degradation due to hydrolysis at neutral (pH≈7) conditions (d^{-1})

$khydr_{alkal}$ = rate constant for degradation due to hydrolysis at alkaline (pH≈8) conditions (d^{-1})

$kbiotot_{water}$ = rate constant for biodegradation in water including hydrolysis and photolysis (d^{-1})

$kbio_{water}$ = rate constant for biodegradation in water (d^{-1})

$kbioh_{water}$ = rate constant for biodegradation in water including hydrolysis (d^{-1})

$kbiotot_{stp}$ = rate constant for biodegradation in STPs including hydrolysis (d^{-1})

$kphototot_{water}$ = rate constant for photolysis including hydrolysis (d^{-1})

$kphoto_{water}$ = rate constant for photolysis (d^{-1})

---

1) This symbol is already used in EUSES.

2) Depending on availability of $DT50bioI_{water}$ or $DT50bioII_{water}$

Table 12.4 Common part for the emission scenarios for calculating the release of slimicides in paper mills taking biodegradation and degradation due to hydrolysis and photolysis into account (continued)

Model calculations:

$\text{khydr}_{\text{acid}} = \ln 2 / \text{DT50hydr}_{\text{acid}}$ (12.11)

$\text{khydr}_{\text{water}} = \ln 2 / \text{DT50hydr}_{\text{water}}$ (12.12)

$\text{khydr}_{\text{alkal}} = \ln 2 / \text{DT50hydr}_{\text{alkal}}$ (12.13)

$\text{kphototot}_{\text{water}} = \ln 2 / \text{DT50photo}_{\text{water}}$ (12.14)

$\text{kphoto}_{\text{water}} = \text{kphototot}_{\text{water}} - \text{khydr}_{\text{water}}$ (12.15)

$\text{kbiotot}_{\text{stp}} = \ln 2 / \text{DT50bio}_{\text{stp}}$ (12.16)

[I]

$\text{kbiotot}_{\text{water}} = \ln 2 / \text{DT50bioI}_{\text{water}}$ (12.17)

$\text{kbioh}_{\text{water}} = \text{kbiotot}_{\text{water}} - \text{kphoto}_{\text{water}}$ (12.18)

$\text{kbio}_{\text{water}} = \text{kbioh}_{\text{water}} - \text{khydr}_{\text{water}}$ (12.19)

[II]

$\text{kbioh}_{\text{water}} = \ln 2 / \text{DT50bioII}_{\text{water}}$ (12.20)

$\text{kbio}_{\text{water}} = \text{kbioh}_{\text{water}} - \text{khydr}_{\text{water}}$ (12.21)

$\text{kbiotot}_{\text{water}} = \text{kbioh}_{\text{water}} + \text{kphoto}_{\text{water}}$ (12.22)

Table 12.5 Model for the calculation of the relevant PECs depending on the user's instructions: [A] amount of biocide per tonne of product and [B/C] amount of biocide per m^3 of water at the wire part of the paper machine

Variable/parameter (unit)	Symbol S/D/O/P	Default	
Input:			
Theoretical concentration of active ingredient (mg.l^{-1})	Cinf		O [1]
Retention time for paper making process (h)	Tpr_h	4	D
Retention time for primary settling (h)	Tps_h	4	D
Retention time for the activated sludge unit (h)	Tas_h	4	D
Retention time for secondary settling (h)	Tss_h	4	D
Retention time for chemical/mechanical treatment (h)	Tmc_h	4	D
Retention time for long-term biological treatment	Tbt_h	40	D
Dilution factor at discharge surface water	DILUTION	10	D [2]

[1] Calculation according to scenario presented in Table 12.1

[2] Default value of USES

Output:

PEC_{ASstp_acid} = Predicted environmental concentration for assessment of micro-organisms in STP with activated sludge for acid conditions at the paper making process (mg.l^{-1})

PEC_{ASstp_neutr} = Predicted environmental concentration for assessment of micro-organisms in STP with activated sludge for neutral conditions at the paper making process (mg.l^{-1})

PEC_{ASstp_alkal} = Predicted environmental concentration for assessment of micro-organisms in STP with activated sludge for alkaline conditions at the paper making process (mg.l^{-1})

PEC_{BTstp_acid} = Predicted environmental concentration for assessment of micro-organisms in STP with a long-term biological treatment for acid conditions at the paper making process (mg.l^{-1})

PEC_{BTstp_neutr} = Predicted environmental concentration for assessment of micro-organisms in STP with a long-term biological treatment for neutral conditions at the paper making process (mg.l^{-1})

PEC_{BTstp_alkal} = Predicted environmental concentration for assessment of micro-organisms in STP with a long-term biological treatment for alkaline conditions at the paper making process (mg.l^{-1})

$PEClocal_{AS\_water\_acid}$ = Predicted Environmental Concentration in receiving surface water after activated sludge treatment for acid process conditions at paper making (mg.l^{-1})

Table 12.5 Model for the calculation of the relevant PECs depending on the user's instructions: [A] amount of biocide per tonne of product and [B/C] amount of biocide per m^3 of water at the wire part of the paper machine (continued)

$PEClocal_{AS\_water\_neutr}$ = Predicted Environmental Concentration in receiving surface water after activated sludge treatment for neutral process conditions at paper making (mg.l^{-1})

$PEClocal_{AS\_water\_alkal}$ = Predicted Environmental Concentration in receiving surface water after activated sludge treatment for alkaline process conditions at paper making (mg.l^{-1})

$PEClocal_{CM\_water\_acid}$ = Predicted Environmental Concentration in receiving surface water after chemical/mechanical treatment for acid process conditions at paper making (mg.l^{-1})

$PEClocal_{CM\_water\_neutr}$ = Predicted Environmental Concentration in receiving surface water after chemical/mechanical treatment for neutral process conditions at paper making (mg.l^{-1})

$PEClocal_{CM\_water\_alkal}$ = Predicted Environmental Concentration in receiving surface water after chemical/mechanical treatment for alkaline process conditions at paper making (mg.l^{-1})

$PEClocal_{BT\_water\_acid}$ = Predicted Environmental Concentration in receiving surface water after long-term biological treatment for acid process conditions at paper making (mg.l^{-1})

$PEClocal_{BT\_water\_neutr}$ = Predicted Environmental Concentration in receiving surface water after long-term biological treatment for neutral process conditions at paper making (mg.l^{-1})

$PEClocal_{BT\_water\_alkal}$ = Predicted Environmental Concentration in receiving surface water after long-term biological treatment for alkaline process conditions at paper making (mg.l^{-1})

Intermediate calculations

Retention times (d) for paper making process, primary settling, activated sludge treatment, secondary settling, chemical/mechanical treatment and long-term biological treatment respectively:

$$Tpr = Tpr_h / 24 \quad (12.19)$$

$$Tps = Tps_h / 24 \quad (12.20)$$

$$Tas = Tas_h / 24 \quad (12.21)$$

$$Tss = Tss_h / 24 \quad (12.22)$$

$$Tmc = Tmc_h / 24 \quad (12.23)$$

$$Tbt = Tbt_h / 24 \quad (12.24)$$

Table 12.5 Model for the calculation of the relevant PECs depending on the user's instructions: [A] amount of biocide per tonne of product and [B/C] amount of biocide per m^3 of water at the wire part of the paper machine (continued)$^{1)}$

Concentrations after primary settling for acid, neutral and alkaline process conditions respectively (mg.l^{-1}):

$$\mathrm{Cacid} = \mathrm{Cinf} * e^{-\{(\mathrm{kbio}_{\mathrm{water}}+\mathrm{khydr}_{\mathrm{acid}})*\mathrm{Tpr}+\mathrm{kbiotot}_{\mathrm{water}}*\mathrm{Tps})\}} \tag{I/II.1}$$

$$\mathrm{Cneutr} = \mathrm{Cinf} * e^{-\mathrm{kbiotot}_{\mathrm{water}}*(\mathrm{Tpr}+\mathrm{Tps})} \tag{I/II.2}$$

$$\mathrm{Calkal} = \mathrm{Cinf} * e^{-\{(\mathrm{kbio}_{\mathrm{water}}+\mathrm{khydr}_{\mathrm{alkal}})*\mathrm{Tpr}+\mathrm{kbiotot}_{\mathrm{water}}*\mathrm{Tps})\}} \tag{I/II.3}$$

Concentrations after secondary settling in the case of activated sludge treatment (mg.l^{-1})

$$\mathrm{Cacid}_{\mathrm{AS}} = \mathrm{Cacid} * e^{-(\mathrm{kbiotot}_{\mathrm{stp}}*\mathrm{Tas}+\mathrm{kbiotot}_{\mathrm{water}}*\mathrm{Tss})} \tag{III.1}$$

$$\mathrm{Cneutr}_{\mathrm{AS}} = \mathrm{Cneutr} * e^{-(\mathrm{kbiotot}_{\mathrm{stp}}*\mathrm{Tas}+\mathrm{kbiotot}_{\mathrm{water}}*\mathrm{Tss})} \tag{III.2}$$

$$\mathrm{Calkal}_{\mathrm{AS}} = \mathrm{Calkal} * e^{-(\mathrm{kbiotot}_{\mathrm{stp}}*\mathrm{Tas}+\mathrm{kbiotot}_{\mathrm{water}}*\mathrm{Tss})} \tag{III.3}$$

Concentrations after chemical/mechanical treatment (mg.l^{-1}):

$$\mathrm{Cacid}_{\mathrm{CM}} = \mathrm{Cacid} * e^{-\mathrm{kbiotot}_{\mathrm{water}}*\mathrm{Tcm}} \tag{IV.1}$$

$$\mathrm{Cneutr}_{\mathrm{CM}} = \mathrm{Cneutr} * e^{-\mathrm{kbiotot}_{\mathrm{water}}*\mathrm{Tcm}} \tag{IV.2}$$

$$\mathrm{Calkal}_{\mathrm{CM}} = \mathrm{Calkal} * e^{-\mathrm{kbiotot}_{\mathrm{water}})*\mathrm{Tcm}} \tag{IV.3}$$

Concentrations after long-term biological treatment (mg.l^{-1}):

$$\mathrm{Cacid}_{\mathrm{BT}} = \mathrm{Cacid} * e^{-\mathrm{Tbt}*(\mathrm{kbiotot}_{\mathrm{water}}+0.5\mathrm{kphoto}_{\mathrm{water}})} \tag{V.1}$$

$$\mathrm{Cneutr}_{\mathrm{BT}} = \mathrm{Cneutr} * e^{-\mathrm{Tbt}*(\mathrm{kbiotot}_{\mathrm{water}}+0.5\mathrm{kphoto}_{\mathrm{water}})} \tag{V.2}$$

$$\mathrm{Calkal}_{\mathrm{BT}} = \mathrm{Calkal} * e^{-\mathrm{Tbt}*(\mathrm{kbiotot}_{\mathrm{water}}+0.5\mathrm{kphoto}_{\mathrm{water}})} \tag{V.3}$$

End calculations

PEC in aeration tank at activated sludge treatment for acid, neutral and alkaline process conditions respectively (mg.l^{-1}):

$$\mathrm{PEC}_{\mathrm{AS}_{\mathrm{stp\_acid}}} = \mathrm{Cacid} * e^{-0.5*\mathrm{kbiotot}_{\mathrm{stp}}*\mathrm{Tas}} \tag{III.4}$$

$$\mathrm{PEC}_{\mathrm{AS}_{\mathrm{stp\_neutr}}} = \mathrm{Cneutr} * e^{-0.5*\mathrm{kbiotot}_{\mathrm{stp}}*\mathrm{Tas}} \tag{III.5}$$

$$\mathrm{PEC}_{\mathrm{AS}_{\mathrm{stp\_alkal}}} = \mathrm{Calkal} * e^{-0.5*\mathrm{kbiotot}_{\mathrm{stp}}*\mathrm{Tas}} \tag{III.6}$$

PEC in aeration basin at long-term biological treatment for acid, neutral and alkaline process conditions respectively (mg.l^{-1}):

$$\mathrm{PEC}_{\mathrm{BT\,stp\_acid}} = \mathrm{Cacid} * e^{-0.5*\mathrm{Tbt}*(\mathrm{kbioh}_{\mathrm{water}}+0.5\mathrm{kphoto}_{\mathrm{water}})} \tag{V.4}$$

$$\mathrm{PEC}_{\mathrm{BT\,stp\_neutr}} = \mathrm{Cneutr} * e^{-0.5*\mathrm{Tbt}*(\mathrm{kbioh}_{\mathrm{water}}+0.5\mathrm{kphoto}_{\mathrm{water}})} \tag{V.5}$$

$$\mathrm{PEC}_{\mathrm{BT\,stp\_alkal}} = \mathrm{Calkal} * e^{-0.5*\mathrm{Tbt}*(\mathrm{kbioh}_{\mathrm{water}}+0.5\mathrm{kphoto}_{\mathrm{water}})} \tag{V.6}$$

---

1) The numbers in roman refer to the wastewater situations depicted in Figure 12.2

Table 12.5 Model for the calculation of the relevant PECs depending on the user's instructions: [A] amount of biocide per tonne of product and [B/C] amount of biocide per m^3 of water at the wire part of the paper machine (continued)$^{1)}$

PEC in receiving surface water after activated sludge treatment for acid, neutral and alkaline process conditions respectively (mg.l^{-1}):

$$PEClocal_{AS\_water\_acid} = Cacid_{AS} * DILUTION \quad (III.7)$$

$$PEClocal_{AS\_water\_neutr} = Cneutr_{AS} * DILUTION \quad (III.8)$$

$$PEClocal_{AS\_water\_alkal} = Calkal_{AS} * DILUTION \quad (III.9)$$

PEC in receiving surface water after chemical/mechanical treatment for acid, neutral and alkaline process conditions respectively (mg.l^{-1}):

$$PEClocal_{CM\_water\_acid} = Cacid_{CM} * DILUTION \quad (IV.4)$$

$$PEClocal_{CM\_water\_neutr} = Cneutr_{CM} * DILUTION \quad (IV.5)$$

$$PEClocal_{CM\_water\_alkal} = Calkal_{CM} * DILUTION \quad (IV.6)$$

PEC in receiving surface water after long-term biological treatment for acid, neutral and alkaline process conditions respectively (mg.l^{-1}):

$$PEClocal_{BT\_water\_acid} = Cacid_{BT} * DILUTION \quad (V.7)$$

$$PEClocal_{BT\_water\_neutr} = Cneutr_{BT} * DILUTION \quad (V.8)$$

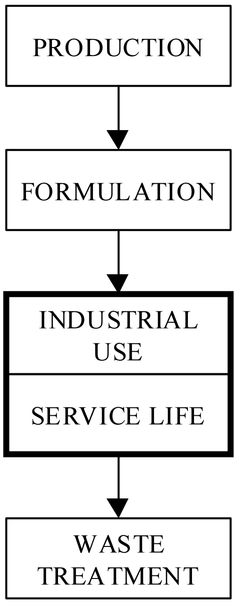
$$PEClocal_{BT\_water\_aa} = Calkal_{BT} * DILUTION \quad (V.9)$$

---

1) The numbers in roman refer to the wastewater situations depicted in Figure 12.2

13. Metalworking-fluid preservatives

USES 3.0 (RIVM, VROM, VWS, 1999) includes an emission scenario for preservatives used in water-based metalworking fluids. The scenario has been derived from Luttik *et al.* (1993) and the defaults for that scenario originate from Van der Poel and Ros (1987).
The scheme of the life cycle stages is presented below. The stage of industrial use (processing) and service life (the time the fluid is in use) are interconnected completely.



The emission scenario is presented in Table 13.1. The parameters required for the distribution model are presented in Table 13.2.

Table 13.1 Emission scenario for calculating the releases from preservatives used in metalworking fluids

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
System capacity[1)] (kg)	Qsyst	100	D
Fraction of fluid supplemented per day (d^{-1})	Fsuppl	0.035	D
Fraction of active ingredient in (diluted) fluid:	Fproc		D
- Emulsions		0.000 5	
- Dispersions		0.000 25	
- Synthetics		0.000 2	
- Semi-synthetics		0.000 35	
- Unknown		0.000 5	

Output:

$Elocal_{3,water}$ = Local emission to wastewater during episode ($kg.d^{-1}$)

Model calculations:

$$Elocal_{3,water} = Qsyst * Fsuppl * Fproc \tag{13.1}$$

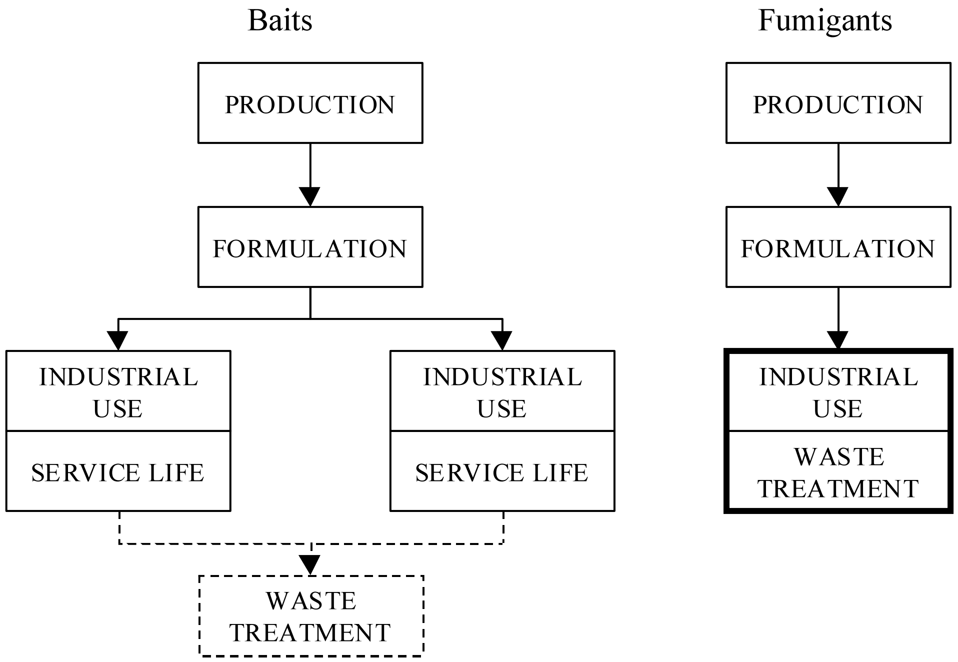
[1)] Amount of metalworking fluid in system of machinery used

Table 13.2 Default values of parameters required for distribution models of USES 3.0

Parameters required	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Number of emission days (d)	Temission	$Temission_{pres}$	$Temission_3$	300

14. Rodenticides

Rodenticides may be applied professionally and by the public at large. The main difference between the various types of rodenticides and their application is the use of rodenticides in baits or as a fumigant. The scheme for the life cycle stages is presented below.



For fumigation of buildings, silos, etc. the emission scenario of USES 3.0 (RIVM, VROM, VWS, 1999) that is described in Luttik *et al.* (1995) is presented in Table 14.1. The parameters required for the distribution model are presented in Table 14.2.

Table 14.1 Emission scenario for calculating the releases from rodenticides used for fogging of buildings, silos, etc.

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Amount used (kg)	Qsubst		S
Fraction of retention in goods (-)	Fret	0.02	D
Fraction of disintegration (-)	Fdisin	0.001	D
Number of emission days for fogging (d)	$Temission_3$	1	D

Output:

$Elocal_{air}$ = Local emission to air during episode ($kg.d^{-1}$)

Model calculations:

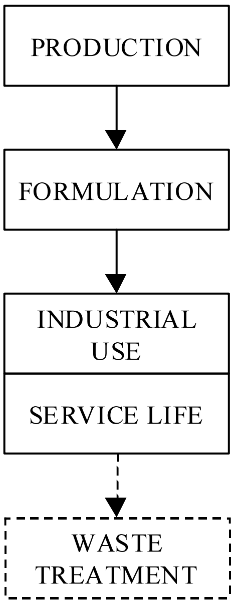
$$Elocal_{3,air} = \frac{Qsubst * (1 - Fret) * (1 - Fdisin)}{Temission_3} \qquad (14.1)$$

Table 14.2 Default values of parameters required for distribution models of USES 3.0

Parameters required	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Number of emission days (d)	Temission	$Temission_{fogging}$	$Temission_3$	1

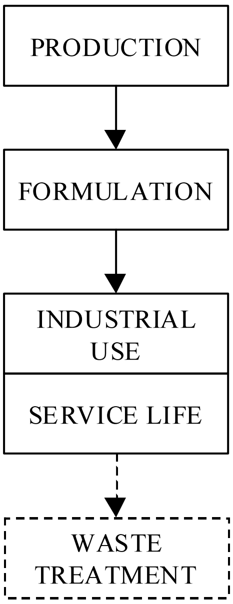
15. Avicides

The scheme of the life cycle stages is presented below. The stage of waste treatment has been denoted by broken lines, as it is not certain that remains after administration of avicides are removed. So far no emission scenario has been developed for avicides.



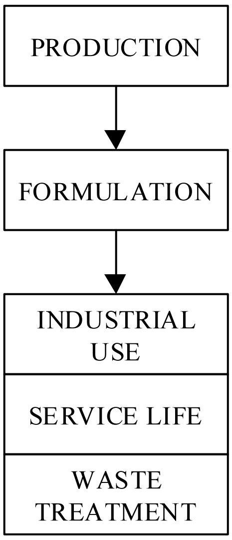
16. Molluscicides

The scheme of the life cycle stages is presented below. The stage of waste treatment has been denoted by broken lines, as it is not certain that remains after administration of moluscicides are removed. So far no emission scenario has been developed for molluscicides.



17. Piscicides

The scheme of the life cycle stages is presented below. The stage of waste treatment has been incorporated with the stages of industrial use and service life. So far no emission scenario has been developed for piscicides.



18. Insecticides, acaricides and products to control other arthropods

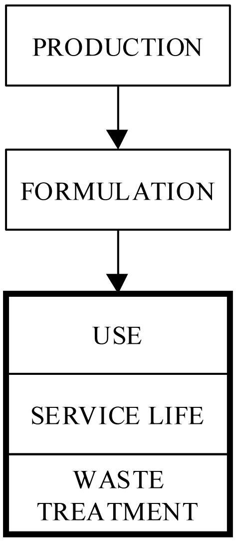
Biocidal products with insecticides are used in many different applications. They may be used in buildings, outdoors, in sewer systems and for veterinary purposes in animal housings (Van Dokkum *et al.*, 1998). The following subgroups may be distinguished:

- Insecticides for manure
- Insecticides for stables
- Insecticides for refuse dumps
- Insecticides for empty spaces and spaces with stocks
- Aerosols/fumigants used outdoors
- Aerosols/fumigants used within fumigation installations
- Aerosols/fumigants used indoors

These subgroups will be discussed in the following sections. The subgroups insecticides for manure and stables have been treated together as well as the subgroup insecticides for empty spaces and spaces with stocks with the three subgroups on aerosols/fumigants.

18.1 Insecticides for animal housings and manure storage systems

In specific cases there may be an interference with product type 4 (food and feeding area disinfectants), and veterinary medicinal products. This can occur if a biocide is used for more than one purpose. This is, for example, the case with the biocide fenitrothion. This biocide is admitted as an insecticide in animal housings, as a preservative in feed (insecticide) and as a medicinal product against ectoparasites for chickens.
The scheme of the life cycle stages is presented below.



A report on these subgroups has been drafted for the EUBEES project (Van der Poel, 2001b). Although this report has not been finalised yet the emission scenarios are presented here. The default values of the draft report concern the Dutch situation and will be updated as soon as EU averages or when pick-lists for member states or other EU regions become available. Figure 18.1 presents an overall flow scheme of the fate of insecticides for both types of application. In practice it turns out that an insecticide may be notified for both application in animal housings as in manure depots (larvicides). In those cases the overall concentration of both applications has to be calculated.

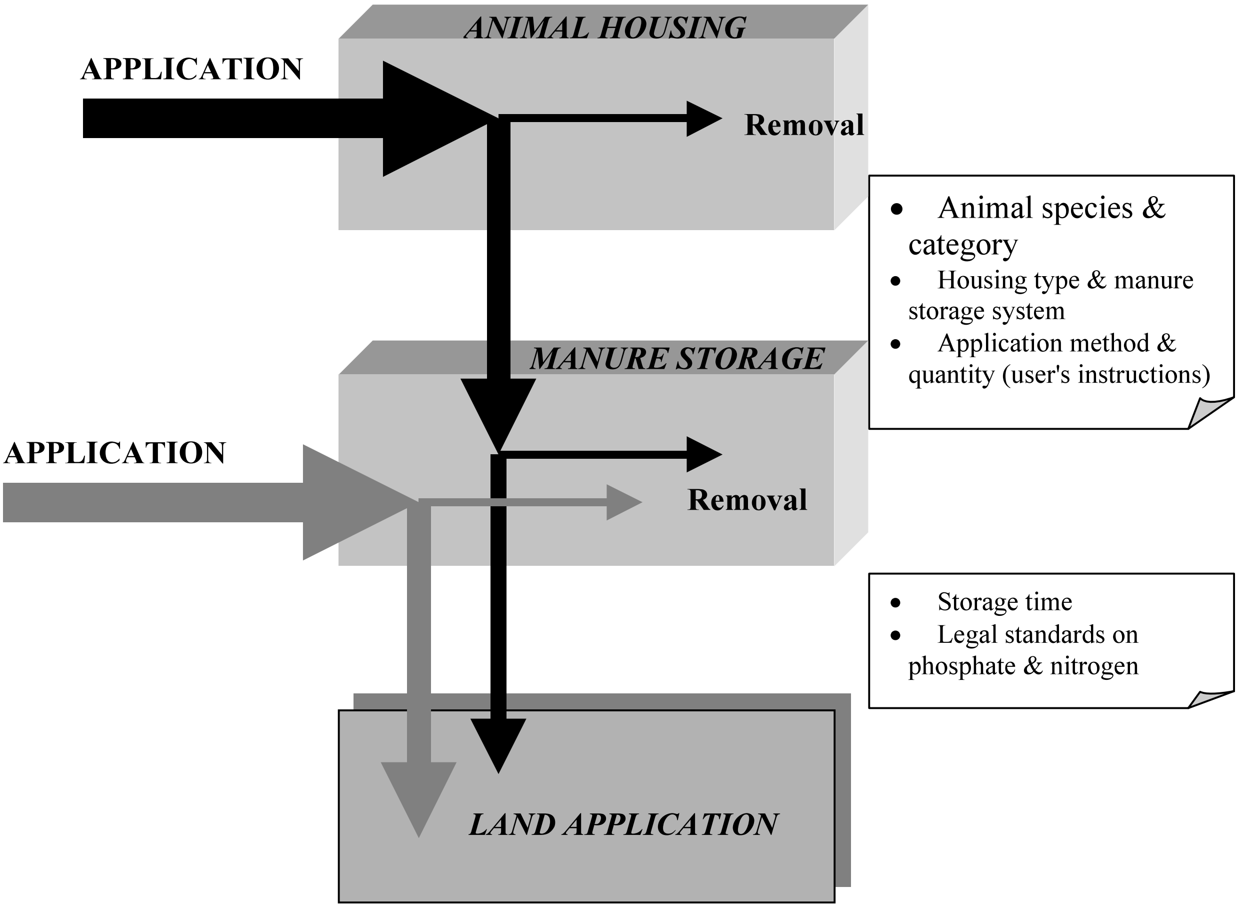


Figure 18.1 Overall flow chart of an insecticide applied in animal housings and manure storage systems; in the blocks at the right the factors influencing the transfer to manure storage and soil have been summarised

Potential effects such as degradation, volatilisation, release to wastewater have been represented as “removal” in this figure. To build the emission scenarios the parameters needed for the factors influencing the releases had to be identified.
Figure 18.2 presents the connection between the various factors influencing the application and emission of insecticides. It should be noted that the type of manure storage and housing are directly linked to each other. They are depicted separately as the emission factor of the insecticide applied in the housing to the manure storage depends on the place where the insecticide has been applied in the housing. The grey and black block arrows represent the flow of insecticides. The numbered bullets in Figure 2.2 at the arrows with broken lines – representing the relations – are discussed below:

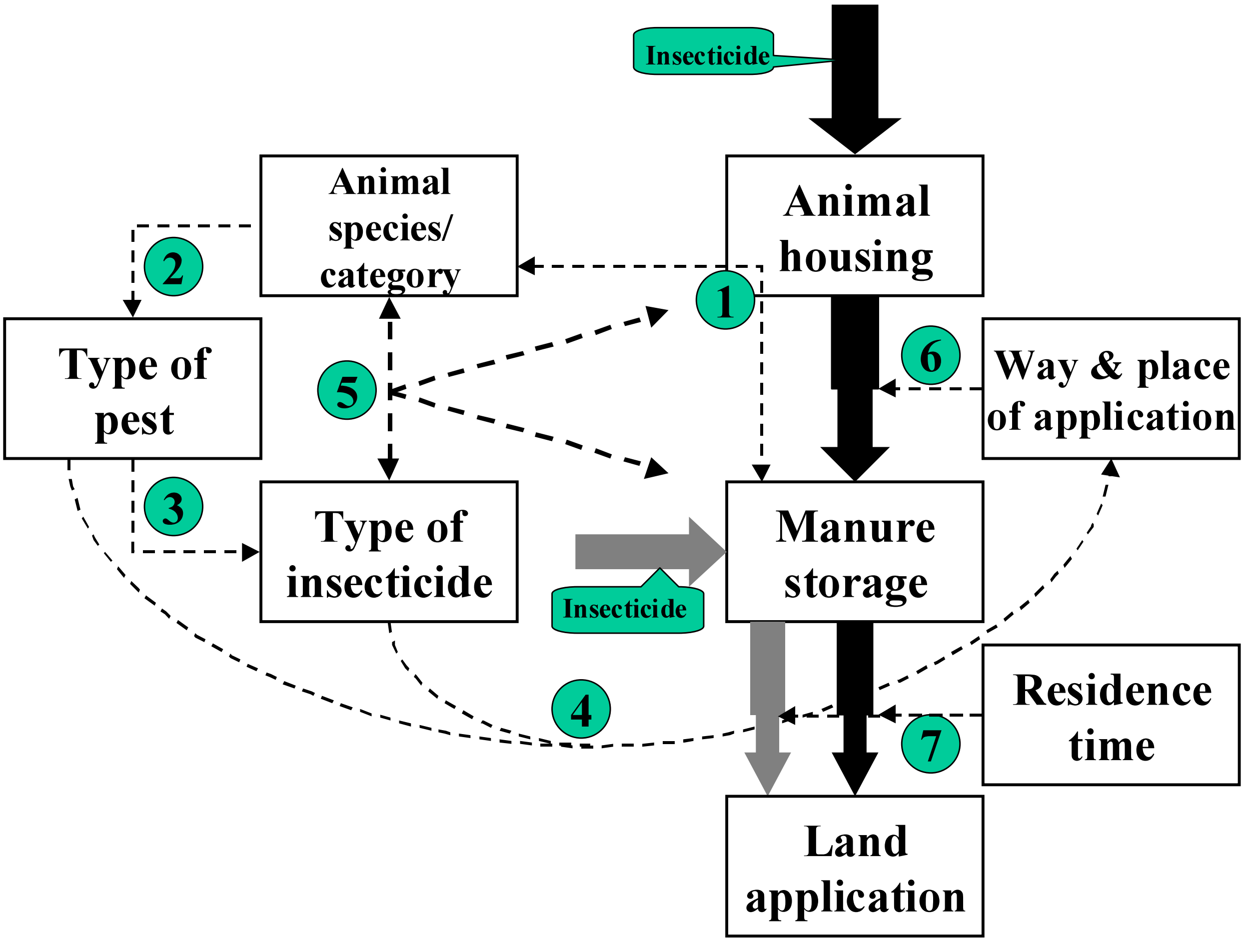


Figure 18.2 Factors influencing the application and emission of insecticides; the block arrows represent the flow of insecticides and the arrows with broken lines the relations (for explanation see text)

- ❶ The type/category of manure storage (including the way the wastewater is used/treated) is linked with the type of housing and the animal species/category.
  Example: For the animal species pigs and category fattening pigs the type of manure storage is wet storage and the category slurry pits. The pigs will be placed in barns with grating floors; the type of housing is connected to the manure storage system.
- ❷ The animal species is linked to the various pests in the housing/manure storage. Flies are in principle a potential pest for all animal species/categories. Especially poultry are susceptible to other insects.
- ❸ The type of pest dictates the type of insecticide to be used.
- ❹ The type of pest and type of insecticide together have an influence on the way and place of application. It should be noted that this is described in the statutory user's instructions together with the dosage.
- ❺ The specific animal category and type of insecticide determine the application in animal housing(s) and/or manure storage systems.

❻ The way and place of application in the animal housing have a direct influence on the fraction of the insecticide going to the manure storage. *Example: Sprinkling of the insecticide on the floor will lead to a larger fraction than bait placed at a windowsill.*

❼ The residence time in the manure storage influences the degree of degradation of the insecticide in the manure at land application.

The legal standards on the phosphate and nitrogen load determine the concentration of the insecticide present in the manure at the moment of land application. Therefore, the parameters needed for the calculation had to be determined "from the bottom up". The whole scheme with the factors and parameters needed are presented in Figure 18.3. The arrows with the broken line denote the relation between the factors/parameters opposed by the factor at the start of the arrow.

In Figure 18.3 the situation for one application has been represented. In the scenario the possibility of several applications of the insecticide is considered. In that case the concentration of the insecticide (active ingredient) is calculated after the last storage period (land application) in the first year that the insecticide is applied; the degradation in the soil of the applications before the last period is taken into account. Many of the parameters involved are dependent on items such as the animal species and category involved, the type of housing for them, the manure storage system, etc.

18.1.1 Emission routes and fate of insecticides

Insecticides applied as a larvicide at manure storage systems end up completely in the manure. The degradation process in the manure storage while the manure is collected and stored until it is used for land application (the storage time has been be taken into account in the emission model).

If a farmer has a dry storage system (manure heap or manure pit), the liquid waste will be discharged to the sewer or be collected in a separate slurry tank (Van der Linden and Post, 2000). The liquid waste then may be either discharged to the sewer that is connected to a sewage treatment plant (STP) or applied via field application. In the case of discharge to the sewer the same situation as with direct discharge occurs. In the case of field application, it may be assumed that the liquid waste is applied evenly on all fields together with the manure, as is the case with wet storage (slurry pits, where manure and wastewater are collected together) (Van der Linden and Post, 2000). This has been visualised in Figure 18.4.

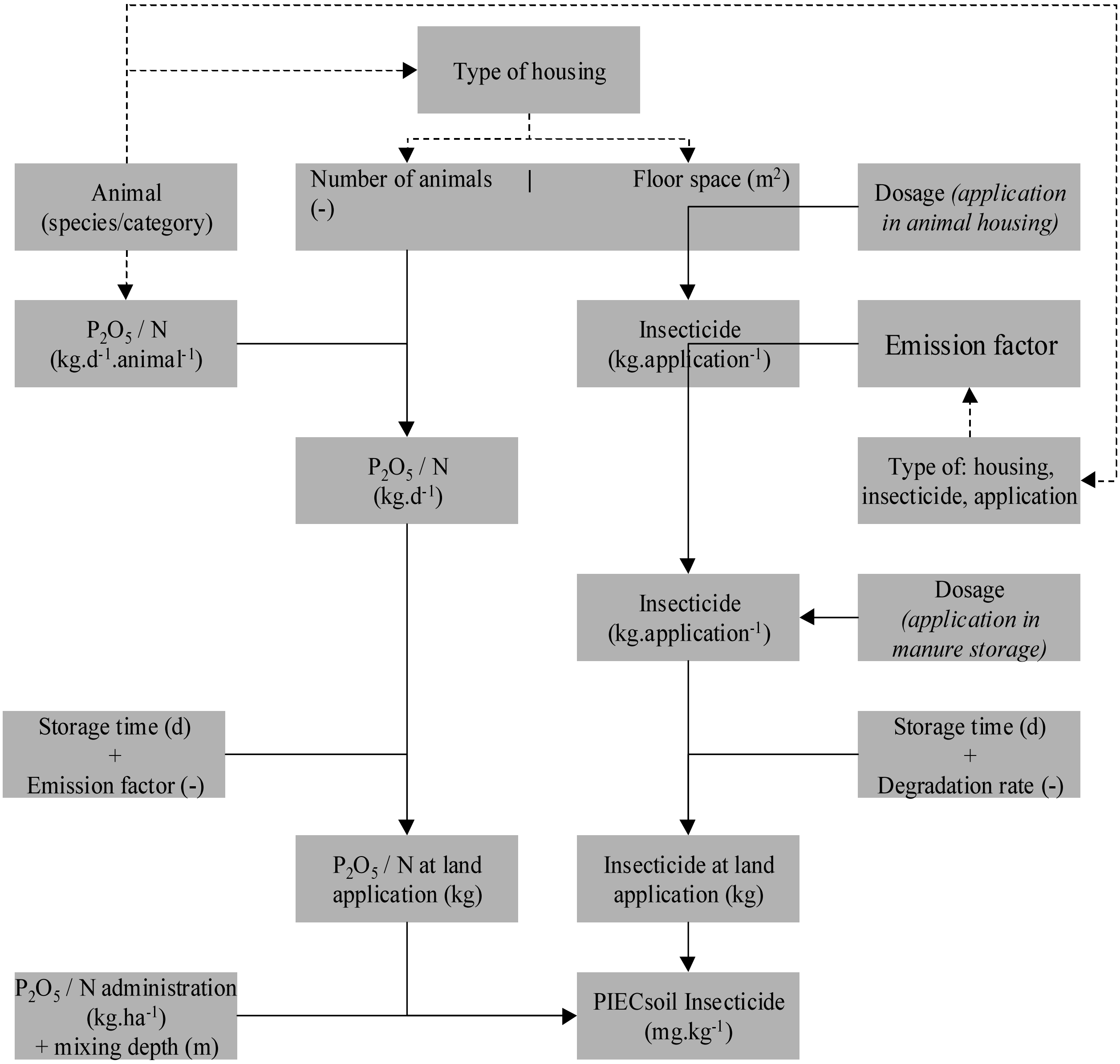


Figure 18.3 Flow chart of an insecticide applied in animal housings and manure storage systems, where the arrows; in the blocks at the right the factors influencing the transfer to manure storage and soil have been summarised

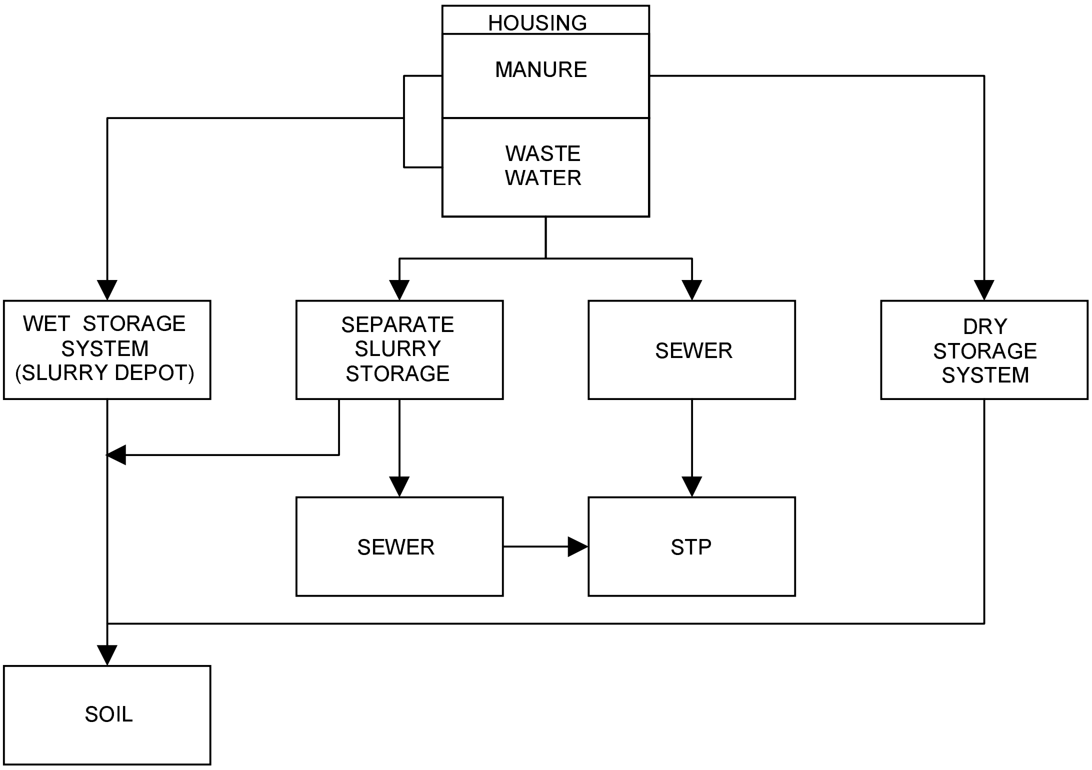


Figure 18.4 Storage systems of manure and destination of wastewater and manure

The ways of manure storage and wastewater destination are independent of the biocide notified and may vary from farm to farm. Therefore, the following situations have to be considered in the risk assessment:

1. Wet storage (slurry), where the whole amount of biocide is being spread on agricultural soil;
2. Dry storage, where a part of the biocide is being spread on agricultural soil with the manure and the other part is going to the STP with the wastewater (USES comprises a STP model with defaults that may be used for the scenarios of this report).

Only for poultry the statutory user's instructions may state that the insecticide is only to be used in housings with dry manure storage. For the emissions the way of application of the insecticide is not important, e.g. sprinkling or spraying. The aim is to cover the whole surface of the manure.

The notifier of a biocide states in the statutory user's instructions how to apply the preparation. This may concern possible dilution, the way of application, for example smearing of certain places or spraying of floor, walls and ceiling, the interval for repetition and need for ventilation after application for treatment of animal housing facilities. This may influence the fraction of the biocide reaching the manure storage system and the fraction emitted directly to the air.

The fraction of the biocide reaching the manure storage ($F_{i1,i2,i3,i4}$) will depend on the animal species and category considered (i.e. the type of housing and manure collection system), the way of application and the way of action of the biocide. The ways of application of importance for the emission to manure are briefly discussed below:

Sprinkling

Granules will be sprinkled on those parts of the floor where organic substrate (manure, bedding material and spilled feed) will be usually present. These places are gratings, manure passages, cracks, the surroundings of feeding- and drinking troughs.

Spraying

Solutions and dispersions, which are sprayed, will reach larger surfaces and may not only be applied on the floor but also on the walls and ceiling. Spraying powders will be mainly applied on floors and the surface of manure heaps.

Smearing

Smearing, for example with a brush ("brushing"), can be carried out on those places where flies use to stay, e.g. on windowsills.

Baiting

In this case, the insecticide is mixed with substances attracting the insects. For flies sugar is used, often in combination with sex attractants. The baits that are admitted in the Netherlands may both be used in open containers and sprinkled.

Figure 18.5 presents the emission routes of insecticides applied in animal housings. This scheme is discussed here for the emission routes of interest for the emission model:

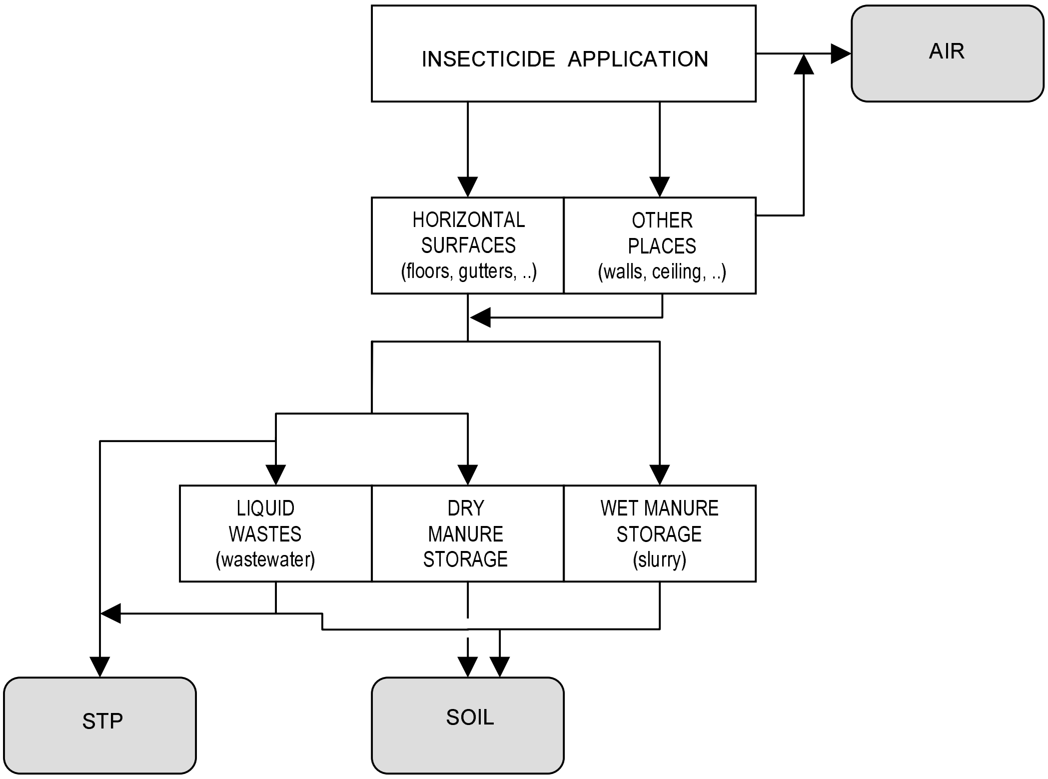


Figure 18.5 Scheme of emission routes of biocides depending on places of application and type of manure storage

18.1.2 Release estimation and steering parameters

The amount of slurry/manure spread on the soil depends on the immission standards for phosphate or nitrogen and the phosphate and nitrogen content of the slurry/manure. Therefore, the concentration of the biocide is calculated based on phosphate or nitrogen production, as in Montforts (1999) for phosphate.
For the modelling of the liquid waste going to an STP the load to the standard STP of USES and EUSES is considered for laying hens in batteries with drying and pens with a grating floor.

The scheme of calculations – depicted by hexagons – and the parameters involved – depicted as rectangles – is presented in Figure 18.6.

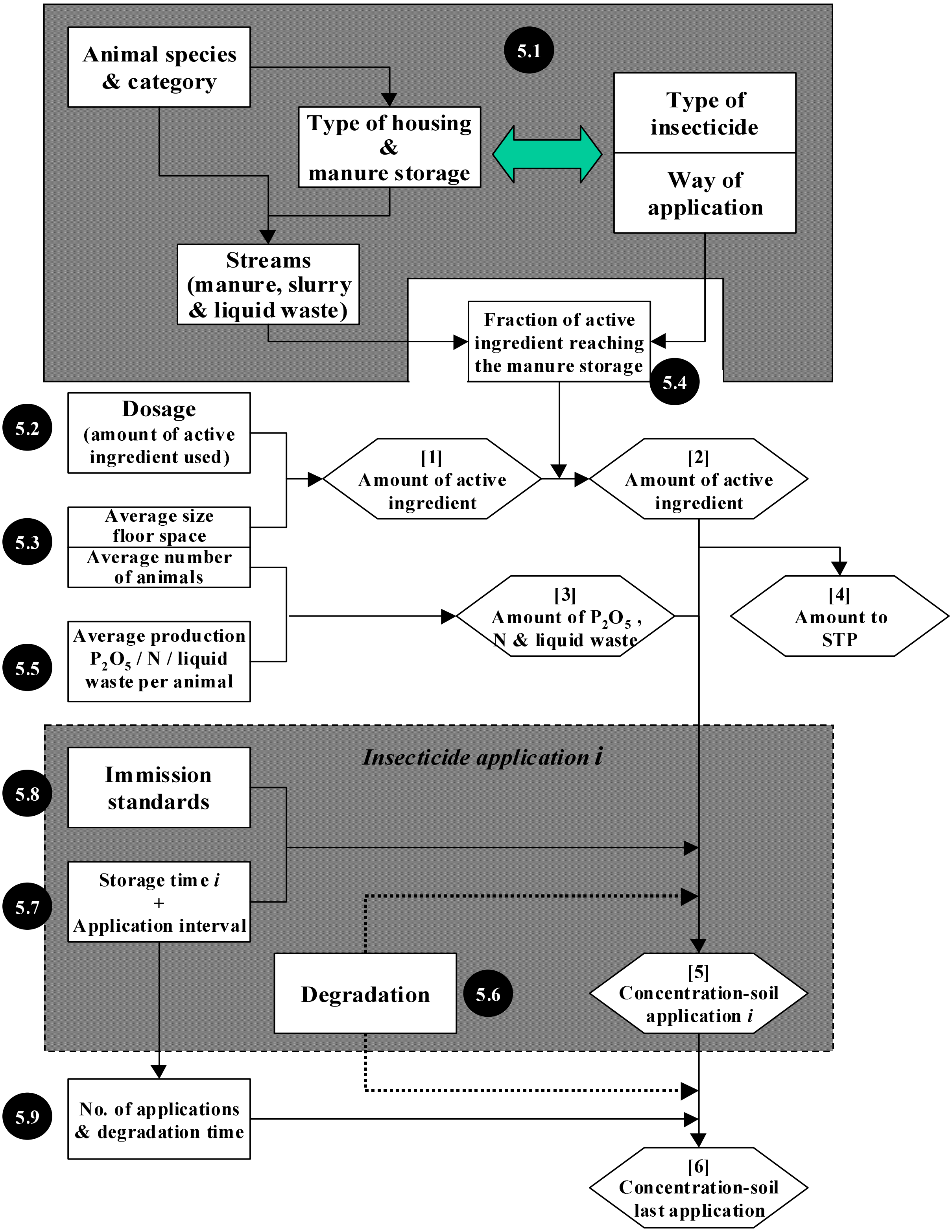


Figure 18.6 Scheme of parameters and variables (rectangles) for the calculations (hexagons); the numbers in the black bullets refer to the sections concerned

As has been show in various figures some parameters are linked to each other. They are at the basis for the release estimation. For modelling they have been provided with variable names. These basic parameters with their variable names (in bold between parentheses) are:

- Animal (sub)categories and/or manure storage system for which the insecticide has been notified (**cat-subcat**).
- For poultry the housing type(s) concerned (**cat-subcat**).
- The way the insecticide is applied (**appway**).
- The type of insecticide (**bioctype**).
- The stream(s) where the biocide is emitted to (**stream**)

It should be noted that the first two parameters have been combined to one. Furthermore, it should be kept in mind that the way of application is "included" so to speak in the parameter for the way the insecticide is applied. This is of particular importance for the emission factor to the manure storage, in other words the fraction of the insecticide (active ingredient) that is transferred to the manure storage.

The variable names are used as subscripts in the symbols for the parameters. To maintain oversight, these variable names in the subscripts of the symbols have been replaced by indices:

index	variable subscript name
i1	cat-subcat
i2	bioctype
i3	appway
i4	stream

Table 18.1 presents the pick list with the values of the variable names with the description of the variable content, the variable names and indices. The values of the variable names are used in the formulas for the calculations.
It should be noted that for laying hens data for hens ≥ 18 weeks are used.

The cat-subcat numbers $i1 = 14$ (manure storage "wet") and $i1 = 15$ (manure storage "dry") are not the same as the respective streams $i4 = 3$ (slurry) and $i4 = 1$ (manure); the cat-subcats are used to identify the application of the biocide directly at the storage systems. The choice of $i1$ (for $i1 = 1$ to 13) implies the value of $i4$ for the waste stream manure or slurry.
In section 4.2 it was already mentioned that, for example, the situation for summer stable feeding should be added in future. This is also the case for other animal species such as various poultry species and for animal species where probably larvicides are used at manure heaps. When data become available new cat-subcats can be added to the scenario easily.

Table 18.1 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 (milking parlour treatment)
2	Beef cattle
3	Veal calves
4	Sows
5	Fattening pigs
6	Laying hens in battery cages without treatment
7	Laying hens in battery cages with aeration (belt drying)
8	Laying hens in battery cages with forced drying (deep pit, high-rise)
9	Laying hens in compact battery cages
10	Laying hens in free range with litter floor
11	Broilers in free range with litter floor
12	Parent broilers in free range with grating floor
13	Parent broilers in rearing with grating floor
14	Manure storage "wet" (slurry pits)
15	Manure storage "dry" (manure heaps)
Variable name: bioctype , Index: i2	
1	Insecticide (adulticide), specifically against flies
2	Insecticide (adulticide) against other insects and arthropods (bloodsucking pests)
3	Larvicide (larvae of flies)
4	Insecticides against other insects (not affecting livestock)
Variable name: appway , Index: i3	
1	Spraying
2	Aerosol
3	Smearing
4	Sprinkling
5	Bait
6	Both sprinkling and bait
Variable name: stream , Index: i4	
1	Manure
2	Wastewater (wwater)
3	Slurry

18.1.3 Emission model

The model comprises the calculation of the concentration in soil of biocides (active ingredient or a.i.) applied in housings and in manure storage systems, and the amount emitted to wastewater treated in an STP (if applicable). In the case that a larvicide is concerned to be used in both housings and manure storage systems, the concentration has to be calculated as the sum of both individual concentrations (the same amount of manure is concerned). This has not been expressed in the presentation of the model by subscripts to avoid further complication.

In the case, an insecticide formulation is notified for the general category “animal housings”, calculations for all animal categories and subcategories have to be performed. This, because it may turn out that application may be without risk for certain (sub)categories but not for others.

In the case of poultry, where the notification comprises application in both batteries (without treatment with an air current) and free-range housings with litter floor, the concentration has to be calculated for the slurry consisting of the manure from the battery plus the liquid waste from the free-range housing (stored in slurry tanks).

For batteries with aeration or forced drying (deep pit, high-rise stables), also the amount of active ingredient going to an STP has to be calculated. It has been assumed that only one farm releases liquid waste with the insecticide involved to the sewer at one day.

A part of the insecticide will be emitted to the air directly, depending on the application method and volatility. In the case, that a formulation is sprayed, most of the product will settle with the droplets (solutions) or particles (powders) soon after the treatment. It is unclear at this moment which fraction of an insecticide on walls, ceilings, windows, etc. will be lost due to degradation, evaporation or run-off (e.g. at cleaning). The fraction of insecticide emitted to the air is expected to have such a low rate that a zero emission is assumed.

An insecticide applied in animal housings will probably degrade to some extent before it reaches the manure storage system (such as pits) or the manure heaps. In one case, a biocide has been admitted for application in both housing and at manure heaps. As the application of a biocide (adulticide) in manure storage systems is not very likely to occur, the situation that the amount present in the manure from the housing will be added to the amount present in the storage system, is not considered here.

It should be noted that a notification is done for a <u>product</u>, for example a spray containing a certain concentration of an active ingredient, but not for the specific <u>active ingredient</u> present in different products. For every product the notifier states in the user's instructions:

1. The applications, i.e. the definition of the type of housing/manure storage 'cat-subcat' (index i1) (animal species, housing type, etc.).
2. The type of biocide 'bioctype' (index i2); this will usually be only one out of the four possibilities.
3. The ways the product may be applied 'appway' (index i3), for example spraying and smearing.

It should also be noted that the model presentation does **not** contain subscripts for the *m* applications (index i1) and *n* types of application (index i3) to maintain overview.

First, Table 18.2 presents the general part of the emission scenarios for all situations of insecticide application in animal housings and at manure storage systems. The numbers in the column "Table" refer to the tables with default values for the parameter concerned

Table 18.2 General part of the emission scenarios for all situations of insecticide application in animal housings and at manure storage systems

Variable/parameter (unit)	Symbol	Value	S/D/O/P
Input:			
Half-life time for biodegradation in slurry (d)	$DT50bio_{slurry}$	$1e^6$	D
Half-life time for biodegradation in soil (d)	$DT50bio_{soil}$	$1e^6$	D
Bulk density of soil (kg.m^{-3})	RHOsoil	1500	D

Output:

$kdeg_{slurry}$	Rate constant for biodegradation in slurry (d^{-1})
$kdeg_{soil}$	Rate constant for biodegradation in soil (d^{-1})

Model calculations:

Rate constant for biodegradation in slurry (d^{-1})

$$kdeg_{slurry} = \frac{\ln 2}{DT50bio_{slurry}} \tag{18.1}$$

Rate constant for biodegradation in soil (d^{-1})

$$kdeg_{soil} = \frac{\ln 2}{DT50bio_{soil}} \tag{18.2}$$

The specific model is presented in Table 18.3 and footnotes placed in the table have been placed after the table. The numbers in the column "Table" refer to the tables with default values for the parameter concerned

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems

Variable/parameter (unit)	Symbol	S/D/O/P	[table]
Input:			
Type of housing/manure storage (for application *m* of the notification) (-)	cat-subcat (i1)	S/P	[18.1]
Type of insecticide (-)	bioctype (i2)	S/P	[18.1]
Type of application *n* (-)	appway (i3)	S/P	[18.1]
Area of housing or manure storage (m^2)	$AREAtarget_{i1}$	D	[18.4]
[A]			
Content of active ingredient in formulation (%)	$Fform_{\%}$	S	
Area to be treated with amount prescribed (m^2) for application *m*	$AREAuins_{i1}$	S	
Amount of product prescribed to be used for area specified (g) for application *m*	$Qform\_uins_{i1,i2,i3}$	S	
[B]			
Content of active ingredient in formulation ($g.l^{-1}$)	$Fform_{vol}$	S	
Area to be treated with amount prescribed (m^2) for application *m*	$AREAuins_{i1}$	S	
Amount of product prescribed to be used for area specified (l) for application *m*	$Vform\_uins_{i1,i2,i3}$	S	
[C]			
Capacity of one aerosol can (g)	$Qsubst_{aer}$	S	
Area to be treated with one aerosol can (m^2)	$AREAuins_{i1}$	S	
[A + B + C]			
For every relevant application *i1* specified in the notification and every relevant stream *i4*:			
Fraction of active ingredient released (-)	$F_{i1,i2,i3,i4}$	D	[18.5]
. . . .			
Start date of period of insecticide application $^{1)}$	Tstart $^{1)}$	D/P	[18.6/18.7]
Or:			
Start day of insecticide application (d)	Ts	D	[18.6/18.7]
. . . .			
End date of period of insecticide application $^{1)}$	Tend $^{1)}$	D/P	[18.6/18.7]
Or:			
Last day of insecticide application (d)	Te	D	[186/18.7]

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

Variable/parameter (unit)	Symbol	S/D/O/P	[table]
Number of days for correction if insecticide application is within that period before land application (d)	Tcorr	D	[18.10]
Maximum number of applications (-)	Nappl_bioc	D	[18.6] 2)
Day of 1st insecticide application:			
a1) by date 1)	$Tappl\_d_1$	D/P	[18.6/18.7]
b1) by day number	$Tappl\_n_1$	D	[18.6/18.7]
If Nappl_bioc > 1:			
Insecticide application interval (d)	Tint_bioc	D	[18.6] 2)
Days of other insecticide applications:			
a1) by date (j = 2··· Nappl_bioc) 1)	$Tappl\_d_j$	D/P	[18.6/18.7]
b1) by day number (j = 2··· Nappl_bioc)	$Tappl\_n_j$	D	[18.6/18.7]
c1) by application interval (Tint_bioc)	***see intermediate calculations: <u>Subroutine 1</u>***		
. . . .	. . . . . .	. . . .	. . . .
Start date land application period grassland 1)	Tgr_start 1)	D/P	[18.8/18.7]
Or:			
Start day of land application grassland (d)	Tgrs	D	[18.7]
. . . .	. . . . . .	. . . .	. . . .
End date period land application grassland 1)	Tgr_end	D/P	[18.8/18.7] 1)
Or:			
Last day of land application grassland (d)	Tgre	D	[18.7]
. . . .	. . . . . .	. . . .	. . . .
Start date land application period arable land 1)	Tar_start	D/P	[18.8/18.7] 1)
Or:			
Start day of land application arable land (d)	Tars	D	[18.7]
. . . .	. . . . . .	. . . .	. . . .
End date period land application arable land 1)	Tar_end	D/P	[18.8/18.7] 1)
Or:			
Last day of land application arable land (d)	Tare	D	[18.7]
. . . .	. . . . . .	. . . .	. . . .
Number of land applications for grassland (yr^{-1})	Nlap_grass	D	[18.9] 3)
If Nlap_grass > 0:			
Day of 1st land application (grassland):			
a) by date 1)	Tgr_app_1	D/P	[18.6/18.7]
b) by day number	$Tgrap_1$	D	[18.6]

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

Variable/parameter (unit)	Symbol	S/D/O/P	[table]
If Nlap_grass >1:			
Land application interval for grassland (d)	Tint_gr	D	[18.6] 3)
Days of other land applications grassland:			
a) by date (j = 2··· Nlap_grass) 1)	Tgr_app_j	D/P	[18.6/18.7]
b) by day number (j = 2··· Nlap_grass)	$Tgrap_j$	D	[18.6]
c) by application interval (Tint_gr)	***see intermediate calculations: <u>Subroutine 2</u>***		
. . . .			
Number of land applications for arable land (yr^{-1})	Nlap_arab	D	[18.9] 3)
If Nlap_arab > 0:			
Day of 1st land application (arable land):			
a) by date 1)	Tar_app_1	D/P	[18.6/18.7]
b) by day number	$Tarap_1$	D	[18.6]
If Nlap_arab >1:			
Land application interval for arable land (d)	Tint_ar	D	[18.6] 3)
Days of other land applications arable land:			
a) by date (j = 2··· Nlap_arab) 1)	Tar_app_j	D/P	[18.6/18.7]
b) by day number (j = 2··· Nlap_arab)	$Tarap_j$	D	[18.6]
c) by application interval (Tint_ar)	***see intermediate calculations: <u>Subroutine 3</u>***		
. . . .			
Number of animals in housing for every relevant category/subcategory *i1* (-)	$Nanimal_{i1}$	D	[18.4]
Amount of phosphate per animal for every relevant category/subcategory *i1* ($kg.d^{-1}$)	$Qphosph\_excr_{i1}$	D	[18.11]
Amount of nitrogen per animal for every relevant category/subcategory *i1* ($kg.d^{-1}$)	$Qnitrog\_excr_{i1}$	D	[18.11]
Fraction of biocide added in the case of a combination of application in both poultry batteries without treatment and free range with litter floor (-)	Fadd	D	[18.10]
If phosphate immission standards are applied: 7)			
Phosphate immission standard for grassland ($kg.ha^{-1}.yr^{-1}$)	$Qphosph\_is_{grass}$	D	[18.9]
Phosphate immission standard for arable land ($kg.ha^{-1}.yr^{-1}$)	$Qphosph\_is_{arable}$	D	[18.9]
. . . .			

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

Variable/parameter (unit)	Symbol	S/D/O/P	[table]
If nitrogen immission standards are applied: [7)]			
Nitrogen immission standard for grassland ($kg.ha^{-1}.yr^{-1}$)	$Qnitrog\_is_{grass}$	D	[18.9]
Nitrogen immission standard for arable land ($kg.ha^{-1}.yr^{-1}$)	$Qnitrog\_is_{arable}$	D	[18.9]
. . . .			
Mixing depth with soil (m)	$DEPTHmix_{grass}$	D	[18.9]
Mixing depth with soil (m)	$DEPTHmix_{arable}$	D	[18.9]
Rate constant for biodegradation in slurry (d^{-1})	$kdeg_{slurry}$	O	[18.2]
Rate constant for biodegradation in soil (d^{-1})	$kdeg_{soil}$	O	[18.2]
Density of bulk soil ($kg.m^{-3}$)	RHOsoil	D	[18.2]

Output:

Soil

For every relevant application *i1* and stream *i4* and

$PIECgrs\_P2O5_{i1,i2,i3,i4}$ = Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) after the first year that the biocide is applied in the case of an immission standard for phosphate and land application on grassland

$PIECgrs\_N_{i1,i2,i3,i4}$ = Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) after the first year that the biocide is applied in the case of an immission standard for nitrogen and land application on grassland

$PIECars\_P2O5_{i1,i2,i3,i4}$ = Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) after the first year that the biocide is applied in the case of an immission standard for phosphate and land application on arable land

$PIECars\_N_{i1,i2,i3,i4}$ = Concentration of the biocide (active ingredient) in soil ($mg.kg^{-1}$) after the first year that the biocide is applied in the case of an immission standard for nitrogen and land application on arable land

STP

$Elocal_{3,water}$ = Amount of biocide (active ingredient) ($kg.d^{-1}$) reaching the standard STP of EUSES/USES for the relevant cases of *i1* = 6, 7, 10 and 11

Intermediate calculations

Subroutine 1:

Days of insecticide applications by application interval

```
    $Nappl\_bioc = Integer[(Te - Tappl\_n_1) / Tint\_bioc] + 1$
╔▶  FOR i = 2 ▪▪▪▪ Nappl_bioc
╚═      $Tappl\_n_i = Tappl\_n_{i-1} + Tint\_bioc$        (18.3)
End of Subroutine 1
```

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

Subroutine 2: Days of land application grassland by application interval

```
        IF Tgrs > Tgre GO_TO #1   ("Split" interval correction, see Appendix 6)

        Nlap_grass = Integer[(Tgre – $Tgrap_1$) / Tint_gr] + 1          (18.4.1)
        m = 1
#2      m = m + 1
        $Tgrap_m$ = $Tgrap_{m-1}$ + Tint_gr                              (18.5.1)
        IF m < Nlap_grass GO_TO #2
        GO_TO End of Subroutine 2

#1      Tgre = Tgre + 365   ("Split" interval correction, see Appendix 6)
        Nlap_grass = Integer[(Tgre – $Tgrap_1$) / Tint_gr] + 1          (18.4.2)
        i = 1
        ih = 0
        $Thelp_1$ = $Tgrap_1$
#3      i = i + 1
        $Thelp_i$ = $Thelp_{i-1}$ + Tint_gr
        IF $Thelp_i$ = <365 GO_TO #4
        ih = ih + 1
#4      IF i < Nlap_grass GO_TO #3
        j = 0
#5      j = j + 1
        k = Nlap_grass + 1 – j
        $Tgrap_j$ = $Thelp_k$ – 365                                     (18.5.2)
        IF j < ih GO_TO #5
#6      j = j + 1
        $Tgrap_j$ = $Thelp_{j-ih}$
        IF j < Nlap_grass GO_TO #6
End of Subroutine 2
```

Subroutine 3:

Days of land application arable land by application interval

```
        IF Tars > Tare GO_TO #7   ("Split" interval correction, see Appendix 6)

        Nlap_arab = Integer[(Tare – $Tarap_1$) / Tint_gr] + 1           (18.6.1)
        m = 1
#8      m = m + 1
        $Tarap_m$ = $Tarap_{m-1}$ + Tint_gr                              (18.7.1)
```

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

```
        IF m < Nlap-arab GO_TO #8
        GO_TO End of Subroutine 3

#7      Tare = Tare + 365   ("Split" interval correction, see Appendix 6)
        $Nlap\_arab = Integer[(Tare - Tarap_1) / Tint\_gr] + 1$                 (18.6.2)
        i = 1
        ih = 0
        $Thelp_1 = Tarap_1$
#9      i = i + 1
        $Thelp_i = Thelp_{i-1} + Tint\_ar$
        IF $Thelp_i$ = <365 GO_TO #10
        ih = ih + 1
#10     IF i < Nlap_arab GO_TO #9
        j = 0
#11     j = j + 1
        k = Nlap_arab + 1 – j
        $Tarap_j = Thelp_k - 365$                                             (18.7.2)
        IF j < ih GO_TO #11
#12     j = j + 1
        $Tarap_j = Thelp_{j-ih}$
        IF j < Nlap_arab GO_TO #12
End of Subroutine 3
```

Subroutine 4:

Correction for insecticide applications just before application interval (grassland situation) *(see Appendix 7)*

```
        m = 0                  (m is numerator for number of land applications)
        j = 1                  (j is numerator for number of insecticide applications)
#13     m = m + 1
        IF m > Nlap_grass GO_TO End
#14     IF $Tappl\_n_j \leq Tgrap_m - Tcorr$ AND $Tappl\_n_j \leq Tgrap_m$ GO_TO #16
        IF $Tappl\_n_j > Tgrap_m$ GO_TO #13
#15     j = j + 1
        IF j > Nappl_bioc GO_TO Subroutine 5
        GO_TO #14
#16     $Tappl\_n_j = Tgrap_m + 1$                                            (18.8.1)
        IF j = Nappl_bioc GO_TO Subroutine 5
        m = m + 1
        IF m > Nlap_grass GO_TO Subroutine 5
```

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

```
        GO_TO #15
```

End of Subroutine 4

Subroutine 5:

Correction for insecticide applications just before application interval (arable land situation) *(see Appendix 7)*

```
        $m = 0$                      (m is numerator for number of land applications)
        $j = 1$                      (j is numerator for number of insecticide applications)
#17     $m = m + 1$
        IF $m > Nlap\_arab$ GO_TO End of Subroutine 5
#18     IF $Tappl\_n_j \geq Tarap_m - Tcorr$ AND $Tappl\_n_j \leq Tarap_m$ GO_TO #20
        IF $Tappl\_n_j > Tarap_m$ GO_TO #17
#19     $j = j + 1$
        IF $j > Nappl\_bioc$ GO_TO End of Subroutine 5
        GO_TO #18
#20     $Tappl\_n_j = Tarap_m + 1$                                              (18.8.2)
        IF $j = Nappl\_bioc$ GO_TO End of Subroutine 5
        $m = m + 1$
        IF $m > Nlap\_arab$ GO_TO End of Subroutine 5
        GO_TO #19
End of Subroutine 5
```

Subroutine 6:

Number of degradation days in manure ($Tddmgr_p$) and soil ($Tddgr_p$) for the grassland situation; help variables for calculations over the year (Tcalc and $T2grap_{j5}$) and a numerator for the number of calculations to carry out for degradation periods (Ncalgr).

```
        $j = 0$
        $Tcalc = 365 + Tappl\_n_1$                                              (18.9)
#21     $j = j + 1$
        $T2grap_j = 365 + T2grap_j$                                             (18.10)
        IF $Tcalc \leq T2grap_j$ GO_TO #22
        $Tgrap_{Nlap\_grass+1} = T2grap_j$                                      (18.11)
        $Nlap\_grass = Nlap\_grass + 1$                                         (18.12)
        GO_TO #21
#22     $p = 0$                      (p is numerator for number of insecticide applications)
        $q = 1$                      (q is numerator for number of land applications)
        $Ncalgr = 0$
#23     $p = p + 1$
        IF $p > Nlap\_grass$ GO_TO Subroutine 7
#24     IF $Tgrap_q \geq Tappl\_n_p$ GO_TO #25
```

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

```
        $q = q + 1$
        GO_TO #24
```

Appendix 5 gives an overview of some theoretically possible insecticide applications and land applications over the year

Intermediate calculations (continued)

```
#25     $Tddmgr_p$ = IF $Tgrap_q - Tappl\_n_p$                (18.13)
        $Tddgr_p = 365 - Tgrap_q + Tappl\_n_p$               (18.14)
        $Ncalgr = Ncalgr + 1$                                (18.15)
        GO_TO #23
End of Subroutine 6
```

Subroutine 7:

Number of degradation days in manure ($Tddmar_p$) and soil ($Tddar_p$) for the arable land situation; help variables for calculations over the year (Tcalc and $T2arap_{j5}$) and a numerator for the number of calculations to carry out for degradation periods (Ncalar).

```
        $j6 = 0$
        $Tcalc = 365 + Tappl\_n_1$                           (18.16)
#26     $j6 = j6 + 1$
        $T2arap_{j6} = 365 + T2arap_{j6}$                    (18.17)
        IF $Tcalc \leq T2arap_{j6}$ GO_TO #27
        $Tarap_{Nlap\_grass+1} = T2arap_{j6}$                (18.18)
        $Nlap\_arab = Nlap\_arab + 1$                        (18.19)
        GO_TO #26
#27     $p = 0$        (p is numerator for number of insecticide applications)
        $q = 1$        (q is numerator for number of land applications)
        $Ncalar = 0$
#28     $p = p + 1$
        IF $p > Nlap\_arab$ GO_TO End of Subroutine 7
#29     IF $Tarap_q \geq Tappl\_n_p$ GO_TO #30
        $q = q + 1$
        GO_TO #29
#30     $Tddmar_p$ = IF $Tarap_q - Tappl\_n_p$                (18.20)
        $Tddar_p = 365 - Tarap_q + Tappl\_n_p$               (18.21)
        $Ncalar = Ncalar + 1$                                (18.22)
        GO_TO #28
End of Subroutine 7
```

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

Appendix 5 gives an overview of some theoretically possible insecticide applications and land applications over the year

Intermediate calculations (continued)

Amount of active ingredient to be used in housing or manure storage (kg)

[A] $$\text{Qsubst\_prescr}_{\text{i1,i2,i3}} = 10^{-1} * \text{Qform\_uins}_{\text{i1,i2,i3}} * \text{Fform}_{\%} * \text{AREAtarget}_{\text{i1}}/\text{AREAuins}_{\text{i1}} \quad (18.23)$$

[B] $$\text{Qsubst\_prescr}_{\text{i1,i2,i3}} = 10^{-3} * \text{Vform\_uins}_{\text{i1,i2,i3}} * \text{Fform}_{\text{vol}} * \text{AREAtarget}_{\text{i1}}/\text{AREAuins}_{\text{i1}} \quad (18.24)$$

[C] $$\text{Q}s\text{ubst\_prescri}_{\text{1,i2,i3}} = 10^{-3} * \text{Qsubst}_{\text{aer}} * \text{AREAtarget}_{\text{i1}}/\text{AREAuins}_{\text{i1}} \quad (18.25)$$

[A + B + C]

Amount of active ingredient in relevant stream *i4* after one application (kg)

$$\text{Qsubst\_stream}_{\text{i1,i2,i3,i4}} = \text{F}_{\text{i1,i2,i3,i4}} * \text{Qsubst\_prescr}_{\text{i1,i2,i3}} \quad (18.26)$$

If the insecticide has been notified for both housings – for every relevant cat-subcat *p* (*p = i1, where i1* = 1 to 13) – and manure storage systems *q* (*q = i1*, where *i1* = 14 or 15):

Amount of active ingredient in relevant stream *i4* after one application (kg) in both a housing and manure storage system

$$\text{Qsubst\_stream}_{\text{p,i2,i3,i4}} = \text{Q}s\text{ubst\_stream}_{\text{p,i2,i3,i4}} + \text{Qsubst\_stream}_{\text{q,i2,i3,i4}} \quad (18.27)$$

Soil

[I] For all relevant applications *i1* (When there is for poultry a combination of application in both batteries without treatment and free range with litter floor: i1 = 6 and i1 = 10 see [II]) and relevant waste streams *i4*

Amount of active ingredient in soil (kg) after the last land application of manure/slurry on grassland after one year since the 1st insecticide application for the maximum number of relevant biocide applications

If Nlap_grass > 0:

$$\text{Qsubst\_grass}_{\text{i1,i2,i3,i4}} = \sum_{j=1}^{\text{Ncalgr}} \text{Qsubst\_stream}_{\text{i1,i2,i3,i4}} * e^{-(\text{kdeg}_{\text{slurry}} * \text{Tddmgr}_j + \text{kdeg}_{\text{soil}} * \text{Tddgr}_j)} \quad (18.28)$$

If Nlap_arab > 0:

$$\text{Qsubst\_arab}_{\text{i1,i2,i3,i4}} = \sum_{j=1}^{\text{Ncalar}} \text{Qsubst\_streami}_{\text{i1,i2,i3,i4}} * e^{-(\text{kdeg}_{\text{slurry}} * \text{Tddmar}_j + \text{kdeg}_{\text{soil}} * \text{Tddar}_j)} \quad (18.29)$$

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

Amount of phosphate applied in one year for every relevant (sub)category of animal/housing *i1* (kg.yr^{-1})

$$Qphosph\_total_{i1,i4} = Nanimal_{i1} * Qphosph\_excr_{i1} \qquad (18.30)$$

Amount of nitrogen applied in one year for every relevant (sub)category of animal/housing *i1* (kg.yr^{-1})

$$Qnitrog\_total_{i1,i4} = Nanimal_{i1} * Qnitrog\_excr_{i1} \qquad (18.31)$$

[II] For poultry, if there is a combination of application in both batteries without treatment and free range with litter floor: (*i1* = 6 <u>and</u> *i1* = 10)

Amounts of active ingredient in soil (kg.yr^{-1}) after the last land application on grassland after one year since the 1st insecticide application for the maximum number of relevant biocide applications when liquid waste from {1} free range with laying hens or {2} free range with broilers is used

If Nlap_grass > 0:

$$Qsubst\_grass - \{1\} = Qsubst\_grass_{6,i2,i3,i4} + Fadd * Qsubst\_grass_{10,i2,i3,i4} \qquad (18.32)$$

$$Qsubst\_grass - \{2\} = Qsubst\_grass_{6,i2,i3,i4} + Fadd * Qsubst\_grass_{11,i2,i3,i4} \qquad (18.33)$$

```
    IF Qai-grass-{1} ≥ Qai-grass-{1} GO_TO #31
    $Qsubst\_grass_{6,i2,i3,i4}$ = Qsubst_grass-{2}          (18.34)
    GO_TO #32 Continue
#31 $Qsubst\_grass_{6,i2,i3,i4}$ = Qsubst_grass-{1}          (18.35)
#32 Continue
```

Amounts of active ingredient in soil (kg.yr^{-1}) after the last land application on arable land after one year since the 1st insecticide application for the maximum number of relevant biocide applications when liquid waste from {1} free range with laying hens or {2} free range with broilers is used

If Nlap_arab > 0:

$$Qsubst\_arab - \{1\} = Qsubst\_arab_{6,i2,i3,i4} + Fadd * Qsubst\_arab_{10,i2,i3,i4} \qquad (18.36)$$

$$Qsubst\_arab - \{2\} = Qsubst\_arab_{6,i2,i3,i4} + Fadd * Qsubst\_arab_{11,i2,i3,i4} \qquad (18.37)$$

```
    IF Qsubst_-grass-{1} ≥ Qsubst_grass-{1} GO_TO #33
    $Qsubst\_arab_{6,i2,i3,i4}$ = Qsubst_arab-{2}          (18.38)
    GO_TO #34 Continue
#33 $Qsubst\_arab_{6,i2,i3,i4}$ = Qsubst_arab-{1}          (18.39)
#34 Continue
```

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

Amounts of phosphate applied in one year ($kg.yr^{-1}$) when liquid waste from {1} free range with laying hens and {2} free range with broilers is used

$$Qphosph\_total-\{1\} = Qphosph\_total_{6,i4} + Fadd * Qphosph\_total_{10,i4} \quad (18.40)$$

$$Qphosph\_total-\{2\} = Qphosph\_total_{6,i4} + Fadd * Qphosph\_total_{11,i4} \quad (18.41)$$

```
     IF Qphosph_total-{1} ≥ Qphosph_total-{2} GO_TO #35
     $Qphosph\_total_{6,i4}$ = Qphosph_total-{2}
     GO_TO #36 Continue
#35  $Qphosph\_total_{6,i4}$ = Qphosph_total-{1}
#36  Continue
```

Amounts of nitrogen applied in one year ($kg.yr^{-1}$) when liquid waste from {1} free range with laying hens and {2} free range with broilers is used

$$Qnitrog\_total-\{1\} = Qnitrog\_total_{6,i4} + Fadd * Qnitrog\_total_{10,i4} \quad (18.42)$$

$$Qnitrog\_total-\{2\} = Qnitrog\_total_{6,i4} + Fadd * Qnitrog\_total_{11,i4} \quad (18.43)$$

```
     IF Qnitrog_total-{1} ≥ Qnitrog-total-{2} GO_TO #37
     $Qnitrog\_total_{6,i4}$ = Qnitrog_total-{2}                    (18.44)
     GO_TO #38 Continue
#37  $Qnitrog\_total_{6,i4}$ = Qnitrog_total-{1}                    (18.45)
#38  Continue
```

End calculations

Soil

For all relevant applications i1 and the waste stream i4:

If the phosphate immission standard is applicable:

Concentration of the active ingredient in soil after the first year that the biocide is applied ($mg.kg^{-1}$) based on the phosphate immission standard for grassland

$$PIECgrs\_P2O5_{i1,i2,i3,i4} = \frac{100 * Qsubst\_grass_{i1,i2,i3,i4} * Qphosph\_is_{grass}}{Qphosph\_total_{i1,i4} * DEPTHmix_{grass} * RHOsoil} \quad (18.46)$$

Concentration of the active ingredient in soil after the first year that the biocide is applied ($mg.kg^{-1}$) based on the phosphate immission standard for arable land

$$PIECars\_P2O5_{i1,i2,i3,i4} = \frac{100 * Qsubst\_arab_{i1,i2,i3,i4} * Qphosph\_is_{arable}}{Qphosph\_total_{i1,i4} * DEPTHmix_{arable} * RHOsoil} \quad (18.47)$$

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems (continued)

If the nitrogen immission standard is applicable:

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the nitrogen immission standard for grassland

$$PIECgrs\_N_{i1,i2,i3,i4} = \frac{100 * Qsubst\_grass_{i1,i2,i3,i4} * Qnitrog\_is_{grass}}{Qnitrog\_total_{i1,i4} * DEPTHmix_{grass} * RHOsoil} \tag{18.48}$$

Concentration of the active ingredient in soil after the first year that the biocide is applied (mg.kg^{-1}) based on the phosphate immission standard for arable land

$$PIECars\_N_{i1,i2,i3,i4} = \frac{100 * Qsubst\_arab_{i1,i2,i3,i4} * Qnitrog_{arable}}{Qnitrog\_total_{i1,i4} * DEPTHmix_{arable} * RHOsoil} \tag{18.49}$$

STP

Amount of active ingredient reaching the standard STP (kg.d^{-1}) (for the relevant cases of *i1* = 6, 7, 10 and 11)

$$Elocal_{3,water} = F_{i1,i2,i3,i4} * Qsubst\_prescr_{i1,i2,i3} \tag{18.50}$$

---

1) The date is automatically converted into the corresponding day number via Table 18.9

2) The maximum number of applications and the application interval are interrelated. So, if the user overwrites one of these values the number of insecticide applications is recalculated: Nappl_bioc = Integer(Te – Tappl_n$_1$) / Tint_bioc + 1

3) If Nlap_grass is set to zero the set of input data till the next dotted line are skipped; for the calculations Subroutine 2 is by-passed.

4) This parameter is interrelated with the application interval. So, if one of their defaults is overwritten the number of land applications is recalculated: Nlap_grass = Integer[(Tgre – Tgrap$_1$) / Tint_gr] + 1.

5) If Nlap_arab is set to zero the set of input data till the next dotted line are skipped; for the calculations Subroutine 3 is by-passed.

6) This parameter is interrelated with the application interval. So, if one of their defaults is overwritten the number of land applications is recalculated: Nlap_arab = Integer[(Tare – Tarap$_1$) / Tint_ar] + 1.

7) At least one of the immission standards should be applied; if none is specified the phosphate immission standard is used with the default values of Table 3.10.

The following tables – as referred to in Tables 18.2 and 18.3 – present the default values for the various parameters of the model.

Table 18.4 Defaults for floor surfaces of animal housings and the surface areas of manure storage systems, $AREAtarget_{cat\text{-}subcat}$ (m^2), with the numbers of animals present, $Nanimal_{cat\text{-}subcat}$ (-); the subscript cat-subcat presents the animal (sub)category and for poultry the type of housing, or the type of manure storage (see Table 18.1).

index i1	Category-subcategory Number animals				Floor surface	
1	Cattle	- Dairy cattle			4000	40
2		- Beef cattle			4000	40
3		- Veal calves			4000	40
4	Pigs	- Sows			210	100
5		- Fattening pigs			390	260
6			- belt drying	Laying hens	4000	27000
7			- deep pit, high-rise	Laying hens	4000	27000
8			- compact	Laying hens	4000	27000
9	Poultry	- Battery	- no treatment	Laying hens	4000	27000
10		- Free range	- litter floor	Laying hens	4000	27000
11		(indoors)	- litter floor	Broilers	4000	27000
12			- grating floor	Parent broilers	2000	9000
13			- grating floor	Parent broilers in rearing	2000	12000
14	Manure storage	- Wet			p.m.	p.m.
15		- Dry			p.m.	p.m.

Table 18.6 Defaults for the insecticide application period as 1) start and end dates Tstart (-) and Tend (-) and 2) start day Ts (d) and end day Te (d) numbers, first application date as 1) first date $Tappl\_d_1$ (-) and 2) first application day $Tappl\_n_1$ (d), application interval Tint_bioc (d) and maximum number of applications Nappl_bioc (-) for all biocide types (index i2) and − if appropriate − category/subcategory (index i1)

		Period of application				1st application		Interval	No. applications
i2	i1	Tstart	Ts	Tend	Te	$Tappl\_d_1$	$Tappl\_n_1$	Tint_bioc	Nappl_bioc
1		1 April	91	30 Sept	273	15 April	105	28	6
2	6-9	1 Jan	1	31 Dec	365	1 Febr	32	91	4
2	10	1 Jan	1	31 Dec	365	1 Febr	32	91	4
2	11	1 Jan	1	31 Dec	365	1 Febr	32	52	7
2	12	1 Jan	1	31 Dec	365	1 Febr	32	91	4
2	13	1 Jan	1	31 Dec	365	1 Febr	32	91	4
3		1 Jan	1	31 Dec	365	1 July	182	(365)	1
4		1 April	91	30 Sept	273	15 April	105	28	6

Table 18.7 Pick-list for conversion of dates into day numbers

Jan	Day	Feb	Day	Mar	Day	Apr	Day	May	Day	Jun	Day
1	1	1	32	1	60	1	91	1	121	1	152
2	2	2	33	2	61	2	92	2	122	2	153
3	3	3	34	3	62	3	93	3	123	3	154
4	4	4	35	4	63	4	94	4	124	4	155
5	5	5	36	5	64	5	95	5	125	5	156
6	6	6	37	6	65	6	96	6	126	6	157
7	7	7	38	7	66	7	97	7	127	7	158
8	8	8	39	8	67	8	98	8	128	8	159
9	9	9	40	9	68	9	99	9	129	9	160
10	10	10	41	10	69	10	100	10	130	10	161
11	11	11	42	11	70	11	101	11	131	11	162
12	12	12	43	12	71	12	102	12	132	12	163
13	13	13	44	13	72	13	103	13	133	13	164
14	14	14	45	14	73	14	104	14	134	14	165
15	15	15	46	15	74	15	105	15	135	15	166
16	16	16	47	16	75	16	106	16	136	16	167
17	17	17	48	17	76	17	107	17	137	17	168
18	18	18	49	18	77	18	108	18	138	18	169
19	19	19	50	19	78	19	109	19	139	19	170
20	20	20	51	20	79	20	110	20	140	20	171
21	21	21	52	21	80	21	111	21	141	21	172
22	22	22	53	22	81	22	112	22	142	22	173
23	23	23	54	23	82	23	113	23	143	23	174
24	24	24	55	24	83	24	114	24	144	24	175
25	25	25	56	25	84	25	115	25	145	25	176
26	26	26	57	26	85	26	116	26	146	26	177
27	27	27	58	27	86	27	117	27	147	27	178
28	28	28	59	28	87	28	118	28	148	28	179
29	29			29	88	29	119	29	149	29	180
30	30			30	89	30	120	30	150	30	181
31	31			31	90			31	151		

Table 18.7 Pick-list for conversion of dates into day numbers (continued)

Jul	Day	Aug	Day	Sep	Day	Oct	Day	Nov	Day	Dec	Day
1	182	1	213	1	244	1	274	1	305	1	335
2	183	2	214	2	245	2	275	2	306	2	336
3	184	3	215	3	246	3	276	3	307	3	337
4	185	4	216	4	247	4	277	4	308	4	338
5	186	5	217	5	248	5	278	5	309	5	339
6	187	6	218	6	249	6	279	6	310	6	340
7	188	7	219	7	250	7	280	7	311	7	341
8	189	8	220	8	251	8	281	8	312	8	342
9	190	9	221	9	252	9	282	9	313	9	343
10	191	10	222	10	253	10	283	10	314	10	344
11	192	11	223	11	254	11	284	11	315	11	345
12	193	12	224	12	255	12	285	12	316	12	346
13	194	13	225	13	256	13	286	13	317	13	347
14	195	14	226	14	257	14	287	14	318	14	348
15	196	15	227	15	258	15	288	15	319	15	349
16	197	16	228	16	259	16	289	16	320	16	350
17	198	17	229	17	260	17	290	17	321	17	351
18	199	18	230	18	261	18	291	18	322	18	352
19	200	19	231	19	262	19	292	19	323	19	353
20	201	20	232	20	263	20	293	20	324	20	354
21	202	21	233	21	264	21	294	21	325	21	355
22	203	22	234	22	265	22	295	22	326	22	356
23	204	23	235	23	266	23	296	23	327	23	357
24	205	24	236	24	267	24	297	24	328	24	358
25	206	25	237	25	268	25	298	25	329	25	359
26	207	26	238	26	269	26	299	26	330	26	360
27	208	27	239	27	270	27	300	27	331	27	361
28	209	28	240	28	271	28	301	28	332	28	362
29	210	29	241	29	272	29	302	29	333	29	363
30	211	30	242	30	273	30	303	30	334	30	364
31	212	31	243			31	304			31	365

Table 18.8 Default values for the periods of land application by target field as start dates (Tgr_start and Tar_start), end dates (Tgr_app$_{Nlap\_grass}$ and Tar_app$_{Nlap\_arab}$), start day numbers (Tgrs and Tars), and end day numbers (Tgre and Tare).

Target field	Start date	First day	End date	Last day
Arable land	1st September	244	1st February	32
Grassland	1st February	32	1st September	244

Table 18.9 Default values for the number of land applications per year, Nlap$_s$ (yr^{-1}), the phosphate immission standards, Qphosph$_s$ (kg.ha^{-1}.yr^{-1}), the nitrogen immission standards, Qnitrog$_s$ (kg.ha^{-1}.yr^{-1}), and the mixing depth with soil, DEPTHmix$_s$ (m), where the subscript "s" stands for the target soil: grassland or arable_land ("grass" and "arable")

Target field	Nlap$_s$	Qphosph_is$_s$ 1)	Qnitrog_is$_s$	DEPTHmix$_s$
Arable land	1	110	170 2)	0.2
Grassland	4	135	210 3)	0.05

1) Values for the Netherlands

2) Value for Germany and Spain

3) Value for Germany

Table 18.10 Default value for two additional parameters

Parameter	Default
Number of days for correction if insecticide application is within that period before land application, Tcorr (d)	5
Fraction of biocide added in the case of a combination of application in both poultry batteries without treatment and free range with litter floor, Fadd (-)	0.1

Table 18.11 *Defaults for the average amounts of liquid waste, Qlwaste*$_{cat\text{-}subcat}$ *(kg.animal*$^{-1}$*.d*$^{-1}$*) in relevant cases, phosphate, Qphosph_excr*$_{cat\text{-}subcat}$ *(kg.animal*$^{-1}$*.d*$^{-1}$*) and nitrogen, Qnitrog_excr*$_{cat\text{-}subcat}$ *(kg.animal*$^{-1}$*.d*$^{-1}$*) per animal (sub) category i1.*

cat-subcat	Category	Subcategory	Housing	Amounts of: liquid waste	P_2O_5	N[3]
1	Cattle	Dairy cow			0.01777	0.07455
2		Beef cattle			0.03677	0.16700
3		Veal calf			0.01422	0.02382
4	Pigs	Sow			0.05566	0.07106
5		Fattening pig			0.02033	0.03043
6	Poultry	Laying hen	Battery + aeration	0.08 [2]	0.00111	0.00181
7			Deep pit, high-rise	0.08 [2]	0.00111	0.00181
8			Compact		0.00111	0.00181
9			Battery (no treatm.)		0.00122 [1]	0.00202 [1]
10			Free-range, litter	0.08 [1] [2]	0.00111	0.00171
11		Broiler	Free-range, litter	0.08 [1] [2]	0.00066	0.00156
12		Parent broiler in rearing	Free-range, grating		0.00077	0.00137
13		Parent broiler ≥18 weeks	Free-range, grating		0.00188	0.00298

---

[1] In the case of admittance for both battery (no treatment) and free-range (litter floor) combination of slurry stream battery and liquid waste stream free-range (only for battery without treatment: 0.0011)

[2] Separate calculation of load to STP

[3] Excluding the nitrogen which volatilised during excretion in the housing and storage

Table 18.5 Estimates for the fraction of active ingredient released to the relevant streams ($F_{cat\text{-}subcat,bioctype,appway,stream}$), for animal (sub)category and housing (variable cat-subcat), type of insecticide (variable bioctype), way of application (variable appway) and stream where the biocide is emitted to (variable stream); • = not applicable.

Category (cat-subcat)	Type of biocide (bioctype)	Spraying (1)			Aerosol (2)			Smearing (3)		
		Manure (1)	Waste water (2)	Slurry (3)	Manure (1)	Waste water (2)	Slurry (3)	Manure (1)	Waste water (2)	Slurry (3)
Livestock										
Cattle, Veal calves, Pigs										
(1,2,3,4,5)	All insecticides (1)	•	•	0.5	•	•	0.35	•	•	0.35
(1,2,3,4,5)	Larvicides (3)	•	•	0.5	•	•	0.35	•	•	0.35
(14)	Larvicides (3)	•	•	1	•	•	1	•	•	•
Poultry										
Battery cage:										
- conveyor belt with aeration										
(7)	All insecticides (1)	•	0.2	0.5	•	0.1	0.35	•	0.1	0.35
(7)	Larvicides (3)	•	0.2	0.5	•	0.1	0.35	•	0.1	0.35
(15)	Larvicides (3)	•	•	1	•	•	1	•	•	•
- forced drying (deep pit, high-rise) (8)	All insecticides (1)	0.5	•	•	0.35	•	•	0.35	•	•
(8)	Flies (2)	0.8	•	•	0.35	•	•	0.35	•	•
(8)	Larvicides (3)	0.8	•	•	0.35	•	•	0.35	•	•
(14)	Larvicides (3)	1	•	•	1	•	•	1	•	•
- conveyor belt (no aeration)										
(6,9)	All insecticides (1)	•	•	0.5	•	•	0.35	•	•	0.35
(6,9)	Larvicides (3)	•	•	0.5	•	•	0.35	•	•	0.35
(14)	Larvicides (3)	•	•	1	•	•	1	•	•	•
Free-range:										
- litter floor (10,11)	All insecticides (1)	0.3	0.2	•	0.25	0.1	•	0.25	0.1	•
(10,11)	Larvicides (3)	0.3	0.2	•	0.25	0.1	•	0.25	0.1	•
(15)	Larvicides (3)	1	•	•	1	•	•	•	•	•
- grating floor (12,13)	All insecticides (1)	•	•	0.5	•	•	0.35	•	•	0.35
(12,13)	Larvicides (3)	•	•	0.5	•	•	0.35	•	•	0.35
(14)	Larvicides (3)	•	•	1	•	•	1	•	•	•

Table 18.5 *(continued) Estimates for the fraction of active ingredient released to the relevant streams ($F_{cat\text{-}subcat,bioctype,appway,stream}$), for animal (sub)category and housing (variable cat-subcat), type of insecticide (variable bioctype), way of application (variable appway) and stream where the biocide is emitted to (variable stream); • = not applicable.*

Category (cat-subcat)	Type of biocide (bioctype)	Sprinkling (1)			Bait (2)			Sprinkling & Bait (3)		
		Manure (1)	Waste water (2)	Slurry (3)	Manure (1)	Waste water (2)	Slurry (3)	Manure (1)	Waste water (2)	Slurry (3)
Livestock										
Cattle, Pigs, Veal calves										
(1,2,3,4,5,6)	All insecticides (1)	•	•	0.9	•	•	0.5	•	•	0.75
(1,2,3,4,5,6)	Larvicides (3)	•	•	•	•	•	•	•	•	•
(14)	Larvicides (3)	•	•	1	•	•	•	•	•	•
Poultry										
Battery cage:										
- conveyor belt with aeration			0.1	0.9	•	0.45	0.5	•	0.35	0.75
(7)	All insecticides (1)	•	•	1	•	•	•	•	•	•
(7)	Larvicides (3)	•								
(14)	Larvicides (3)	•								
- forced drying (deep pit, high-rise) (8)	All insecticides (1)	0.8	•	•	0.4	•	•	0.75	•	•
(8)	Flies (2)	0.9	•	•	0.5	•	•	0.8	•	•
(8)	Larvicides (3)	0.9	•	•	•	•	•	•	•	•
(15)	Larvicides (3)	1	•	•	•	•	•	•	•	•
- conveyor belt (no aeration)										
(6,9)	All insecticides (1)	•	•	0.9	•	•	0.5	•	•	0.75
(6,9)	Larvicides (3)	•	•	0.9	•	•	•	•	•	•
(14)	Larvicides (3)	•	•	1	•	•	•	•	•	•
Free-range:										
- litter floor (10,11)	All insecticides (1)	0.8	0.1	•	0.05	0.45	•	0.4	035	•
(10,11)	Larvicides (3)	0.8	0.1	•	•	•	•	•	•	•
(15)	Larvicides (3)	1	•	•	•	•	•	•	•	•
- grating floor (12,13)	All insecticides (1)	•	•	0.9	•	•	0.5	•	•	0.75
(12,13)	Larvicides (3)	•	•	0.9	•	•	•	•	•	•
(14)	Larvicides (3)	•	•	1	•	•	•	•	•	•

18.2 Insecticides for refuse dumps

So far, no data are available for the application of insecticides at refuge dumping sites. As freshly landfilled refuse has to be topped off daily no emission scenario has been developed yet.

18.3 Insecticides for empty spaces and spaces with stocks

In the case of insecticides for empty spaces and spaces with stocks it is most likely that fumigation will be applied. When aerosols/fumigants are used outdoors the objects to be treated will be covered as the insecticide will disappear almost completely before having the desired effect. So, this can be regarded in the same way as aerosols/fumigants used indoors. This on its turn can be regarded in the same way as aerosols/fumigants used within fumigation installations.

For all these subgroups the emission scenario of USES 3.0 (RIVM, VROM, VWS, 1999) that is described in Luttik *et al.* (1995) for fumigation of buildings, silos, etc. can be used. The emission scenario is presented in Table 18.12 (Table 18.13 presents the defaults for the parameters required for the distribution modules of USES 3.0)

Table 18.12 Emission scenario for calculating the releases from insecticides used for fogging of buildings, silos, etc.

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Amount used (kg)	Qsubst		S
Fraction of retention in goods (-)	Fret	0.02	D
Fraction of disintegration (-)	Fdisin	0.001	D
Number of emission days for fogging (d)	$Temission_3$	1	D

Output:

$Elocal_{3,air}$ = Local emission to air during episode ($kg.d^{-1}$)

Model calculations:

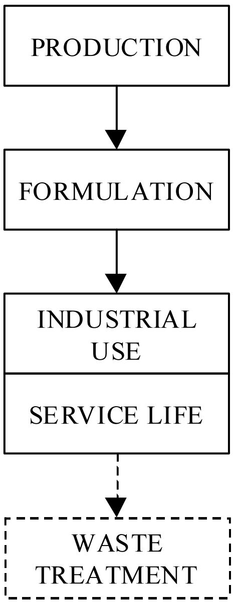
$$Elocal_{3,air} = \frac{Qsubst * (1 - Fret) * (1 - Fdisin)}{Temission_3} \quad (13.1)$$

Table 18.13 Default values of parameters required for distribution models of USES 3.0

Parameters required	Symbol USES 3.0	Symbol for this scenario	Symbol for this report	Value
Number of emission days (d)	Temission	$Temission_{fogging}$	$Temission_3$	1

19. Repellents and attractants

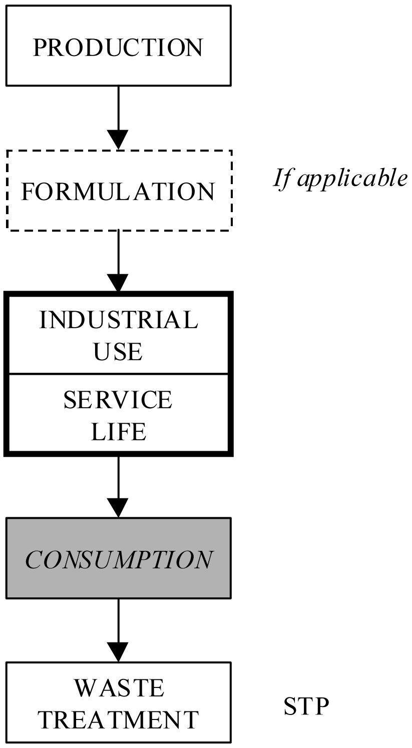
The scheme of the life cycle stages is presented below. The stage of waste treatment has been denoted by broken lines as it is not certain that remains after application are removed. It may be expected that the point sources will be rather small and hence that the emissions are rather diffuse. So far no emission scenario has been developed for repellents and attractants.



20. Preservatives for food or feedstocks

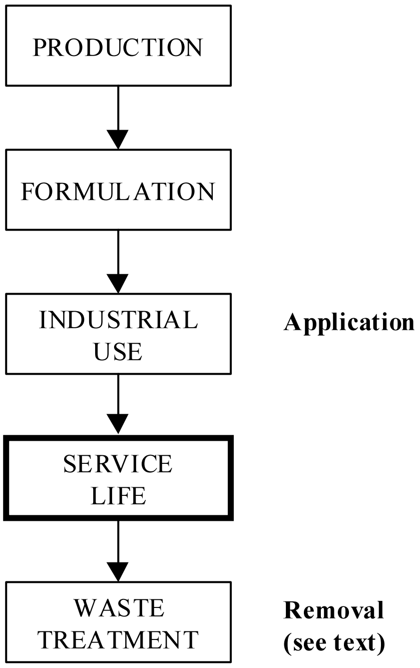
So far no emission scenario has been developed for preservatives for food or feedstocks. Before an emission scenario document is prepared the overlap, c.q. the distinction with food and feed additives, which fall under different legislation, has to be looked into.

The life cycle scheme is presented below. As food and feed is eaten by men and animals the (grey) box “Consumption” has been added.



21. Antifouling products

Antifoulings can be seen as a special type of coating (paint) used on underwater constructions and ship hulls. The scheme of the life cycle stages is presented below. It should be noted that waste treatment will be when old antifouling coatings are removed by sanding, sandblasting, scraping, etc. and disposed off before application of a new coating; during removal emissions of antifouling (present in particles) will occur.



The 1st emission scenario for antifoulings – concerning the releases from ship hulls in a harbour – was published in Luttik *et al.* (1993). This emission scenario is also present in USES 3.0 (RIVM, VROM, VWS, 1999) and is presented in this report in Table 21.1. Recently several other emission scenarios/models have been published:

- Model by CEPE (1999)
- REMA model by UK Health and Safety Executive (HSE, 1999)
- Danish emission scenario (MST, 2000)

In this report only the emission scenario of USES is presented (Table 21.1).

Table 21.1 Emission scenario for calculating the releases of antifoulings from ships in a harbour

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Number of yachts in yacht-basin (-)	Nship	250	D
Mean ship deck area (m^2)	AREAdeck	10	D
Ratio water/ship in yacht-basin (-)	Fwater/ship	3	D
Fraction ships in water:	Fship		D
Whole year		0.5 [1)]	
Summer		1.0	
Winter		0.25	
Volume of paint per yacht (m^3)	Vform	0.002	D
Cover of antifouling paint ($m^2.m^{-3}$)	$AREAlitre_{anti}$	2500	D
Depth of yacht-basin (m)	DEPTHbasin	2.5	D
Fraction of ships in yacht-basin (-)	Fpres	0.71	D
Mean flux of compound ($kg_c.m^{-2}.d^{-1}$)	FLUXsubst	2.5e-5	D
Advection half-life time in basin (d)	$DT50advec_{basin}$	50	D
Solids-water partition coefficient for suspended matter ($m^{-3}.kg^{-1}$)	Kp_{susp}		O [2)]
Concentration suspended matter ($kg.m^{-3}$)	SUSPwater	0.015	D [3)]
Degradation rate in surface water (d^{-1})	$kdeg_{water}$		O [2)]
Test duration for bird toxicity test (d)	T_{bird}		S
Test duration for mammalian toxicity test (d)	T_{mammal}		S

[1)] The whole year value is used as default, the user is able to make a selection

[2)] Calculated in USES

[3)] Default for the regional system in USES 3.0 (default continental system: 0.025)

Output:

$Cwater_{pest-0}$ = Peak concentration in water ($kg.m^{-3}$)

$Cwater_{pest-T}$ = Average concentration in water over T days ($kg. m^{-3}$)

Intermediate calculations:

Necessary harbour area per yacht (m^2)

$$AREAship = (1 + Fwater/ship)*AREAdeck \qquad (21.1)$$

Amount of water in yacht-basin (m^3)

$$Vbasin = Nship * AREAship * DEPTHbasin \qquad (21.2)$$

Table 21.1 Emission scenario for calculating the releases of antifoulings from ships in a harbour (continued)

Antifouling surface per yacht-basin (m^2)

$$AREAanti = AREAlitre_{anti} * Vform * Nship * Fship * Fpres \qquad (21.3)$$

Rate constant for advection (d^{-1})

$$kadvec_{basin} = \frac{\ln 2}{DT50advec_{basin}} \qquad (21.4)$$

Overall rate constant for removal from basin (d^{-1})

$$krem_{basin} = \frac{kdeg_{water}}{1 + Kp_{susp} * SUSPwater} + kadvec_{basin} \qquad (21.5)$$

Concentration equivalent ($kg.m^{-3}$)

$$Cwater_{pest} = \frac{AREAanti * FLUXanti}{Vbasin * krem_{basin}} \qquad (21.6)$$

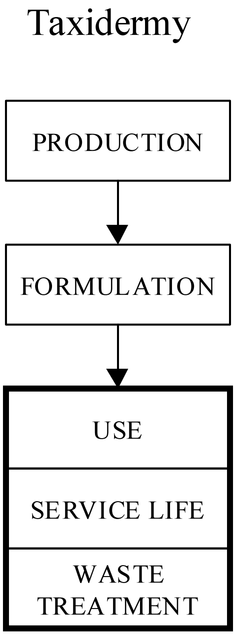
End calculations:

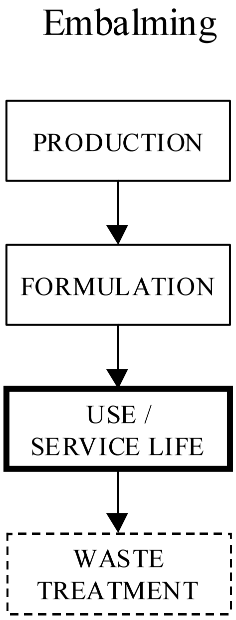
$$C_{waterpest-T} = \frac{C_{waterpest,eq}}{1 + Kp_{susp} * SUSP_{water}} \quad T \in \{0,4,7,14,21,28,T_{bird},T_{mammal},365\} \qquad (21.7)$$

---

22. Embalming and taxidermist fluids

Taxidermy includes the preservation of animals and concerns small as well as large mammals, fishes, birds and reptiles. Embalming consists of three different procedures which involve the use of biocides: surface disinfection (soaps, solutions), arterial injection of fluids and injection of cavity fluids into the torso to substitute body fluids.
The scheme of the stage of the life cycle is presented below.





For this product type an emission scenario document has been prepared for the EUBEES working group (Tissier and Migné, 2001b).
The emission scenarios are presented in Tables 22.1, 22.2 (taxidermy) and 22.3 up to and including 22.5 (embalming) and have been modified slightly.

Table 22.1 Emission scenario for calculating the releases of biocides used in taxidermy

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Quantity of treated drained skin per day ($kg.d^{-1}$)	Qskin	4	D
Quantity of active substance applied per kg of drained skin ($kg.kg^{-1}$)	Qsubst	0.02	P [22.2]
Fixation fraction (-)	Ffix	0.95	S/D
Output:			
$Elocal_{3,water}$	= Total local emission of active substance for all treatment steps i = 1 to m ($kg.d^{-1}$)		

1) A maximum number of 3 treatment steps (soaking, pickling, and tanning) is possible; the maximum number applicable is called *m* here.

Intermediate calculation:

Local emission of active substance to wastewater for treatment step *i* ($kg.d^{-1}$)

$$Elocal\_water_i = Qskin * Qsubst * (1 - Ffix) \tag{22.1}$$

End calculation:

$$Elocal_{3,water} = \sum_{i=1}^{m} Elocal\_water_i \tag{22.2}$$

Table 22.2 Pick-list for the quantity of active ingredient applied per kg of drained skin Qsubst ($kg.kg^{-1}$)

Treatment step	Type of agent applied	Qsubst
Pickling	Formaldehyde	0.005
	Tanning agent	0.02
Soaking	Bactericide	0.002
Preservation	Insecticide	0.02
	Arsenic or borax	. 1)

1) No information available.

Table 22.3 Emission scenario for calculating the releases of biocides used in the embalming process

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Volume of solution applied per embalmed corpse for arterial injection (l)	$Vform_{arterial}$		P [22.4]
Volume of solution applied per embalmed corpse for cavity treatment (l)	$Vform_{cavity}$		P [22.4]
Specific density of solution ($kg.m^{-3}$)	RHOform	1 000	D
Content of active substance in solution for arterial injection ($kg.kg^{-1}$)	$Cform_{arterial}$		S
Content of active substance in solution for cavity treatment ($kg.kg^{-1}$)	$Cform_{cavity}$		S
Retention rate of arterial fluid (-)	$Fret_{arterial}$		S/P [22.4]
Retention rate of cavity fluid (-)	$Fret_{cavity}$		S/P [22.4]

Output:

$Elocal_{3,water}$ = Local emission of active substance to wastewater ($kg.d^{-1}$)

Model calculation:

$$Elocal_{3,water} = Vform_{arterial} * RHOform * Cform_{arterial} * (1 - Fret_{arterial}) * 10^{-3} + Vform_{cavity} * RHOform * Cform_{cavity} * (1 - Fret_{cavity}) * 10^{-3} \quad (22.3)$$

Table 22.4 Pick-list for amounts of biocide solution used for one embalming, $Vform_{arterial}$ and $Vform_{cavity}$ (l), and fixation fraction according to the type of preservation, $Fret_{,arterial}$ and $Fret_{cavity}$ (-)

Type of preservation	Biocide	$Vform_{arterial}$ / $Vform_{cavity}$	$Fret_{arterial}$ / $Fret_{cavity}$
Short-term	Formaldehyde 4%	6	0.9
	Formaldehyde 22%	0.5	0.9
Long-term	Formaldehyde 4%	10	0.8
	Formaldehyde 22%	0.5	0.9

Table 22.5 Emission scenario for calculating the releases in cemeteries

Variable/parameter (unit)	Symbol	Default	S/D/O/P [table]
Input:			
Volume of solution applied per embalmed corpse for arterial injection (l)	$Vform_{arterial}$		P [22.4]
Volume of solution applied per embalmed corpse for cavity treatment (l)	$Vform_{cavity}$		P [22.4]
Specific mass of solution ($kg.m^{-3}$)	RHOform	1000	D
Content of active substance in solution for arterial injection ($kg.kg^{-1}$)	$Cform_{arterial}$		S
Content of active substance in solution for cavity treatment ($kg.kg^{-1}$)	$Cform_{cavity}$		S
Retention rate of arterial fluid (-)	$Fret_{arterial}$		S/ P [22.4]
Retention rate of cavity fluid (-)	$Fret_{cavity}$		S/ P [22.4]
Factor for reaction with body (-)	Freact	0	S/D
Number of embalmed corpses buried per year (-)	Ncorpse	24	D
Length of the cemetery (m)	LENGTHcem	100	D
Width of the cemetery (m)	WIDTHcem	100	D
Mixing depth of soil (m)	$DEPTHmix_{cem\_soil}$	0.5	D
Bulk density of soil ($kg.m^{-3}$)	RHOsoil	1700	D
Soil-water partitioning coefficient ($m^3.m^{-3}$)	$K_{soil-water}$		O^c [1)]
First order rate constant for removal from soil (d^{-1})	$krem_{soil}$		O [1)]

Output:

$Elocal_{3,soil}$ = Yearly average input of active substance to the cemetery ($kg.yr^{-1}$)

$Csoil\_av_{cem}$ = Average concentration in soil ($mg.kg_{ww}^{-1}$)

$Cporew\_av_{cem}$ = Average concentration in soil pore water ($mg.l^{-1}$)

Model calculations:

$$Elocal_{3,soil} = [Vform_{arterial} * RHOform * Cform_{arterial} \times (Fret_{arterial}) * 10^{-3} + Vform_{cavity} * RHOform * Cform_{cavity} * (Fret_{cavity}) * 10^{-3}] * (1 - Freact) * Ncorpse \quad (22.4)$$

$$Csoil\_av_{cem} = Elocal_{3,soil} * 10^{6} / (LENGTHcem * WIDTHcem * DEPTHmix_{cem\_soil} * RHOsoil * krem_{soil} * 365) \quad (22.5)$$

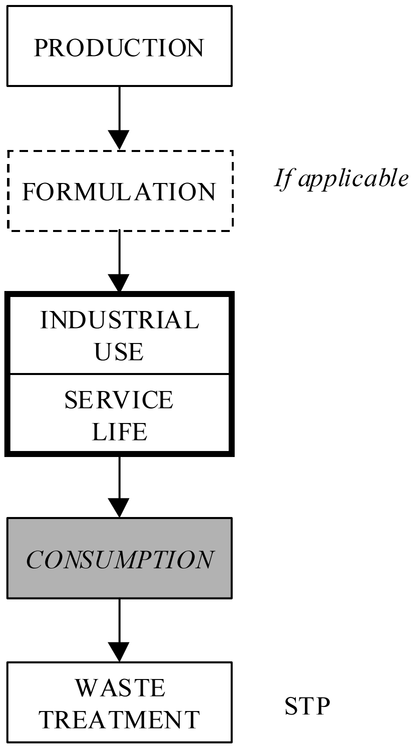
$$Cporew\_av_{cem} = (Csoil\_av_{cem} * RHOsoil) / (K_{soil-water} * 10^{3}) \quad (22.6)$$

[1)] Calculated in USES

23. Control of other vertebrates

For this product type no emission scenario document exists. As it is not clear what other vertebrates than rodents (and possibly some bird species in some countries) will be controlled no emission scenario has been developed yet for this report.

The life cycle scheme is presented below. As the remainder of this biocidal product, i.e. the fraction which is not ingested by the target animals, applied may be left at the application site the (grey) box 'Environment' has been used as well.



24. Waste treatment

For waste treatment the present TGD does not contain any emission scenarios. At the moment Denmark and WWF (World Wildlife Fund) make proposals for an approach. For the Dutch situation a report on emission scenarios for waste treatment, elaborated for biocides, has been produced (Van der Poel, 1999b). The report includes an emission scenario for a landfill and is presented in Table 24.1. It should be noted, however, that some modifications were made due to errors found in the equations. Furthermore, the effect of the installation of a final top seal after a number of years – Tfinal_top – has been incorporated. In the Netherlands every period of about five years the most recently filled sectors of a landfilled are covered with the final layer.

For incineration no emission scenario was developed as it may be assumed that under the conditions that exist in incinerators for municipal and hazardous waste in the Netherlands all (organic) substances will be degraded/combusted completely. This means zero emissions of the substances (biocides) assessed.

24.1 Landfill model

The model of a sanitary landfill calculates for a certain year the maximum quantities of the biocide loads to percolating water, subsoil and landfill gas ("air") via intermediate steps as the main outputs. That is from the first year after the start of utilisation of the landfill up to 5 years after closure (5 has been chosen because the maximum is not likely to appear after closure). If one wants to perform PEC/NEC calculations for the situation that landfill gas is not burnt and percolating water is discharged without treatment, the specific calculations have been added in *italic*.

The calculations present a worst case situation as the model assumes that the substance will be directly available for degradation, leaching, and volatilisation. It is more likely that the substance will become available at a rate corresponding with the degradation rate of the product on or in which it occurs. For example, a plastic additive will be released very slowly from a sizeable piece made out of a persistent type of polymer, and moderately fast from a thin layer of degradable polymer.

In the original report (Van der Poel, 1999) some errors occur, and the School-Canyon equation was proposed for the total landfill gas formation (assuming an equal amount of waste input to the landfill each year of operation). This results, however, in a considerable difference in outcome of calculations compared to the equations requiring summation. So, some changes have been made in the model.

Table 24.1 Sanitary landfill model

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Bottom surface of the landfill (m^2)	AREAlandf	300,000	D
Total height of waste dumped	DEPTHwaste	20	D
Density of waste ($kg.m^{-3}$)	RHOwaste	1000	D
Utilisation period (yr^{-1})	Tutil	15	D
Period of installation of final top seal (yr)	Tfinal_top	5	D
Wet precipitation ($m.yr^{-1}$)	RAINRATE	0.7 1)	D
Precipitation surplus in sector with:			D
- surface without vegetation ($m.yr^{-1}$)	WS_{bare}	0.45	D
- surface with vegetation ($m.yr^{-1}$)	WS_{veg}	0.3	D
- surface with top seal ($m.yr^{-1}$)	WS_{final}	0.05	D
Water produced in waste sector ($m^3.yr^{-1}$)	$Vwater_{produced}$	0	D
Factor of (gas) formation (-)	$Fgas_{formation}$	0.58	D
Volume of landfill gas produced from organic carbon ($m^3.kg^{-1}$)	$Vgas_{orgC}$	1.87	D
Content of biodegradable organic carbon in the waste ($kg.tonne^{-1}$):	$Corg_{landf}$		D
- inorganic waste		50	
- domestic waste		112	
Rate constant for biodegradation of organic carbon in waste (yr^{-1})	$kdeg_{waste\_orgC}$	0.094	D
Rate constant for degradation in bulk soil (d^{-1})	$kdeg_{soil}$		O
Soil-water partition coefficient ($m^3.m^{-3}$)	$K_{soil-water}$		O[c]
Partial mass-transfer coefficient at soil-water side of air-soil interface ($m^3.m^{-3}$)	$K_{air-water}$		O[c]
Partial mass-transfer coefficient at air side of air-soil interface ($m.s^{-1}$)	$kasl_{air}$	1.39E-03	D
Partial mass-transfer coefficient at soil-air side of air-soil interface ($m.s^{-1}$)	$kasl_{soil-air}$	5.56E-06	D
Partial mass-transfer coefficient at soil-water side of air-soil interface ($m.s^{-1}$)	$kasl_{soil-water}$	5.56E-10	D
Fraction of substance leached and penetrating into the subsoil (-)	$Fleach_{subsoil}$	0.05	D
Fraction of substance volatilised and escaping into the air (-)	Fvolat	0.15	D
Initial concentration of substance in landfilled waste (sector with bare surface) ($mg.kg^{-1}$)	$Csubst\_landf_0$		O 2)

---

1) In confirmity with EUSES 1.0

2) Output from calculations for specific biocide applications according to Table 24.2

Table 24.1 *Sanitary landfill model (continued)*

Output:

$Qsubst\_STP_i$	=	Amount of substance leached in year *i* (kg) and transported to the STP for i = 1...Tutil+5
$Qsubst\_soil_i$	=	Amount of substance leached in year *i* (kg) and penetrating into the subsoil of the landfill for i = 1...Tutil+5
$Qsubst\_air_i$	=	Amount of substance volatilised in year *i* (kg) and escaped to the air for i = 1...Tutil+5
$Csubst\_perc_i$	=	Concentration of substance in percolating water in year *i* ($mg.l^{-1}$) *for i=1...Tutil+5*
$Csubst\_gas_i$	=	Concentration of substance in landfill gas in year *i* ($mg.m^{-3}$) *for i=1...Tutil+5*

Intermediate calculations

Total volume of the landfill (m^3)

$$Vlandf = AREAlandf * DEPTHwaste - 4\pi * DEPTHwaste^2 * (AREAlandf/\pi)^{1/2} + 16/3\pi * DEPTHwaste^3 \quad \text{(L-1)}$$

Mass of the waste dumped annually ($tonnes.yr^{-1}$) (L-2)

$$Qwaste_{landf} = Vlandf * RHOwaste * 10^{-3} / Tutil$$

Amount of percolating water in section where dumping takes place in current year ($m^3.yr^{-1}$)

$$Vwater_{dump} = AREAlandf / Tutil * WS_{bare} \quad \text{(L-3)}$$

Amount of percolating water in a section where dumping has taken place in one of the previous years during the utilisation period ($m^3.yr^{-1}$)

$$Vwater_{veg} = AREAlandf / Tutil * WS_{veg} \quad \text{(L-4)}$$

Amount of percolating water in section where dumping has taken place after closure of the landfill and application of final seal ($m^3.yr^{-1}$)

$$Vwater_{final} = AREAlandf / Tutil * WS_{final} \quad \text{(L-5)}$$

Amount of water in section where dumping still has to take place in future year ($m^3.yr^{-1}$)

$$Vwater_{open} = AREAlandf / Tutil * RAINRATE \quad \text{(L-6)}$$

Amount of percolating water for year i = 1...Tutil+5 in the entire landfill ($m^3.yr^{-1}$)

$$\begin{aligned} Vwater\_percol_i &= Vwater_{dump} + [i - 1 - INT\{(i-1)/Tfinal\_top\}] * Tfinal\_top * \\ &\quad Vwater_{veg} + (Tutil - i) * Vwater_{open} + INT\{(i-1)/Tfinal\_top\} * \\ &\quad Tfinal\_top * Vwater_{final} + i * Vwater_{produced} \ [for\ i = 1...Tutil] && \text{(L-7)} \\ &= Tutil * Vwater_{final} + Tutil * Vwater_{produced} \ [for\ i > Tutil] && \text{(L-8)} \end{aligned}$$

Table 24.1 Sanitary landfill model (continued)

Amount of gas produced in the whole landfill in year i for i = 1...Tutil+5 ($m^3.yr^{-1}$) and j sectors (j = 1...Tutil)

$$Vgas\_landf_i = \sum_{i=1}^{Tutil}\sum_{j=1}^{i} (Fgas_{formation} * Vgas_{orgC} * Qwaste_{landf} * Corg_{landf} * k\,deg_{waste\_orgC} * e^{-k\,deg_{waste\_orgC} * i})$$

$$[for\ i = 1...Tutil] \qquad \text{(L-9)}$$

$$Vgas\_landf_i = \sum_{i=Tutil+1}^{Tutil+5}\sum_{j=1}^{Tutil} (Fgas_{formation} * Vgas_{orgC} * Qwaste_{landf} * Corg_{landf} * k\,deg_{waste\_orgC} * e^{-k\,deg_{waste\_orgC} * i})$$

$$[for\ i > Tutil] \qquad \text{(L-10)}$$

Rate constant for degradation of substance in waste (d^{-1}) [1)]
$kdeg_{waste\_subst} = kdeg_{soil}$ (L-11)

Rate constant for leaching of substance in sector with a surface without vegetation (yr^{-1})
$kleach_{bare} = WS_{bare} / (K_{soil\text{-}water} * DEPTHwaste)$ (L-12)

Rate constant for leaching of substance in sector with a surface with vegetation (yr^{-1})
$kleach_{veg} = WS_{veg} / (K_{soil\text{-}water} * DEPTHwaste)$ (L-13)

Rate constant for leaching of substance in sector with a surface with top seal (yr^{-1})
$kleach_{final} = WS_{final} / (K_{soil\text{-}water} * DEPTHwaste)$ (L-14)

Rate constant for volatilisation of substance (d^{-1})
$1 / kvolat_{waste} = [1 / (kasl_{air} * K_{air\text{-}water}) + 1 / (kasl_{soil\text{-}air} * K_{air\text{-}water} + kasl_{soil\text{-}water})] * K_{soil\text{-}water} * DEPTHwaste$ (L-15)

Overall removal rate constant in sector with surface without vegetation (yr^{-1})
$krem_{bare} = kdeg_{waste\_subst} * 365 + kleach_{bare} + kvolat_{waste} * 365$ (L-16)

Overall removal rate constant in sector with surface with vegetation (yr^{-1})
$krem_{veg} = kdeg_{waste\_subst} * 365 + kleach_{veg} + kvolat_{waste} * 365$ (L-17)

Overall removal rate constant in sector with surface with top seal (yr^{-1})
$krem_{final} = kdeg_{waste\_subst} * 365 + kleach_{final} + kvolat_{waste} * 365$ (L-18)

[1)] equal to 0 (zero) in the case of metal compounds such as salts used for wood preservation.

Table 24.1 Sanitary landfill model (continued)

Concentration in waste ($mg.kg^{-1}$) at beginning of year *i* per sector for consecutive years (up to Tutil

The following help variables are used (see also Appendix #):
Isect = number of sector; maximum = Tutil. j = year; maximum = Tutil + 5. Is = test number 1. Nm = test number 2

```
    Isect = 1
#0  j = Isect
    $Csubst\_landf_{Isect,j} = Csubst\_landf_0 * e^{-krem_{bare}}$        (L-19)
    Nm = INT((Isect – 1) / Tfinal_top)
#1  j = j + 1
    Is = INT((j – 1) / Tfinal_top)
    IF Is > Nm GO_TO_#2
    $Csubst\_landf_{Isect,j} = Csubst\_landf_{Isect,j-1} * e^{-krem_{veg}}$        (L-20)
    GO_TO_#1
#2  $Csubst\_landf_{Isect,j} = Csubst\_landf_{Isect,j-1} * e^{-krem_{final}}$        (L-21)
    j = j + 1
    IF j ≤ Tutil + 5 GO_TO_#2
    Isect = Isect + 1
    IF isect ≤ Tutil GO_TO_#0
END_OF_SUBROUTINE
```

Amount removed from waste ($kg.yr^{-1}$) in a sector in year *i* for i = 1....Tutil+5

$$Qrem\_sec_i = (Csubst\_landf_{i-1} - Csubst\_landf_i) * Qwaste_{landf} * 10^{-3} \qquad (L-22)$$

Amount of substance leached ($kg.yr^{-1}$) in a sector in year *i* for i = 1...Tutil+5

$$Qleach\_sec_i = kleach_{bare} / krem_{bare} * Qrem\_sec_i \quad \textit{[for i = 1]} \qquad (L-23)$$

$$= kleach_{veg} / krem_{veg} * Qrem\_sec_i \quad \textit{[for i = 2...Tutil]} \qquad (L-24)$$

$$= kleach_{final} / krem_{final} * Qrem\_sec_i \quad \textit{[for i > Tutil]} \qquad (L-25)$$

Total amount of substance leached from landfill ($kg.yr^{-1}$) in year *i* for i = 1...Tutil+5

$$Qleach\_landf_i = \sum_{j=1}^{i} Qleach\_sec_i \qquad (L-26)$$

Amount of substance volatilised in a sector ($kg.yr^{-1}$) in year *i* for i = 1....Tutil+5

$$Qvolat\_sec_i = kvolat_{waste} / krem_{bare} * Qrem\_sec_i \quad \textit{[for i = 1]} \qquad (L-27)$$

$$= kvolat_{waste} / krem_{veg} * Qrem\_sec_i \quad \textit{[for i = 2...Tutil]} \qquad (L-28)$$

$$= kvolat_{waste} / krem_{final} * Qrem\_sec_i \quad \textit{[for i > Tutil]} \qquad (L-29)$$

Total amount of substance volatilised in landfill ($kg.yr^{-1}$) in year *i* for i = 1...Tutil+5

$$Qvolat\_landf_i = \sum_{j=1}^{i} Qvolat\_sec_i \qquad \text{(L-30)}$$

End calculations

N.B. All calculations for i = 1…Tutil+5

$Qsubst\_STP_i$ = $(1 - Fleach_{subsoil}) * Qleach\_landf_i$ (L-31)

$Qsubst\_soil_i$ = $Fleach_{subsoil} * Qleach\_landf_i$ (L-32)

$Qsubst\_air_i$ = $Fvolat * Qvolat\_landf_i$ (L-33)

$Csubst\_perc_i$ = $Qleach\_landf_i / Vwater\_percol_i * 10^3$ (L-34)

$Csubst\_gas_i$ = $Qvolat\_landf_i / Vgas\_landf_i * 10^6$ (L-35)

It should be noted that for the rate constant for degradation of substance in waste the rate constant for degradation in bulk soil is used (L-12). The use of the rate constant for abiotic degradation, $kabio_{soil}$, might be preferable instead.

24.2 Product types and waste treatment

Emission scenarios for the stage of waste processing are only needed in situations where products (objects) containing biocides end up in waste streams, e.g. biocides in plastic objects, woollen articles or paper. The product types where this applies have been identified in Van der Poel (1999b) as:

6 In-can preservatives (paint products and adhesives)
7 Film preservatives (paint products and adhesives)
8 Wood preservatives
9 Fibre, leather, rubber and polymerised materials preservatives

As has been stated in several chapters of this document, emission scenarios may have two different starting points. First, the tonnage of the biocide applied/used (production + import – export in EU) may be used as a starting point. This is normally the case for new and existing substances in risk assessment where the notifier supplies data on production and/or import. Second, the concentration of the biocide assessed is used as a starting point. This data has to be specified by the notifier.

The model that calculates the initial concentration of the substance (in this case a biocide) in landfilled waste (sector with bare surface) $Csubst\_Lwaste_0$ uses the following parameters for the calculation of the concentration in (domestic and ordinary industrial) waste of biocides applied in products (e.g. preservatives in coatings and adhesives):

1. Fraction of biocide in the product
2. Quantity of the product
3. Fraction of the product with a biocide added
4. Penetration factor
5. Fraction lost due to diffuse releases
6. Fraction lost due to degradation
7. Fraction of waste with the product landfilled
8. Fractions of (total) waste landfilled
9. Total quantity of waste processed in the region

1. Fraction of biocide in the product

This parameter, $Fsubst\_prod_i$, concerns the fraction of the biocide in the product, e.g. a preservative in adhesives. Though the notifier of the biocide has to specify the dosage, the model uses a default value for this parameter. The default value has to be generated for every product type and application separately.

2. Quantity of the product

This parameter, $Qreg\_prod_i$, has to be generated for the regional scale. Normally such data can be obtained from industries, trade organisations, statistical bureaux, etc. For the region 'the Netherlands' national figures can be used.

3. Fraction of the product with a biocide added

It is possible that not all – often water-based – products will contain preservatives. This parameter, $Fpres\_prod_i$, offers the possibility to correct for that possibility.

4. Penetration factor

As it is not likely that only one and the same biocide will be used for the application in a certain product or product group, a penetration factor is applied, i.e. the fraction of the total amount of product i with the biocide assessed. As these data are usually unknown, the arbitrary default value $Fpenetr_i = 0.25$ is used. Only in some instances will market shares be known, enabling use of real values. If one wants to compare different biocides for the same purpose to obtain hazard ranking, it is important to use the same value for every biocide.

5. Fraction lost due to diffuse releases

EUSES and USES do not estimate the total diffuse emissions at the life cycle stage of product life so far; this is due to losses caused by leaching and volatilisation. Therefore this parameter, $Fdiff_i$, has been introduced.

6. Fraction lost due to degradation

During product life the biocide may be degraded to some extent due to processes like oxidation, microbial attack and so on. Therefore this parameter, $Fdeg_i$, has been introduced.

7. Fractions of waste with product landfilled

For the emissions at the stage of waste treatment the fractions of the streams to landfill and incinerator (for domestic and ordinary industrial waste), $Flandf_i$ and $Fincin_i$, have to be quantified.

8. Fractions of waste landfilled

The fractions of (total) waste landfilled and incinerated may vary from year to year and from region to region. The model uses the ratio landfill : incinerator = 6 : 4 (Van der Poel, 1999b): $Flandf_{total} = 0.6$ and $Fincin_{total} = 1 - \mathrm{Flandf}_{\mathrm{total}} = 0.4$.

9. Total quantity of waste processed in the region

The default value for the total quantity of (domestic and ordinary industrial) waste, *Qwaste_reg*, has been set at the value of 11,880 ktonnes.yr^{-1} for the region 'the Netherlands' (Van der Poel, 1999b).

Table 24.2 Model for calculating the concentration of biocides in waste landfilled and incinerated

Variable/parameter (unit)	Symbol	Default	S/D/O/P
Input:			
Fraction of biocide (by weight) in the product before application (-)	$Fsubst\_prod_i$		D [1)]
Quantity of product i in the region (ktonnes.yr^{-1})	$Qreg\_prod_i$		D [1)]
Fraction of product with a biocide added (-)	$Fpres\_prod_i$		D [1)]
Penetration factor (-)	$Fpenetr_i$		D [1)]
Fraction lost due to diffuse releases (-)	$Fdiff_i$		D [1)]
Fraction lost due to degradation (-)	$Fdeg_i$		D [1)]
Fraction of product waste landfilled (-)	$Flandf_i$		D [1)]
Fraction of (total) waste landfilled (-)	$Flandf_{total}$		D [1)]
Total quantity of waste in the region (ktonnes.yr^{-1})	Qwaste_reg	11880	D

Output:

$Csubst\_landf_0$ = Concentration of biocide in waste landfilled (mg.kg^{-1})

Intermediate calculations:

Quantity of biocide for application in product i in total waste (kg.yr^{-1})

$$Qsubst\_reg_i = Qreg\_prod_i * 10^6 * Fsubst\_prod_i * Fpres\_prod_i * Fpenetr_i * (1 - Fdiff_i - Fdeg_i) \quad \text{(L-37)}$$

End calculations:

$$Csubst\_landf_0 = \sum_{i=1}^{n} \frac{(Qsubst\_reg_i * Flandf_i)}{(Qwaste\_reg * Flandf_{total})} \quad \text{(L-38)}$$

[1)] The defaults are presented in the relevant sections for product types where life cycle stage 5a (waste treatment) is applicable

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Appendix 1 Mailing list

1 Directoraat-Generaal Milieubeheer, Directeur Bodem, Water, Landelijk Gebied, Drs. J.A. Suurland
2 Directoraat-Generaal Milieubeheer, Directeur Stoffen, Afvalstoffen, Straling, Dr. C.M. Plug
3 Plv. Directeur-Generaal Milieubeheer, Dr.Ir. B.C.J. Zoeteman, DGM/DWL
4 Drs. W. Tas, DGM/DWL
5 Drs. A.W. van der Wielen, DGM/SVS
6 EU-SCHP d.t.v. Dr.Ir. H. de Heer
7 Ing. A.C.M. van Straaten, LNV, SG Bestrijdingsmiddelenbeleid
8 J.M.C. Appelman (CTB)
9 Prof.Dr. J.S.M. Boleij, CTB
10 A. Van Gelder (CTB)
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12 Dr. M. Lans, CTB
13 Ing. R. Faassen, RIZA
14 H. Roelfzema, VWS/IGZ
15 Ir. D.J. Bakker, TNO-MEP
16-19 K. Rasmussen, European Commission, DG JRC, Institute for Health and Consumer Protection, European Chemicals Bureau, (Ispra, Italy)
20 V. Migné, INERIS (Paris)
21 J. Larsen, Miljøstyrelsen (København)
22 J. Tadeo, INIA (Madrid)
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47-52 Toetsgroep M, d.t.v. Ir. J.B.H.J. Linders
53-54 Centrum voor Stoffen en Risicobeoordeling
55-58 Laboratorium voor Ecotoxicologie
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60 Dr.ir. B. Hakkert, CSR
61 Ir. A. van der Linden, LBG
62 Dr.Ir. F.A. Swartjes, LBG

63	Dr. D.T.H.M. Sijm, CSR
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Appendix 2 Differences between emission scenarios for the local situation

In general two types of emission scenarios may be distinguished, viz one based on the regional tonnage and the other on the consumption.

1. Emission scenario based on tonnages

In general no regional tonnage will be known for an arbitrary substance. In that case the regional tonnage is derived from the EU tonnage by multiplication by 0.1 (10 % rule). This is about twice the amount that may be expected on account of the fraction of inhabitants in the region of the EU (see 4). Such a situation will not be unlikely in most cases as it may be expected that the more densely populated areas will have more industrial activities than the rural areas.

For diffuse emissions caused by e.g. households the standard STP with 10,000 inhabitants feeding the system and an amount of 0.2 m^3 wastewater per inhabitant per day is considered as a point source. If the use of a substance would be evenly distributed over the population (consumers) and STPs in a region and over the week, the fraction of this substance reaching the standard STP of EUSES would be *number of inhabitants connected to the STP (Nlocal) / number of inhabitants in the region (N)*. This means a fraction of 10,000 / $20.0.10^6$ = 0.0005 with the defaults of EUSES. As the use of (formulation containing) substances never will be distributed evenly over the population and the week, a safety factor of four was assumed at the time. This means that the *fms* (fraction of the main source) = 0.002. This value is used in the emission tables of the TGD. In this case the nds (number of emission days) is equal to 365.

There may be other applications where a point source is considered such as a hospital. In Van der Poel (2001) the *fms* for the model hospital has been estimated to be 0.007. This fraction was calculated as from the average number of beds in a region per hospital and the total number of beds in that region. The nds may be less than 365 in specific cases.

2. Emission scenario based on the consumption

This type of emission scenarios apply either the average consumption per inhabitant or the – estimated – use in a process. An example of the average consumption is the use of soaps and detergents for cleaning and washing ($l.cap^{-1}.d^{-1}$ or $g.cap^{-1}.d^{-1}$). The emission scenario is simple and applies an emission factor, the concentration of the substance in the product (in this report a disinfectant for which the notifier has to specify the value) and the penetration factor (i.e. the fraction of the product on the market containing the specific substance) *Fpenetr*.

For a point source like a hospital it may be also the use of this kind of products (usually known in $kg.y^{-1}$). The emission scenario is even more simple as there is no penetration factor

needed. Only an emission factor and an amount of product used is needed besides the concentration of the substance in the product.
The *nds* (number of emission days) will be 365 days for consumption data for the public at large but may be less in specific cases as in the example of hospital applications.

3. Tonnage versus Consumption

When a substance with diffuse emissions is assessed the scenarios based on the tonnage will produce emissions directly related to the volume of the use. This is an advantage compared to scenarios that are based on consumptions.
There are, however, also some disadvantages in using scenarios based on the tonnage; there is an uncertainty in the regional tonnage if this is not known and another uncertainty in the fraction reaching the standard STP.

The use of average consumptions has several disadvantages. First, there is no direct relation with the actual quantity of the disinfectant for the application in the case of diffuse emissions. Second, the average consumptions are often not specifically for e.g.detergents with a biocide leading to an uncertainty and for many products no reliable data are known. Third, the average consumption in a region may be different from the EU average leading to an uncertainty (reason for the 'safety factor' of 4 applied in the STP calculations with tonnages). Last but not least, the factor for the market penetration has a considerable uncertainty.
For point sources the main disadvantage is the fact that calculations of the consumption may have considerable uncertainties because of lacking data impelling detours to obtain estimates.

Because of the complete different character the two types of scenarios will provide outcomes which may be quite different. The emission factor and concentration of the substances in the product will be the same. For the diffuse emissions, i.e. emissions caused by use by the public at large, the scenario with the average consumption will give a fixed value whereas the scenario with the tonnage will give the emission as a linear relation to the quantity. It may be assumed that the tonnage scenario is more realistic as the consumption per habitant determines the tonnage.
For the point sources there may be a situation that the use of the tonnage scenario is underestimating the emission. This is the case where the substance is not used in the product by all sources. For example, if we consider a cleaner with a disinfectant for sanitary purposes in hospitals the various manufacturers of that product may apply different active substances. So, one hospital will apply the disinfectant assessed but another applies a different substance. The tonnage scenario, however, will distribute the whole amount over all hospitals so to say by using the fraction of its relative size (0.007). So, there will be a break even point below which the consumption scenario will be better. The break-even point is found by matching the equations for emission calculation (ef = emission factor):

A) Consumption per day per person for diffuse emissions collected at a point source (STP)

Tonnage (10^3 kg.yr^{-1}): Emission I = Tonnage * 10^3 * fms * ef / nds
Consumption (kg.d^{-1}): Emission II = Npers * Fpers * Consumption * Concentration * ef * Fpenetr
(where:
Npers = numer of persons regarded
Fpers = fraction of persons using the product

Emission I = Emission II, So:
Tonnage * 10^3 * fms * ef / nds = Consumption * Concentration * ef
Tonnage = (Npers * Fpers * Consumption * Concentration * nds * Fpenetr) / (10^3 * fms)

Example for a fictious situation with the following data:

Numer of persons *Npers* (-)	10,000
Fraction of persons *Fpers* (-)	0.5
Number of emission days *nds* (y^{-1})	365
fraction for main point source (-)	0.005
Consumption point source (kg. d^{-1})	0.02
Concentration of substance (%)	10
Penetration factor (-)	1

Tonnage = (10,000 * 0.02 * 0.5 * 10/100 * 365 * 1) / (10^3 * 0.005) = 730 tonnes

B) Consumption per day for a point source
Tonnage (10^3 kg.yr^{-1}): Emission = Tonnage * 10^3 * fms * ef / nds
Consumption (kg.d^{-1}): Emission = Consumption * Concentration * ef

Tonnage * 10^3 * fms * ef / nds = Consumption * Concentration * ef
Tonnage at break-even = (Consumption * Concentration * nds) / (10^3 * fms)

Example for a fictious situation with the following data:

Number of emission days *nds* (y^{-1})	365
fraction for main point source (-)	0.005
Consumption point source (kg. y^{-1})	100
Concentration of substance (%)	10

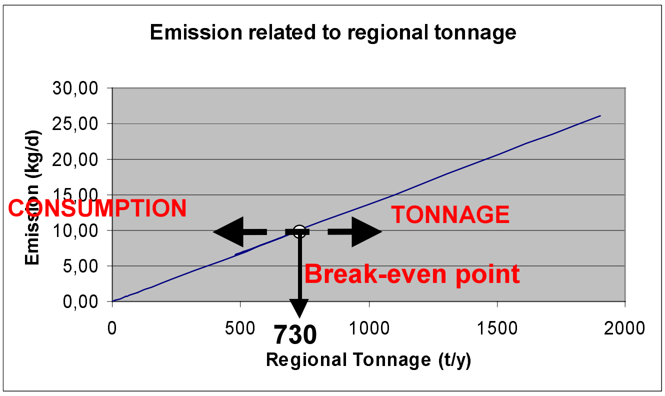
Tonnage at break-even = (10 * 10/100 * 365) / (10^3 * 0.005) = 730 tonnes

C) Consumption per year for a point source
Tonnage (10^3 kg.yr^{-1}): Emission = Tonnage * 10^3 * fms * ef / nds
Consumption (kg.yr^{-1}): Emission = Consumption * Concentration * ef * / nds

Tonnage at break-even = (Consumption * Concentration) / (10^3 * fms)

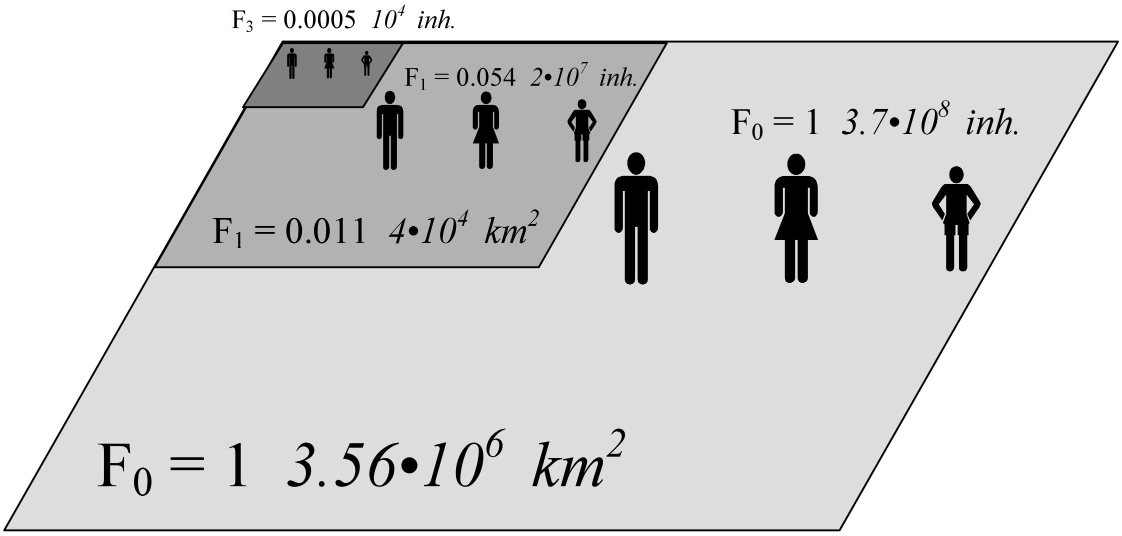
Example for a fictious situation with the following data:
fraction for main point source (-) 0.005
Consumption point source (kg. y^{-1})36500
Concentration of substance (%) 10
Tonnage at break-even = (36500 * 10/100) / (10^3 * 0.005) = 730 tonnes

For a consumption pattern that yields 10 kg.d^{-1} for the point source the situation compared to the emission scenario based on the tonnage this has been illustrated in the figure below:



4. Number of inhabitants and area sizes in the TGD

In the TGD the area of the region is 200 x 200 km^2, which is more densely populated than the average region of that size elsewhere in the EU (total area of the EU $3.56 \cdot 10^6$ km^2). The number of inhabitants considered in the TGD is $2 \cdot 10^7$ in the region and $3 \cdot 7.10^8$ in the EU. So, the number of inhabitants per km2 is 500 in the region and 104 in the EU. This means that the fraction of inhabitants in the region is $2 \cdot 10^7 / 3 \cdot 7.10^8 = 0.054$ and the fraction of the regional area $4 \cdot 10^4 / 3.56 \cdot 10^6 = 0.011$.



Appendix 3: Emission factors to the relevant streams for animal subcategories and housing type in disinfection of animal housing

Index	Cat	Sub Cat	Housing type	Manure storage	Spray/Unknown			Fog		
					M	W	S	M	W	S
1	Cattle	Dairy					0.65			0.50
2		Beef					0.65			0.50
3		Calves					0.65			0.50
4	Pigs	Sows					0.65			0.50
5		Fattening					0.65			0.50
6	Poultry	Laying hens	Battery	No treatment			0.65			0.50
7			Battery	Belt drying		0.20	0.45		0.15	0.35
8			Battery	Deep pit	0.65			0.50		
9			Battery	Compact			0.65			0.50
10			Free range	Litter floor	0.40	0.25		0.30	0.20	
11		Broilers	Free range	Litter floor	0.40	0.25		0.30	0.20	
12		Parent broilers	Free range	Grating floor			0.65			0.50
13		Parent broilers in rearing	Free range	Grating floor			0.65			0.50
14	Manure	Wet					0.65			0.50
15		Dry			0.65			0.50		

M = Manure; W = Wastewater; S = Sludge

Emission factors to the relevant streams for animal subcategories and housing type in disinfection of footwear and animals' feet

Index	Cat	Sub Cat	Housing type	Manure storage	Dipping		
					M	W	S
1	Cattle	Dairy					0.25
2		Beef					0.25
3		Calves					0.25
4	Pigs	Sows					0.75
5		Fattening					0.75
6	Poultry	Laying hens	Battery	No treatment			0.75
7			Battery	Belt drying		0.20[1]	0.55
8			Battery	Deep pit	0.75		
9			Battery	Compact			0.75
10			Free range	Litter floor	0.45	0.30[1]	
11		Broilers	Free range	Litter floor	0.45	0.30[1]	
12		Parent broilers	Free range	Grating floor			0.75
13		Parent broilers in rearing	Free range	Grating floor			0.65

---

[1] Probably no emissions to wastewater, as assumed by Monfoort *et al.*, 1996 all emissions take place to the manure storage system

Emission factors to the relevant streams for cattle subcategories in disinfection of milk extraction systems

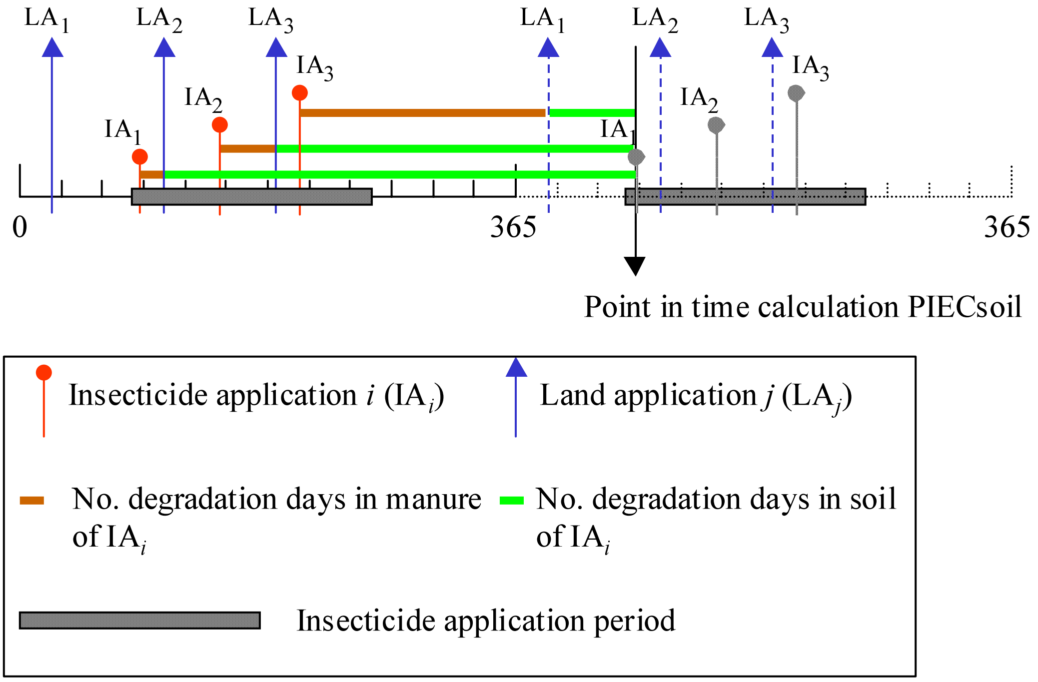
Index	Cat	Sub Cat	Housing type	Manure storage	Dipping		
					M	W	S
1	Cattle	Dairy					0.75
2		Beef					0.75
3		Calves					0.75

Appendix 4: Concentration of active ingredients (g·l^{-1}) used for disinfection in various situations in livestock farming

Application	Aldehydes	Chlorine	Hydroxides	Mixed		Quats	Others
				Quats	Aldehydes		
Housing							
All	2			0.7-1.4	5.25-10.5		40
Pigs	40						
Poultry		40	10.5				
Feet and Footwear							
Feet	2						
Footwear	40						
Feet and Footwear		0.2	10.5	0.7-1.4	5.25-10.5	0.5-2	40
Milk extraction		0.19	0.62				0.62
Means of transport		0.2	10.5				10.5

Appendix 5 Overview insecticide and land applications

Graphic presentation of the calculations for the degradation days in manure and soil in the case of three insecticide applications and three land applications

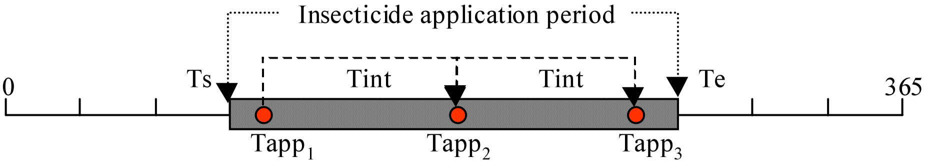


Graphic presentation of the determination of the number and days of insecticide applications from the end day of the insecticide application period (Tend), the day of the 1st insecticide application (Tappl_n$_1$) and the insecticide application interval:

1) Number of applications Nappl_bioc = (Tend – Tappl_n$_1$) / Tint

2) For i = 2 ▪▪▪ Nappl_bioc:

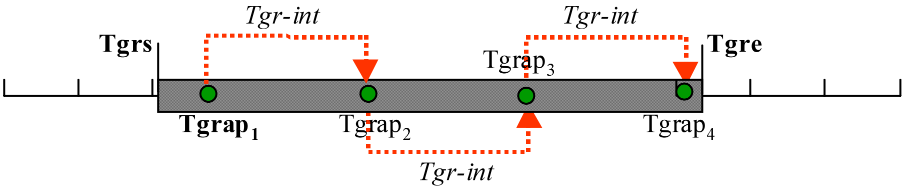
Day of 2nd insecticide application Tappl_n$_2$ = Tappl_n$_1$ + Tint
‖
‖
Day of last insecticide application Tappl_n$_{\text{Nappl\_bioc}}$ = Tappl_n$_{\text{Nappl\_bioc-1}}$ + Tint



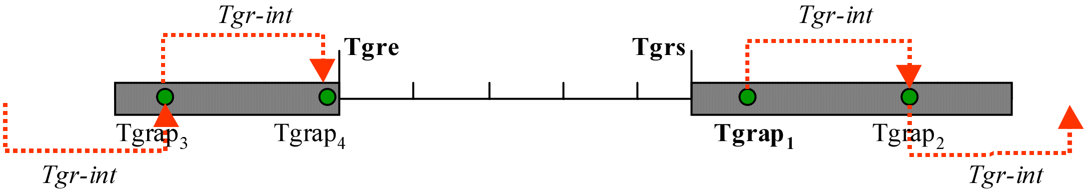
Appendix 6 Split interval correction

The land application period – in this example for grassland – is specified by the start day (Tgrs) and the end day (Tgre). The start day is either lower then the end day or higher ("split period"). This is presented below for land applications on grassland with the same application intervals and two application periods of the same length:

A) Tgrs < Tgre



B) Tgrs < Tgre



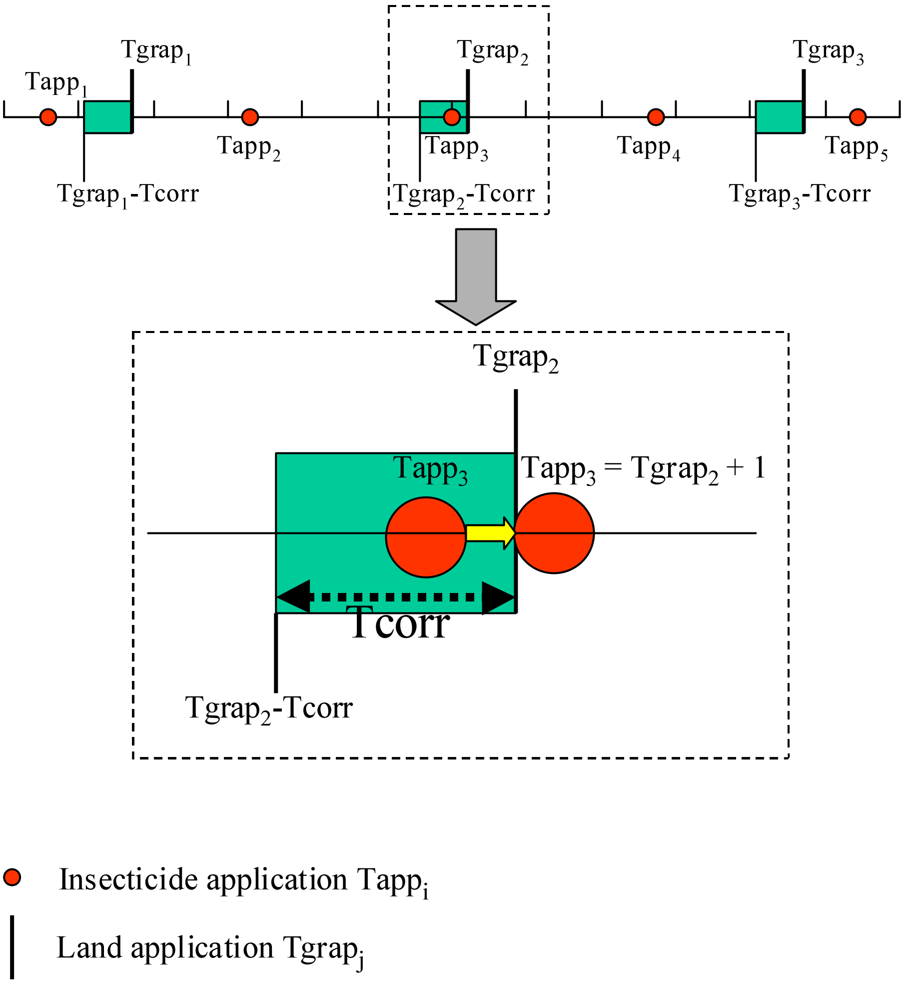
Note: Tgrap$_3$ *and Tgrap*$_3$ *are before Tgrap*$_1$*; this correction is made automatically by the program*

Appendix 7 Correction insecticide application day

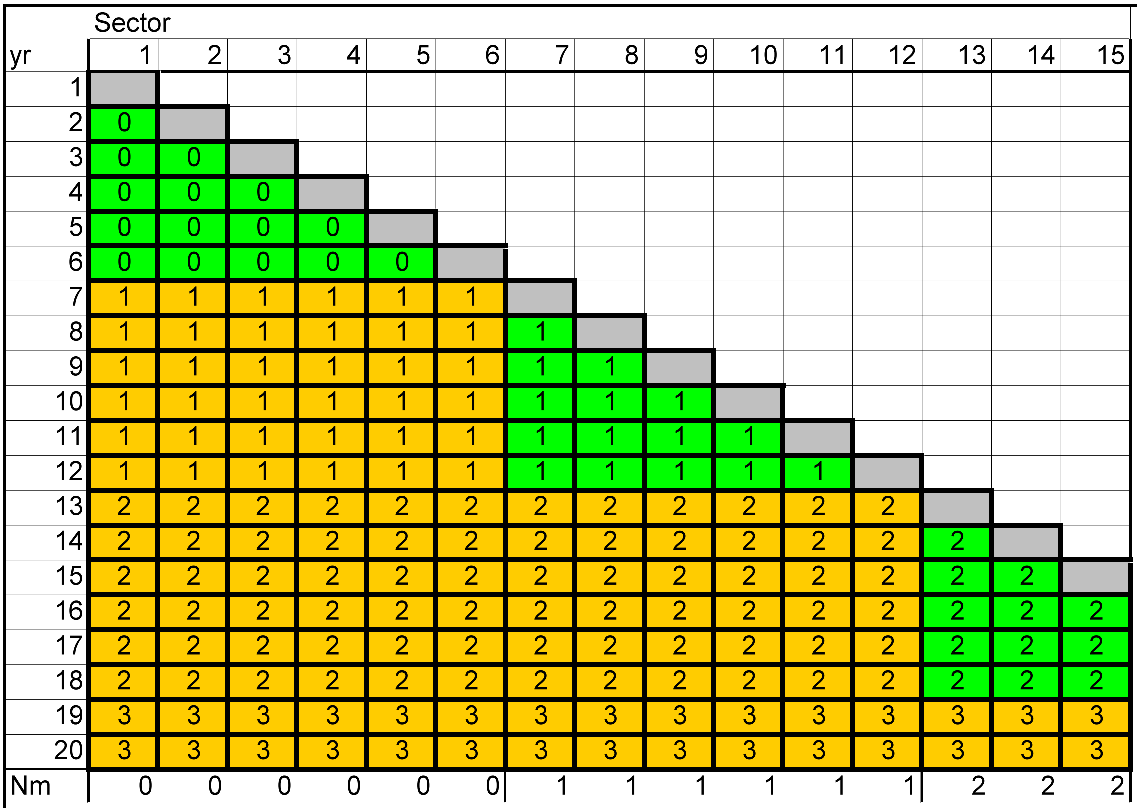
The graphic presentation below shows how a correction should be made if one of the insecticide applications is within a short period – called Tcorr here – before a land application. If this is the case the insecticide application is shifted to the day after the land application. In the graphic presentation this has been worked out for land applications on grassland.

Land application *j* ($Tgrap_j$) and insecticide application *i* ($Tapp_i$):

IF $Tgrap_j - Tcorr \leq Tapp_i \leq Tgrap_j$ THEN $Tapp_i = Tgrap_j + 1$



Appendix 8 Use of help variables for determination of degradation equation



yr	Sector 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	▨														
2	0	▨													
3	0	0	▨												
4	0	0	0	▨											
5	0	0	0	0	▨										
6	0	0	0	0	0	▨									
7	1	1	1	1	1	1	▨								
8	1	1	1	1	1	1	1	▨							
9	1	1	1	1	1	1	1	1	▨						
10	1	1	1	1	1	1	1	1	1	▨					
11	1	1	1	1	1	1	1	1	1	1	▨				
12	1	1	1	1	1	1	1	1	1	1	1	▨			
13	2	2	2	2	2	2	2	2	2	2	2	2	▨		
14	2	2	2	2	2	2	2	2	2	2	2	2	2	▨	
15	2	2	2	2	2	2	2	2	2	2	2	2	2	2	▨
16	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
17	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
18	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
19	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Nm	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2

▨ Sector where landfilling takes place

🟩 Is Sector with vegetation on top

🟨 Is Sector with final top

Is = INT((yr-1) / Tfinal_top)	Test value 1 for determination of degradation equation
Nm = INT((Sector-1)/Tfinal_top)	Test value 2 for determination of degradation equation

If Is > Nm : final top, If Is

Appendix 9 Symbols of parameters and variables (I. by type of parameter / variable)

This appendix deals with the symbols in the order of the type of parameters and variables as in Van der Poel (2000).

Physico-chemical properties

The only parameter in the various emission scenarios is the **density** (unit kg.m^{-3}). This is may be the density of soil, a product (i.e. a formulation) or waste (module of a landfill).

General symbol:	RHO	
Specifications:	soil	for density of bulk soil
	form	for density of formulation
	waste	for density of waste
Subscripts:	-	

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Density of bulk soil					
8.10	RHOpest	2 [2.5]	.	RHO_{soil}	USES 4.0: RHO_{pest}
8.9	RHOsatsoil	2 [2.4]	.	RHO_{soil}	USES 4.0: $RHO_{satsoil}$
3.2	RHOsoil	3 [1]	.	RHO_{soil}	General parameter USES
3.6	RHOsoil	3 [2]	.	RHO_{soil}	General parameter USES
3.8	RHOsoil	3 [3]	.	RHO_{soil}	General parameter USES
18.2	RHOsoil	11 [5.5]	RHOsoil	RHO_{soil}	General parameter USES
18.3	RHOsoil	11 [5.5]	RHOsoil	RHO_{soil}	General parameter USES
22.5	RHOsoil	5 [5]	RHO_{soil}	RHO_{soil}	General parameter USES
Density of formulation					
1.2	RHOform	-	.	.	New emission scenario
8.7	RHOform	1 [12]	R_{den}	RHO_{form}	
12.1	RHOform	12 [3.1]	RHOprod	.	
22.3	RHOform	5 [4]	$RHO_{solution}$	.	
22.5	RHOform	5 [5]	$RHO_{solution}$	.	
Density of waste					
24.1	RHOwaste	9 [4.1]	RHOwaste		

[1)] Report number according to the list of Appendix 11 + [Table number]

Partition coefficients

The name for the symbol is in all cases "K". There is no clear difference whether a specification or subscripts are used in the USES 3.0 manual.

The following partition coefficients occur:

- Air-water partitioning coefficient (partial mass-transfer coefficient at soil-water side of air-soil interface)
- Soil-water partitioning coefficient
- Solids-water partition coefficient for suspended matter
- Octanol-water partition coefficient

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Air-water partitioning coefficient					
24.1	$K_{air\text{-}water}$	9 [4.1]	$K_{air\text{-}water}$	$K_{air\text{-}water}$	
Soil-water partitioning coefficient					
8.9	Kp_{soil}	2 [2.4]	.	Kp_{soil}	in soil
8.10	Kp_{soil}	2 [2.4]	.	Kp_{soil}	in soil
22.5	$K_{soil\text{-}water}$	5 [5]	$K_{soil\text{-}water}$	$K_{soil\text{-}water}$	
24.1	$K_{soil\text{-}water}$	9 [4.1]	$K_{soil\text{-}water}$	$K_{soil\text{-}water}$	
Solids-water partition coefficient for suspended matter					
8.8	Kp_{susp}	1 [13]	.	Kp_{susp}	
11.1	Kp_{susp}	1 [5]	.	Kp_{susp}	
21.1	Kp_{susp}	1 [14]	.	Kp_{susp}	
Octanol-water partition coefficient					
21.1	.	1 [14]	K_{ow}	Kow	

[1)] Report number according to the list of Appendix 11 + [Table number]

Rate constants

For rate constants the USES 3.0 manual applies lower case "k" with or without a specification and with a subscript. The following general formats for symbols are present in USES 3.0:

$kabio_{subscript}$	rate constant for abiotic degradation in (subscript)
$kbio_{subscript}$	rate constant for biodegradation in (subscript)
$kdeg_{subscript}$	(total) rate constant for degradation in (subscript)
$khydr_{subscript}$	rate constant for hydrolysis in (subscript)
$kphoto_{subscript}$	rate constant for photolysis in (subscript)

The emission scenarios presented in the tables of this report have sometimes specific rate constants, for example for hydrolysis under acidic or alkaline process conditions (slimicides).

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
rate constant for biodegradation in …					
12.4	$kbiotot_{water}$	12 [4.1]	$kbiotot_{water}$	.	including hydrolysis
12.4	$kbio_{water}$	12 [4.1]	$kbio_{water}$	$kbio_{water}$	
12.4	$kbiotot_{stp}$	12 [4.1]	$kbiotot_{stp}$	.	including hydrolysis
rate constant for degradation in …					
21.1	$kdeg_{water}$	1 [14]	k_1	$kdeg_{water}$	surface water
2.14	$kdeg_{disinf}$	10 [3.7]	$kdeg_{disinf}$	.	in washer/disinfector
2.15	$kdeg_{disinf}$	10 [3.7]	$kdeg_{disinf}$	.	in washer/disinfector
3.2	$kdeg_{soil}$	3 [1]	.	$kdeg_{soil}$	
3.6	$kdeg_{soil}$	3 [2]	.	$kdeg_{soil}$	
3.8	$kdeg_{soil}$	3 [3]	.	$kdeg_{soil}$	
18.2	$kdeg_{soil}$	11 [6.1]	.	$kdeg_{soil}$	
18.3	$kdeg_{soil}$	11 [6.1]	.	$kdeg_{soil}$	
3.2	$kdeg_{slurry}$	3 [1]	.	.	in manure (slurry)
3.6	$kdeg_{slurry}$	3 [2]	.	.	in manure (slurry)
3.8	$kdeg_{slurry}$	3 [3]	.	.	in manure (slurry)
18.2	$kdeg_{slurry}$	11 [6.1]	.	.	in manure (slurry)
18.3	$kdeg_{slurry}$	11 [6.1]	.	.	in manure (slurry)
24.1	$kdeg_{waste\_orgC}$	9 [4.1]	$kdeg_{waste}$	.	organic carbon in waste
24.1	$kdeg_{waste\_subst}$	9 [4.1]	$kdeg_{subst}$	.	substance in landfill
rate constant for hydrolysis in …					
12.4	$khydr_{acid}$	12 [4.1]	$khydr_{acid}$	.	at acid conditions
12.4	$khydr_{alkal}$	12 [4.1]	$khydr_{alkal}$	.	at alkaline conditions
12.4	$khydr_{water}$	12 [4.1]	$khydr_{water}$	$khydr_{water}$	at neutral conditions [2)]
rate constant for photolysis in …					
12.4	$kphototot_{water}$	12 [4.1]			including hydrolysis
12.4	$kphoto_{water}$	12 [4.1]		$kphoto_{water}$	excluding hydrolysis

[1)] Report number according to the list of Appendix 11 + [Table number]

[2)] In USES 3.0 in surface water

Rate constants (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
other rate constants for …					
21.1	$kadvec_{basin}$	1 [14]	k_a	$k_{advec,basin}$	advection in basin
24.1	$kleach_{bare}$	9 [4.1]	$kbar_{leach\ waste}$	.	leached in dumping section
24.1	$kleach_{final}$	9 [4.1]	$kfin_{leach\ waste}$	.	leached in section with top seal
24.1	$kleach_{veg}$	9 [4.1]	$kveg_{leach\ waste}$	.	leached in section with vegetation
21.1	$krem_{basin}$	1 [14]	k	k_{basin}	removal from basin
22.5	$krem_{soil}$	5 [5]	k		soil of cemetry
24.1	$krem_{bare}$	9 [4.1]	$k_{removal\ 1}$	.	removed from dumping section
24.1	$krem_{veg}$	9 [4.1]	$k_{removal\ 2}$	.	removed from section with vegetation
24.1	$krem_{final}$	9 [4.1]	$k_{removal\ 3}$	.	removed from section with top seal
24.1	$kvolat_{waste}$	9 [4.1]	$k_{volat\ waste}$	.	volatised from landfill

1) Report number according to the list of Appendix 11 + [Table number]

Mass transfer coefficients

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
24.1	$kasl_{air}$	9 [4.1]	$kasl_{air}$	$kasl_{air}$	
24.1	$kasl_{soil-air}$	9 [4.1]	$kasl_{soil-air}$	$kasl_{soilair}$	
24.1	$kasl_{soil-water}$	9 [4.1]	$kasl_{soil-water}$	$kasl_{soilwater}$	

1) Report number according to the list of Appendix 11 + [Table number]

Half-life times

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
half-life time for biodegradation in …					
12.4	$DT50bio_{water}$	12 [4.1]	$DT50bio_{water}$	$DT50bio_{water}$	in bulk surface water (USES)
12.4	$DT50bio_{stp}$	12 [4.1]	$DT50bio_{stp}$	$DT50bio_{stp}$	
3.2	$DT50bio_{soil}$	3 [1]	$DT50bio_{soil}$	$DT50bio_{soil}$	in bulk soil (USES)
3.6	$DT50bio_{soil}$	3 [2]	$DT50bio_{soil}$	$DT50bio_{soil}$	in bulk soil (USES)
3.8	$DT50bio_{soil}$	3 [3]	$DT50bio_{soil}$	$DT50bio_{soil}$	in bulk soil (USES)
18.2	$DT50bio_{soil}$	11 [6.2]	$DT50bio_{soil}$	$DT50bio_{soil}$	in bulk soil (USES)
3.2	$DT50bio_{slurry}$	3 [1]	.	.	in manure
3.6	$DT50bio_{slurry}$	3 [2]	.	.	in manure
3.8	$DT50bio_{slurry}$	3 [3]	.	.	in manure
18.2	$DT50bio_{slurry}$	11 [6.2]	$DT50bio_{slurry}$	.	in manure
half-life time for hydrolysis in …					
12.4	$DT50hydr_{water}$	12 [4.1]	$DT50hydr_{water}$	$DT50hydr_{water}$	
12.4	$DT50hydr_{acid}$	12 [4.1]	$DT50hydr_{acid}$	.	in acid environment
12.4	$DT50hydr_{alkal}$	12 [4.1]	$DT50hydr_{alkal}$		in alkaline environment
half-life time for photolysis in …					
12.4	$DT50photo_{water}$	12 [4.1]	$DT50photo_{water}$	$DT50photo_{water}$	
half-life time for …					
21.1	$DT50advec_{basin}$	1 [14]	$DT50_{a}$	$DT50_{advec,basin}$	for advection in basin

[1)] Report number according to the list of Appendix 11 + [Table number]

Dimensions

Distinction has been made between parameters with one, two and three dimensions. The fixed names for the symbols used have been standardized in this report:

One dimension

- length	LENGTH
- height	HEIGHT
- width	WIDTH
- depth	DEPTH
- diameter	DIAM
- radius	RAD
Two dimensions	
- surface, area	AREA
Three dimensions	
- volume, content, capacity	V

As the amount of a product, formulation and substance often is expressed by its volume the symbol V is used.

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
One dimension					
8.10	LENGTHfence	2 [2.5]	.	LENGTH$_{\text{fence}}$	
22.5	LENGTHcem	5 [5]	LENGTH$_{\text{cem}}$	.	
8.10	HEIGHTfence	2 [2.5]	W$_{\text{hight}}$	HEIGHT$_{\text{fence}}$	
22.5	WIDTHcem	5 [5]	WIDTH$_{\text{cem}}$	.	
8.8	WIDTHwway	1 [13]	W$_{\text{width}}$	WIDTH$_{\text{wway}}$	
8.10	WIDTHfence	2 [2.5]	W$_{\text{width}}$	WIDTH$_{\text{fence}}$	
21.1	DEPTHbasin	1 [14]	D$_{\text{y-b}}$	DEPTH$_{\text{basin}}$	depth of yacht-basin
2.2	DEPTHditch	2 [2.3]	W$_{\text{depth}}$	DEPTH$_{\text{ditch}}$	
8.10	DEPTHfence	2 [2.5]	W$_{\text{depth}}$	DEPTH$_{\text{fence}}$	depth of soil layer
3.2	DEPTHmix$_{\text{arable}}$	3 [1]	.	.	mixing depth arable l.
3.6	DEPTHmix$_{\text{arable}}$	3 [2]	.	.	mixing depth arable l.
3.8	DEPTHmix$_{\text{arable}}$	3 [3]	.	.	mixing depth arable l.
18.3	DEPTHmix$_{\text{arable}}$	11 [6.2]	DEPTH$_{\text{arable\_land}}$	.	mixing depth arable l.
22.5	DEPTHmix$_{\text{cem\_soil}}$	5 [5]	DEPTH$_{\text{soil}}$	DEPTH$_{\text{soil}}$	cemetry soil
3.2	DEPTHmix$_{\text{grass}}$	3 [1]	.	DEPTH$_{\text{grassland}}$	mixing depth grassland
3.6	DEPTHmix$_{\text{grass}}$	3 [2]	.	DEPTH$_{\text{grassland}}$	mixing depth grassland
3.8	DEPTHmix$_{\text{grass}}$	3 [3]	.	DEPTH$_{\text{grassland}}$	mixing depth grassland
18.3	DEPTHmix$_{\text{grass}}$	11 [6.2]	DEPTH$_{\text{grassland}}$	.	mixing depth grassland
18.9	DEPTHmix$_{\text{s}}$	11 [5.9]	DEPTH$_{\text{s}}$	.	mixing depth grass/arable
8.9	DEPTHpole	2 [2.4]	.	DEPTH$_{\text{pole}}$	saturated zone

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1) Report number according to the list of Appendix 11 + [Table number]

Dimensions (continued)

Table	Symbol	Report$^{1)}$	Symbol	USES 3.0	Remarks
One dimension					
2.1	DEPTHswimw	2 [2.2]	W_{depth}	$DEPTH_{swimw}$	
24.1	DEPTHwaste	9 [4.1]	DEPTHwaste	.	
8.8	DEPTHwway	1 [13]	W_{depth}	$DEPTH_{wway}$	waterway
8.8	DIAMpole	1 [13]	P_{diam}	$DIAM_{pole}$	
8.9	RADpole	2 [2.4]	.	RAD_{pole}	
8.9	RADsoil	2 [2.4]	.	RAD_{soil}	
Two dimensions					
21.1	AREAanti	1 [14]	A_{surf}	$AREA_{anti}$	
21.1	AREAdeck	1 [14]	$AREA_{deck}$	$AREA_{deck}$	
11.1	AREAdepos	1 [5]	A_{soil}	$AREA_{soil,cooling}$	
3.2	$AREAhousing_{i1}$	3 [1]	$A_{housing}$	.	
3.3	$AREAhousing_{i1}$	3 [1]	$A_{housing}$	.	
24.1	AREAlandf	9 [4.1]	AREAlandf	.	
8.8	AREAleach	1 [13]	L_{surf}	$AREA_{leach}$	
8.9	AREAleach	2 [2.4]	.	$AREA_{leach}$	
8.10	AREAleach	2 [2.5]	L_{surf}	$AREA_{fence}$	
21.1	$AREAlitre_{anti}$	1 [14]	C_{anti}	$AREA_{litre}$	
21.1	AREAship	1 [14]	A_{ship}	$AREA_{ship}$	
2.1	AREAswimw	2 [2.2]	L_{surf}	$AREA_{swimw}$	
18.3	$AREAtarget_{i1}$	11 [6.2]	$AREA_{i1}$	.	
18.4	$AREAtarget_{cat\text{-}subcat}$	11 [5.2]	$AREA_{i1}$	.	
3.9	AREAtransp	3 [4]	$A_{boxes/transport}$	.	
3.10	AREAtransp	3 [4]	$A_{boxes/transport}$	.	
18.3	$AREAuins_{i1}$	11 [6.2]	$AREAui_{i1}$	.	
Three dimensions					
amounts of formulation (e.g. disinfectant solution, biocidal product)					
2.7	Vform	10 [2.2]	$Q_{product}$	.	
7.2	Vform	4 [10]	.	.	
7.3	Vform	4 [11]	.	.	
6.8	Vform	4 [10]	.	.	
8.7	Vform	1 [12]	A_{fluid}	$APPl_{fluid}$	
6.10	Vform	4 [11]	.	.	
21.1	Vform	1 [14]	V_{anti}	V_{anti}	
3.2	$Vform\_area_{i1,i2}$	3 [1]	$Q_{disinfectant}$	.	
3.4	$Vform\_area_{i1,i2}$	3 [1]	$Q_{disinfectant}$	.	
3.9	$Vform\_area_{i1}$	3 [4]	$Q_{disinfectant}$	.	
3.10	$Vform\_area_{i1}$	3 [4]	$Q_{disinfectant}$	.	
3.9	$Vform\_box_{i1}$	3 [4]	$Q_{disinfectant}$		

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1) Report number according to the list of Appendix 11 + [Table number]

Dimensions (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Three dimensions					
amounts of formulation (e.g. disinfectant solution, biocidal product)					
3.10	$Vform\_box_{i1}$	3 [4]	$Q_{disinfectant}$	.	
18.3	$Vform\_uins_{i1,i2,i3}$	11 [6.2]	$Vprod\text{-}uins_{i1i2,13}$	.	
3.2	$Vform\_vol_{i1,i2}$	3 [1]	$Q_{disinfectant}$	.	
3.4	$Vform\_vol_{i1,i2}$	3 [1]	$Q_{disinfectant}$	.	
1.2	$Vform_{appl}$	-	.	.	per application
1.3	$Vform_{appl}$	-	.	.	per application
6.1	$Vform_{appl}$	-	.	.	
22.4	$Vform_{arterial}$	5 [2]	$Q_{arterial}$	.	
22.3	$Vform_{arterial}$	5 [4]	$Q_{arterial}$	.	
22.5	$Vform_{arterial}$	5 [5]	$Q_{arterial}$	.	
22.4	$Vform_{cavity}$	5 [2]	Q_{cavity}	.	
22.3	$Vform_{cavity}$	5 [4]	Q_{cavity}	.	
22.5	$Vform_{cavity}$	5 [5]	Q_{cavity}	.	
9.7	Vform	4 [10]	.	.	for process step *i*
9.8	Vform	4 [11]	.	.	for process step *i*
6.14	$Vform_i$	7 [9]	.	.	for process step *i*
6.15	$Vform_i$	6 [7]	.	.	for process step *i*
9.6	$Vform_i$	6 [7]	.	.	for process step *i*
1.2	$Vform_{inh}$	-	.	.	per inhabitant
1.3	$Vform_{inh}$	-	.	.	per inhabitant
6.1	$Vform_{inh}$	-	.	.	
3.8	$Vform_{inst}$	3 [3]	V_{inst}	.	
3.8	$Vform_{tank}$	3 [3]	V_{inst}	.	
2.16	$Vform_{weight}$	10 [3.9]	$V_{product}$	.	
2.17	$Vform_{weight}$	10 [3.10]	$V_{product}$	.	
amount of processing material (with biocide)					
2.14	Vproc	10 [3.7]	$Q_{machine}$		
amount of volume consumed					
2.13	$Vcons_{obj}$	10 [3.6]	Q_{water_obj}	.	
2.13	$Vcons_{san}$	10 [3.6]	Q_{water_san}	.	

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1) Report number according to the list of Appendix 11 + [Table number]

Dimensions (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Three dimensions					
various					
12.2	$EFFLUENT_{stp}$	12 [3.1]	.	$EFFLUENTlocal_{stp,paper}$	default for USES 3.0
21.1	Vbasin	1 [14]	V_{basin}	V_{basin}	yacht-basin
24.1	Vgas_landf$_i$	9 [4.1]	$Q_{gas\ i}$	.	
24.1	$Vgas_{orgC}$	9 [4.1]	$Q_{gas\ orgC}$	.	
3.2	$Vhousing_{i1}$	3 [1]	.	.	
3.3	$Vhousing_{i1}$	3 [1]	.	.	
24.1	Vlandf	9 [4.1]	Vlandf	.	volume landfill
8.9	Vporew	2 [2.4]	. V_{pore}		
8.10	Vporew	2 [2.5]	. V_{pore}		
2.1	Vrepl	2 [2.2]	Q_{repl}	Qrepl	
3.6	$Vreserv_{i1}$	3 [2]	$Q_{disinfectant}$	.	
3.7	$Vreserv_{i1}$	3 [2]	$Q_{disinfectant}$	.	
8.9	Vsoil	2 [2.4]	.	V_{pore}	
8.10	Vsoil	2 [2.5]	.	V_{pore}	
24.1	$Vwater_{produced}$	9 [4.1]	$Q_{water-prod}$	.	
24.1	$Vwater_{dump}$	9 [4.1]	$Q_{water-dump}$	.	
24.1	$Vwater_{veg}$	9 [4.1]	$Q_{water-veg}$	.	
24.1	$Vwater_{final}$	9 [4.1]	$Q_{water-final}$	.	
24.1	$Vwater_{open}$	9 [4.1]	$Q_{water-open}$	.	
24.1	Vwater_percol$_i$	9 [4.1]	$Q_{percol\ i}$	.	
12.1	Vww	12 [3.1]	WW	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Quantities, doses and amounts (by weight)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Quantities of substance					
2.8	Qsubst	2 [2.7]	Q_{subst}	Q_{subst}	
2.15	Qsubst	10 [3.8]	$Qyear_{disinf}$	.	
3.11	Qsubst	3 [5]	$Q_{disinfectant}$	.	
3.12	Qsubst	3 [5]	$Q_{disinfectant}$	.	
6.8	Qsubst	4 [10]	Q_{active}	.	
6.10	Qsubst	4 [11]	Q_{active}	.	
7.2	Qsubst	4 [10]	Q_{active}	.	
7.3	Qsubst	4 [11]	Q_{active}	.	
8.3	Qsubst	1 [10]	Q_{salt}	Q_{salt}	

[1)] Report number according to the list of Appendix 11 + [Table number]

Quantities, doses and amounts (by weight) (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Quantities of substance					
8.5	Qsubst	1 [11]	$Q_{a.i.}$	$Q_{ai,drench}$	
8.7	Qsubst	1 [12]	Q_{wood}	$DOSE_{wood}$	
9.7	Qsubst	4 [10]	Q_{active}	.	
9.8	Qsubst	4 [11]	Q_{active}	.	
14.1	Qsubst	2 [2.7]	Q_{subst}	Q_{subst}	
18.12	Qsubst	2 [2.7]	Q_{subst}	Q_{subst}	
22.1	Qsubst	5 [3]	Q_{active}	.	
22.2	Qsubst	5 [1]	Q_{active}	.	
24.1	Qsubst_air$_{i}$	9 [*4.4.2*]	$Q_{subst\text{-}air\ i}$	.	
3.2	Qsubst_arab$_{i1,i2,i3,i4}$	3 [1]	.	.	
3.6	Qsubst_arab$_{i1,i2,i3,i4}$	3 [2]	.	.	
3.8	Qsubst_arab	3 [3]	.	.	
18.3	Qsubst_arab$_{i1,i2,i3,i4}$	11 [6.2]	Qai-arab$_{i1,i2,i3,i4}$	.	
3.2	Qsubst_grass$_{i1,i2,i3,i4}$	3 [1]	.	.	
3.6	Qsubst_grass$_{i1,i2,i3,i4}$	3 [2]	.	.	
3.8	Qsubst_grass	3 [3]	.	.	
18.3	Qsubst_grass$_{i1,i2,i3,i4}$	11 [6.2]	Qai-grass$_{i1,i2,i3,i4}$	.	
3.6	Qsubst_stream$_{i1,i2,i3}$	3 [2]	.	.	
3.8	Qsubst_stream	3 [3]	.	.	
8.11	Qsubst_prep$_{i}$	9 [8.7]	$Qreg_{subst\text{-}prep\,i}$	.	
8.12	Qreg_prod$_{i}$	9 [8.8]	$Qreg_{subst\text{-}prod\,i}$	.	
18.3	Qsubst_prescr$_{i1,i2,i3}$	11 [6.2]	Qsubst_prescr$_{i1,i2,i3}$	.	
24.2	Qsubst_reg$_{i}$	9 [*7.3*]	$Qreg_{subst\text{-}prod\,i}$	.	
24.1	Qsubst_soil$_{i}$	9 [*4.4.2*]	$Q_{subst\text{-}soil\ i}$	.	
18.3	Qsubst_stream$_{i1,i2,i3,i4}$	11 [6.2]	$Qai_{i1,i2,i3,i4}$	.	
24.1	Qsubst_STP$_{i}$	9 [*4.4.2*]	$Q_{subst\text{-}STP\ i}$	.	
9.4	Qsubst_tot$_{k}$	7 [10]	$Qtot_{k}$	.	
18.3	$Qsubst_{aer}$	11 [6.2]	Qaerosol	.	
3.8	$Qsubst_{day}$	3 [3]	.	.	
6.14	$Qsubst_{i}$	7 [9]	Q_{x_active}	.	
6.15	$Qsubst_{i}$	6 [7]	Q_{active}	.	
6.16	$Qsubst_{i}$	6 [7]	Q_{active}	.	
9.2	$Qsubst_{i}$	7 [8]	Q_{active}	.	
9.6	$Qsubst_{i}$	6 [7]	Q_{active}	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Quantities, doses and amounts (by weight) (continued)

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
8.9	$Qsubst_{leach}$	2 [2.4]	.	Q_{pole}	
8.10	$Qsubst_{leach}$	2 [2.5]	L_{comp}	Q_{fence}	
1.5	$Qsubst_{occup\_bed}$	-	.	.	
1.6	$Qsubst_{occup\_bed}$	-	.	.	
1.5	$Qsubst_{pres\_bed}$	-	.	.	
1.6	$Qsubst_{pres\_bed}$	-	.	.	
24.1	$Qleach\_landf_i$	9 [4.1]	$Q_{subst\text{-}leachtot\ i}$	.	
24.1	$Qleach\_sec_i$	9 [4.1]	$Q_{subst\text{-}leach\ i}$	.	
24.1	$Qrem\_sec_i$	9 [4.1]	$Q_{removed\ i}$	.	
24.1	$Qvolat\_landf_i$	9 [4.1]	$Q_{subst\text{-}volattot\ i}$	.	
24.1	$Qvolat\_sec_i$	9 [4.1]	$Q_{subst\text{-}volat\ i}$	.	
Quantities of formulation					
7.2	Qform	4 [10]	.	.	
7.3	Qform	4 [11]	.	.	
8.1	Qform	1 [9]	Q_{creos}	Q_{creos}	
8.7	Qform	1 [12]	A_{solid}	$APPl_{solid}$	
1.2	$Qform_{appl}$	-	.	.	
1.3	$Qform_{appl}$	-	.	.	
6.1	$Qform_{appl}$	-	.	.	
6.1	$Qform_{inh}$	-	.	.	
1.2	$Qform_{inh}$	-	.	.	
1.3	$Qform_{inh}$	-	.	.	
12.1	Qform_uins	12 [3.1]	Q_{prod_uins}	.	
18.3	$Qform\_uins_{i1,i2,i3}$	11 [6.2]	$Qprod\text{-}uins_{i1,i2,i3}$	.	
Quantities of "materials"					
3.2	.	3 [1]	Q_{manure}	.	no more used
3.6	.	3 [2]	Q_{manure}	.	no more used
6.14	.	7 [9]	Q_{prod}	.	no more used
6.15	.	6 [7]	Q_{prod}	.	no more used
18.11	.	11 [*5.9*]	$Qlwaste_{cat\text{-}subcat}$	.	
11.1	Qcirc	1 [5]	Q_{circ}	Q_{circ}	
6.14	Qfibres	7 [8]	Q_{fibres}	.	
9.1	Qfibres	7 [8]	Q_{fibres}	.	
9.2	Qfibres	7 [9]	Q_{fibres}	.	
9.3	Qfibres	7 [3]	Q_{fibres}	.	
6.15	Qleather	6 [7]	$Q_{leather}$	.	

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1) Report number according to the list of Appendix 11 + [Table number]

Quantities, doses and amounts (by weight) (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
9.6	Qleather	6 [7]	$Q_{leather}$	.	
2.16	Qmat	10 [3.9]	Cap	.	
2.17	Qmat	10 [3.10]	Cap	.	
3.2	$Qnitrog\_excr_{i1}$	3 [1]	.	.	
3.3	$Qnitrog\_excr_{i1}$	3 [1]	.	.	
3.6	$Qnitrog\_excr_{i1}$	3 [2]	.	.	
3.8	Qnitrog_excr	3 [3]	.	.	
18.3	$Qnitrog\_excr_{i1}$	11 [6.2]	$Qnitrog_{i1}$	.	
18.11	$Qnitrog\_excr_{cat\text{-}subcat}$	11 [*5.9*]	$Qnitrog_{cat\text{-}subcat}$	.	
3.2	$Qnitrog\_is_{arable}$	3 [1]	.	.	
3.6	$Qnitrog\_is_{arable}$	3 [2]	.	.	
3.8	$Qnitrog\_is_{arable}$	3 [3]	.	.	
18.3	$Qnitrog\_is_{arable}$	11 [6.2]	$Q_{N,arable\_land}$	.	
18.8	$Qnitrog\_is_{s}$	11 [5.9]	$Q_{N,s}$	.	
3.2	$Qnitrog\_is_{grass}$	3 [1]	.	.	
3.6	$Qnitrog\_is_{grass}$	3 [2]	.	.	
3.8	$Qnitrog\_is_{grass}$	3 [3]	.	.	
18.3	$Qnitrog\_is_{grass}$	11 [6.2]	$Q_{N,grassland}$	.	
3.2	$Qnitrog\_total_{i1,i4}$	3 [1]	.	.	
3.6	$Qnitrog\_total_{i1,i3}$	3 [2]	.	.	
3.8	Qnitrog_total	3 [3]	.	.	
18.3	$Qnitrog\_total_{i1,i4}$	11 [6.2]	$Qnitrog\_total_{i1,i4}$	.	
6.8	Qpaper	4 [10]	Q_{paper}	.	
6.8	Qpaper	4 [3]	Q_{paper}	.	
6.9	Qpaper	4 [3]	Q_{paper}	.	
6.10	Qpaper	4 [11]	Q_{paper}	.	
7.2	Qpaper	4 [10]	Q_{paper}	.	
7.3	Qpaper	4 [11]	Q_{paper}	.	
9.7	Qpaper	4 [10]	Q_{paper}	.	
9.8	Qpaper	4 [11]	Q_{paper}	.	
3.2	$Qphosph\_excr_{i1}$	3 [1]	.	.	
3.3	$Qphosph\_excr_{i1}$	3 [1]	.	.	
3.6	$Qphosph\_excr_{i1}$	3 [2]	.	.	
3.8	Qphosph_excr	3 [3]	.	.	
18.3	$Qphosph\_excr_{i1}$	11 [6.2]	$Qphosp_{i1}$	.	
18.11	$Qphosph\_excr_{cat\text{-}subcat}$	11 [*5.9*]	$Qphosph_{cat\text{-}subcat}$	.	
3.2	$Qphosph\_is_{arable}$	3 [1]	.	.	
3.6	$Qphosph\_is_{arable}$	3 [2]	.	.	
3.8	$Qphosph\_is_{arable}$	3 [3]	.	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Quantities, doses and amounts (by weight) (continued)

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
Quantities of "materials"					
18.3	$Qphosph\_is_{arable}$	11 [6.2]	$Q_{P2O5,arable\_land}$	.	
18.8	$Qphosph\_is_{s}$	11 [5.9]	$Q_{P2O5,s}$	.	
3.2	$Qphosph\_is_{grass}$	3 [1]	.	.	
3.6	$Qphosph\_is_{grass}$	3 [2]	.	.	
3.8	$Qphosph\_is_{grass}$	3 [3]	.	.	
18.3	$Qphosph\_is_{grass}$	11 [6.2]	$Q_{P2O5,grassland}$	.	
3.2	$Qphosph\_total_{i1,i4}$	3 [1]	.	.	
3.6	$Qphosph\_total_{i1,i3}$	3 [2]	.	.	
3.8	Qphosph_total	3 [3]	.	.	
18.3	$Qphosph\_total_{i1,i4}$	11 [6.2]	$Qphosph\_total_{i1,i4}$	.	
6.7	$Qreg\_prod_{i}$	9 [*7.3*]	$Qreg_{prod\ i}$	.	
7.1	$Qreg\_prod_{i}$	9 [8.3]	$Qreg_{prodi}$	.	
24.2	$Qreg\_prod_{i}$	9 [*7.3*]	$Qreg_{prodi}$	.	
22.1	Qskin	5 [3]	Q_{skin}	.	
8.9	Qsoil	2 [2.4]	.	M_{soil}	
8.10	Qsoil	2 [2.5]	.	M_{soil}	
13.1	Qsyst	1 [7]	Q_{syst}	Q_{pres}	
24.1	$Qwaste_{landf}$	9 [4.1]	Massw	.	
24.2	Qwaste_reg	9 [*7.3*]	$Qreg_{waste}$	.	
8.1	Qwood	1 [9]	Q_{mater}	$Q_{mater,creos}$	
8.3	Qwood	1 [10]	Q_{mater}	$Q_{mater,salt}$	
8.5	Qwood	1 [11]	Q_{mater}	$Q_{mater,drench}$	
Quantities expressed as doses					
3.2	.	3 [1]	DOSE	.	no more used
3.6	.	3 [2]	DOSE	.	no more used
3.8	.	3 [3]	DOSE	.	no more used
8.1	$DOSE_{pest}$	1 [9]	D_{soil}	$DOSE_{pest}$	
8.3	$DOSE_{pest}$	1 [10]	D_{soil}		
8.5	$DOSE_{pest}$	1 [11]	D_{soil}	$DOSE_{pest}$	
11.1	$DOSE_{pest}$	1 [5]	D_{soil}	$DOSE_{pest}$	
12.1	Qsubst	12 [3.1]	$DOSE_{ai}$	.	

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1) Report number according to the list of Appendix 11 + [Table number]

Quantities, doses and amounts (by weight) (continued)

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
Relevant tonnage in EU or region					
1.1	TONNAGE	-	.	TONNAGE	
1.4	TONNAGE	-	.	TONNAGE	
2.3	TONNAGE	TGD	TONNAGE	TONNAGE	
2.6	TONNAGE	10 [2.1]	TONNAGE	TONNAGE	
2.10	TONNAGE	-	.	TONNAGE	
2.12	TONNAGE	10 [3.5]	TONNAGE	TONNAGE	
6.2	TONNAGE	TGD	TONNAGE	TONNAGE	
6.12	TONNAGE	4 [12]	TONNAGE	TONNAGE	
1.1	TONNAGEreg	-	.	TONNAGE	
1.4	TONNAGEreg	-	.	TONNAGE	
2.3	TONNAGEreg	-	.	TONNAGEreg	
2.6	TONNAGEreg	10 [2.1]	TONNAGEREG	TONNAGEreg	
2.10	TONNAGEreg	-	.	TONNAGEreg	
2.12	TONNAGEreg	10 [3.5]	TONNAGEREG	TONNAGEreg	
6.2	TONNAGEreg	-	.	TONNAGEreg	
6.4	TONNAGEreg_{form}	-	.	TONNAGEreg_{form}	
6.6	TONNAGEreg_{form}	-	.	TONNAGEreg_{form}	
6.12	TONNAGEreg	4 [12]	TONNAGEREG	TONNAGEreg	
Various quantities not used anymore in present emission scenarios					
3.2	-	3 [1]	$Q_{application\ manure}$	.	
3.2	-	3 [3.1]	$APPL_{sludge}$	.	
3.2	-	3 [1]	$Q_{a.i.}$	.	
3.6	-	3 [2]	$Q_{application\ manure}$	.	
3.6	-	3 [3.2]	$APPL_{sludge}$	.	
3.6	-	3 [2]	$Q_{a.i.}$	.	
3.8	-	3 [3]	$Q_{application\ manure}$	.	
3.8	-	3 [3.3]	$APPL_{sludge}$	.	
3.8	-	3 [3]	$Q_{a.i.}$	.	
3.9	-	3 [4]	$Q_{a.i.}$	.	
12.2	-	1 [4]	Q_{water}		

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1) Report number according to the list of Appendix 11 + [Table number]

Releases and emissions

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
3.2	.	3 [1]	$Edirect_{manure\ storage}$	.	not used anymore
3.6	.	3 [2]	$Edirect_{manure\ storage}$	.	not used anymore
9.4	.	7 [10]	$RELEASEtot_{k,j}$	.	
9.4	.	7 [10]	$RELEASEcont_k$	.	
9.1	$Eimport_{water}$	7 [8]	$Elocal_{i,water}$	.	
9.2	$Eimport_{water}$	7 [9]	$Elocal_{i,water}$	.	
6.14	$Elocal\_water_i$	7 [9]	$Elocal_{x,water}$	$Elocal_{i,j}$	
6.15	$Elocal\_water_i$	6 [7]	$Elocal_{x,water}$	$Elocal_{i,j}$	
9.2	$Elocal\_water_i$	7 [9]	$Elocal_{x,water}$	.	
9.6	Elocal_water	6 [7]	$Elocal_{x,water}$	.	
22.1	$Elocal\_water_i$	5 [3]	$Elocal_{x,water}$	.	
2.3	$Elocal_{2,air}$	TGD	$Elocal_{air}$	$Elocal_{i,j}$	
6.2	$Elocal_{2,air}$	TGD	$Elocal_{air}$	$Elocal_{i,j}$	
2.3	$Elocal_{2,water}$	TGD	$Elocal_{water}$	$Elocal_{i,j}$	
6.2	$Elocal_{2,water}$	TGD	$Elocal_{water}$	$Elocal_{i,j}$	
2.8	$Elocal_{3,air}$	2 [2.7]	Q_{emis}	$Elocal_{i,j}$	
3.2	$Elocal_{3,air}$	3 [1]	$Edirect_{air}$	$Elocal_{i,j}$	
3.6	$Elocal_{3,air}$	3 [2]	$Edirect_{air}$	$Elocal_{i,j}$	
3.11	$Elocal_{3,air}$	3 [5]	$Edirect_{air}$	$Elocal_{i,j}$	
6.8	$Elocal_{3,air}$	4 [10]	$Elocal_{air}$	$Elocal_{i,j}$	
7.2	$Elocal_{3,air}$	4 [10]	$Elocal_{air}$	$Elocal_{i,j}$	
8.1	$Elocal_{3,air}$	1 [9]	L_{air}	$Elocal_{i,j}$	
8.5	$Elocal_{3,air}$	1 [11]	L_{air}	$Elocal_{i,j}$	
9.7	$Elocal_{3,air}$	4 [10]	$Elocal_{air}$	$Elocal_{i,j}$	
14.1	$Elocal_{3,air}$	2 [2.7]	Q_{emis}	$Elocal_{i,j}$	
18.12	$Elocal_{3,air}$	2 [2.7]	Q_{emis}	$Elocal_{i,j}$	
22.5	$Elocal_{3,soil}$	5 [5]	$Ecemetery_{soil}$	.	
1.4	$Elocal_{3,water}$	-	.	$Elocal_{i,j}$	
2.1	$Elocal_{3,water}$	2 [2.2]	C_{surfI}	$Elocal_{water}$	
2.1	$Elocal_{3,water}$	2 [2.2]	C_{surfII}	$Elocal_{water}$	
2.12	$Elocal_{3,water}$	10 [3.5]	$Elocal_{3,water}$	$Elocal_{i,j}$	
2.13	$Elocal_{3,water}$	10 [3.6]	$Elocal_{3,water}$	$Elocal_{i,j}$	
2.14	$Elocal_{3,water}$	10 [3.7]	$Elocal_{3,water}$	$Elocal_{i,j}$	
2.15	$Elocal_{3,water}$	10 [3.8]	$Elocal_{3,water}$	$Elocal_{i,j}$	
2.16	$Elocal_{3,water}$	10 [3.9]	$Elocal_{3,water}$	$Elocal_{i,j}$	
2.17	$Elocal_{3,water}$	10 [3.10]	$Elocal_{3,water}$	$Elocal_{i,j}$	
3.2	$Elocal_{3,water}$	3 [1]	$Edirect_{water}$	$Elocal_{i,j}$	
3.6	$Elocal_{3,water}$	3 [2]	$Edirect_{water}$	$Elocal_{i,j}$	
3.9	$Elocal_{3,water}$	3 [4]	$Edirect_{water}$	$Elocal_{i,j}$	
3.11	$Elocal_{3,water}$	3 [5]	$Edirect_{water}$	$Elocal_{i,j}$	
6.10	$Elocal_{3,water}$	4 [11]	$Elocal_{water}$	$Elocal_{i,j}$	
6.14	$Elocal_{3,water}$	7 [9]	$Elocal_{tot,water}$	$Elocal_{i,j}$	

[1)] Report number according to the list of Appendix 11 + [Table number]

Releases and emissions (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
6.15	$Elocal_{3,water}$	6 [7]	$Elocal_{tot,water}$	$Elocal_{i,j}$	
7.3	$Elocal_{3,water}$	4 [11]	$Elocal_{water}$	$Elocal_{i,j}$	
8.1	$Elocal_{3,water}$	1 [9]	L_{wwt}	$Elocal_{i,j}$	
8.3	$Elocal_{3,water}$	1 [9]	L_{wwt}	$Elocal_{i,j}$	
8.5	$Elocal_{3,water}$	1 [11]	L_{wwt}	$Elocal_{i,j}$	
9.1	$Elocal_{3,water}$	7 [8]	.	$Elocal_{i,j}$	
9.2	$Elocal_{3,water}$	7 [9]	$Elocal_{tot,water}$	$Elocal_{i}$	
9.6	$Elocal_{3,water}$	6 [7]	$Elocal_{tot,water}$	$Elocal_{i,j}$	
9.8	$Elocal_{3,water}$	4 [11]	$Elocal_{water}$	$Elocal_{i,j}$	
12.2	$Elocal_{3,water}$	1 [4]	L_{wwt}	$Elocal_{water}$, $Elocal_{i,j}$	
13.1	$Elocal_{3,water}$	1 [7]	$Elocal_{water}$	$Elocal_{i,j}$	
18.3	$Elocal_{3,water}$	11 [6.2]	$Qai_{i1,i2,i3,i4}$	$Elocal_{i,j}$	
22.1	$Elocal_{3,water}$	5 [3]	$Elocal_{tot,water}$	$Elocal_{i,j}$	
22.3	$Elocal_{3,water}$	5 [4]	$Elocal_{3,water}$	$Elocal_{i,j}$	
1.1	$Elocal_{4,water}$	-	.	$Elocal_{i,j}$	
1.2	$Elocal_{4,water}$	-	.	$Elocal_{i,j}$	
1.5	$Elocal_{4,water}$	-	.	$Elocal_{i,j}$	
2.6	$Elocal_{4,water}$	10 [2.1]	$Elocal_{4,water}$	$Elocal_{i,j}$	
2.7	$Elocal_{4,water}$	10 [2.2]	$Elocal_{4,water}$	$Elocal_{i,j}$	
2.10	$Elocal_{4,water}$	-	.	$Elocal_{i,j}$	
6.12	$Elocal_{5,water}$	4 [12]	$Elocal_{water}$	$Elocal_{i,j}$	
9.4	$Elocal_{service,water}$	7 [10]	.	.	
9.4	$RELEASEreg_{k,service,j}$	7 [10]	$RELEASEreg_{k,j}$	.	for article *k*
9.4	$RELEASEreg_{service,j}$	7 [10]	.	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Fractions, percentages and emission factors

Table	Symbol	Report[1]	Symbol	USES 3.0	Remarks
Emission factors to an environmental compartment					
2.3	$F_{2,air}$	TGD	$F_{i,j}$	$F_{i,j}$	
6.3	$F_{2,air}$	TGD	$F_{i,j}$	$F_{i,j}$	
2.3	$F_{2,water}$	TGD	$F_{i,j}$	$F_{i,j}$	
6.3	$F_{2,water}$	TGD	$F_{i,j}$	$F_{i,j}$	
3.11	$F_{3,air}$	3 [5]	F_{air}	$F_{i,j}$	
6.5	$F_{3,air}$	TGD	$F_{i,j}$	$F_{i,j}$	
8.5	$F_{3,air}$	1 [11]	f_a	$F_{a,drench}$	
8.1	$F_{3,air}$	1 [9]	f_a	$F_{a,creos}$	
3.2	$F_{3,air,i1,i2}$	3 [1]	F_{air}	.	for application *i2*
3.4	$F_{3,air,i1,i2}$	3 [1]	F_{air}	.	for application *i2*
3.6	$F_{3,air,i1,i2,i3}$	3 [2]	F_{air}	.	for application *i2*
8.1	$F_{3,soil}$	1 [9]	f_s	$F_{s,creos}$	
8.3	$F_{3,soil}$	1 [10]	f_s	$F_{s,salt}$	
8.5	$F_{3,soil}$	1 [11]	f_s	$F_{s,drench}$	
1.4	$F_{3,water}$	-	.	$F_{i,j}$	
1.5	$F_{3,water}$	-	.	$F_{i,j}$	
2.12	$F_{3,water}$	10 [3.5]	$F_{3,water}$	$F_{i,j}$	
3.2	$F_{3,water,i1,i2,i3}$	3 [1]	$F_{3,water}$	$F_{i,j}$	
3.4	$F_{3,water,i1,i2,i3}$	3 [1]	$F_{3,water}$	$F_{i,j}$	
3.6	$F_{3,water,i1,i2,i3}$	3 [2]	.	$F_{i,j}$	
3.7	$F_{3,water,i1,i2,i3}$	3 [2]	.	$F_{i,j}$	
3.9	$F_{3,water}$	3 [4]	F_{water}	$F_{i,j}$	
3.11	$F_{3,water}$	3 [5]	F_{water}	$F_{i,j}$	
6.5	$F_{3,water}$	TGD	$F_{i,j}$	$F_{i,j}$	
8.1	$F_{3,water}$	1 [9]	f_w	$F_{w,creos}$	
8.3	$F_{3,water}$	1 [10]	f_w	$F_{w,salt}$	
8.5	$F_{3,water}$	1 [11]	f_w	$F_{w,drench}$	
1.1	$F_{4,water}$	-	.	$F_{i,j}$	
1.2	$F_{4,water}$	-	.	$F_{i,j}$	
2.6	$F_{4,water}$	10 [2.1]	$F_{4,water}$	$F_{i,j}$	
2.7	$F_{4,water}$	10 [2.2]	$F_{4,water}$	$F_{i,j}$	
2.10	$F_{4,water}$	-	.	$F_{i,j}$	
6.2	$F_{i,j}$	TGD	$F_{i,j}$	$F_{i,j}$	
9.4	$F_{service,j}$	7 [10]	F_j	.	service life

[1] Report number according to the list of Appendix 11 + [Table number]

Fractions, percentages and emission factors (continued)

Table	Symbol	Report(1)	Symbol	USES 3.0	Remarks
Other emission factors					
3.8	$F_{3,waste}$	3 [1]	$F_{manure\ storage}$		.
3.2	$F_{3,waste,i1,i2,i3}$	3 [1]	$F_{manure\ storage}$		.
3.4	$F_{3,waste,i1,i2,i3}$	3 [1]	$F_{manure\ storage}$		.
3.6	$F_{3,waste,i1,i2,i3}$	3 [1]	$F_{manure\ storage}$		.
3.7	$F_{3,waste,i1,i2,i3}$	3 [1]	$F_{manure\ storage}$		.
18.5	$F_{cat-subcat,bioctype,appway,stream}$	11 [5.3]	$F_{cat-subcat,bioctype,appway,stream}$		.
18.3	$F_{i1,i2,i3,i4}$	11 [6.2]	$F_{i1,i2,i3,i4}$		.
8.2	Fsoil	1 [9]	.		F_{soil}
8.4	Fsoil	1 [10]	.		F_{soil}
8.6	Fsoil	1 [11]	.		F_{soil}
11.2	Fsoil	1 [9]	.		F_{soil}
Fraction of a substance in a formulation or product					
8.7	Fform	1 [12]	$f_{a.i.}$		$F_{ai,remed}$
18.3	$Fform_{\%}$	11 [6.2]	Fbioc%		.
18.3	$Fform_{vol}$	11 [6.2]	Fbioc		.
8.1	Fcreos	1 [9]	F_{creos}		F_{creos} wood preservative
6.7	$Fsubst\_prod_i$	9 [*7.3*]	$F_{subst-prodi}$		.
7.1	$Fsubst\_prod_i$	9 [8.3]	$F_{subst-prodi}$		.
8.11	Fsubst	9 [8.7]	F_{creos}		.
8.12	$Fsubst\_prod_i$	9 [8.8]	F_{creos}		.
24.2	$Fsubst\_prod_i$	9 [*7.3*]	$F_{subst-prodi}$		
Fraction of a substance in process liquid or mass					
13.1	Fproc	1 [7]	F_{ai}		$F_{ai,pres}$
Fraction of the main source					
9.4	.	7 [10]	F_{cont}		.
2.3	$Fmainsource_2$	TGD	.		$Fmainsource_i$
6.4	$Fmainsource_2$	TGD	.		$Fmainsource_i$
1.4	$Fmainsource_3$	-	.		$Fmainsource_i$
6.6	$Fmainsource_3$	TGD	.		$Fmainsource_i$
1.1	$Fmainsource_4$	-	.		$Fmainsource_i$
2.6	$Fmainsource_4$	10 [2.1]	$Fmainsource_{water}$		$Fmainsource_i$
2.10	$Fmainsource_4$	-	.		$Fmainsource_i$
6.12	$Fmainsource_5$	4 [12]	f		$Fmainsource_i$
6.2	$Fmainsource_i$	TGD	.		$Fmainsource_i$
9.4	$Fmainsource_{service}$	7 [10]	F_{reg}		.

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(1) Report number according to the list of Appendix 11 + [Table number]

Fractions, percentages and emission factors (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Fractions for degradation/decomposition/disintegration					
3.2	.	3 [1]	F_{dis}	.	
6.8	Fdecomp	6 [10]	F_{decomp}	.	
6.12	Fdecomp	4 [12]	F_{decomp}	.	
7.2	Fdecomp	4 [10]	F_{decomp}	.	
9.7	Fdecomp	4 [10]	F_{decomp}	.	
6.7	$Fdeg_i$	9 [*7.3*]	F_{degri}	.	
7.1	$Fdeg_i$	9 [*7.3*]	F_{degri}	.	
24.2	$Fdeg_i$	9 [*7.3*]	F_{degri}	.	
3.6	$Fdeg_{int}$	3 [1]	.	.	
3.8	$Fdeg_{int}$	3 [1]	.	.	
2.8	Fdisin	2 [2.7]	F_{disin}	F_{disin}	
14.1	Fdisin	2 [2.7]	F_{disin}	F_{disin}	
18.12	Fdisin	2 [2.7]	F_{disin}	F_{disin}	
Other fractions					
8.8	.	1 [13]	.	$Fdiss_{ditch}$	dissolved
3.2	Fadd	3 [1]	.	.	
3.6	Fadd	3 [2]	.	.	
18.3	Fadd	11 [6.2]	Fadd	.	additional
18.10	Fadd	11 [*5.9*]	Fadd	.	additional
6.10	Fbroke	4 [11]	F_{broke}	.	
7.3	Fbroke	4 [11]	F_{broke}	.	
9.8	Fbroke	4 [11]	F_{broke}	.	
2.14	Fcarry_over	10 [3.7]	Fcarry-over	.	
6.10	Fclosure	4 [6]	$F_{closure}$	.	
6.11	Fclosure	4 [6]	$F_{closure}$	.	
7.3	Fclosure	4 [11]	$F_{closure}$	.	
9.8	Fclosure	4 [11]	$F_{closure}$	.	
6.12	Fdeink	4 [12]	$F_{deinking}$	.	
11.1	Fdepos	1 [5]	W_{depos}	F_{depos}	deposition
6.7	$Fdiff_i$	9 [*7.3*]	F_{diffi}	.	
7.1	$Fdiff_i$	9 [8.3]	F_{diffi}	.	
8.12	$Fdiff_i$	9 [8.8]	F_{diff}	.	
24.2	$Fdiff_i$	9 [*7.3*]	F_{diff}	.	diffuse
2.2	Fdrift	2 [2.3]	.	F_{drift}	diffuse

[1)] Report number according to the list of Appendix 11 + [Table number]

Fractions, percentages and emission factors (continued)

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
Other fractions					
6.8	Fevap	4 [10]	F_{evap}	.	evaporation
7.2	Fevap	4 [10]	F_{evap}	.	evaporation
9.7	Fevap	4 [10]	F_{evap}	.	evaporation
6.10	Ffix	4 [11]	F_{fix}	.	fixation
6.14	Ffix	7 [9]	F_{fix}	.	fixation
6.15	Ffix	6 [7]	F_{fix}	.	fixation
7.3	Ffix	4 [11]	F_{fix}	.	fixation
9.2	Ffix	7 [9]	F_{fix}	.	fixation
9.6	Ffix	6 [7]	F_{fix}	.	fixation
9.8	Ffix	4 [11]	F_{fix}	.	fixation
22.1	Ffix	5 [3]	F_{fix}	.	fixation
24.1	$Fgas_{formation}$	9 [4.1]	Fform	.	
2.12	Fhospital	10 [3.5]	$F_{hospital}$	.	
24.2	$Fincin_i$	9 [*7.3*]	$F_{inciner_i}$	.	
8.9	Finfluence	2 [2.4]	.	$F_{influence}$	
1.2	Finh	-	.	.	inhabitants
1.3	Finh	-	.	.	inhabitants
6.1	Finh	-	.	.	inhabitants
6.7	$Flandf_i$	9 [*7.3*]	$F_{landfill_i}$	.	landfill
6.7	$Flandf_{total}$	9 [*7.3*]	F_{twl}	.	landfill
7.1	$Flandf_i$	9 [8.3]	$F_{landfill_i}$	.	
7.1	$Flandf_{total}$	9 [8.3]	F_{twl}	.	
8.11	$Flandf_i$	11 [8.7]	$F_{landfill_i}$	.	landfill
8.11	$Flandf_{total}$	9 [8.7]	F_{twl}	.	landfill
8.12	$Flandf_i$	11 [8.8]	$F_{landfill_i}$	.	landfill
8.12	$Flandf_{total}$	9 [8.8]	F_{twl}	.	landfill
24.2	$Flandf_i$	9 [*7.3*]	$F_{landfill}$	.	landfill
24.2	$Flandf_{total}$	9 [*7.3*]	F_{twl}	.	
24.1	$Fleach_{subsoil}$	9 [4.1]	F_{subst}	.	
2.13	Fobj	10 [3.6]	$Fobj_{3,water}$	.	objects
1.5	Foccup	-	.	.	occupied
1.2	Fpenetr	-	.	.	penetration
2.7	Fpenetr	10 [2.2]	F_{penetr}	.	penetration
6.7	$Fpenetr_i$	9 [*7.3*]	F_{penetr_i}	.	
7.1	$Fpenetr_i$	9 [8.3]	F_{penetr_i}	.	
8.11	$Fpenetr_i$	9 [8.7]	F_{penetr_i}	.	penetration
8.12	$Fpenetr_i$	9 [8.8]	F_{penetr_i}	.	penetration
24.2	$Fpenetr_i$	9 [*7.3*]	F_{penetr}	.	penetration

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1) Report number according to the list of Appendix 11 + [Table number]

Fractions, percentages and emission factors (continued)

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
Other fractions					
6.12	Fprelim	4 [12]	$F_{preliminary}$	.	preliminary
21.1	Fpres	1 [14]	$F_{s/ns}$	$F_{s\text{-}ns}$	presence
6.7	$Fpres\_prod_i$	9 [*7.3*]	$F_{prodpresi}$	.	
7.1	$Fpres\_prod_i$	9 [8.3]	$F_{prodpresi}$	.	
24.2	$Fpres\_prod_i$	9 [*7.3*]	$F_{prodpres}$	.	
1.1	$Fprodvol_{reg}$	-	.	$Fprodvol_{reg}$	
1.4	$Fprodvol_{reg}$	-	.	$Fprodvol_{reg}$	
2.3	$Fprodvol_{reg}$	-	.	$Fprodvol_{reg}$	
2.6	$Fprodvol_{reg}$	10 [2.1]	Fl_{reg}	$Fprodvol_{reg}$	
2.10	$Fprodvol_{reg}$	-	.	$Fprodvol_{reg}$	
2.12	$Fprodvol_{reg}$	10 [3.5]	Fl_{reg}	$Fprodvol_{reg}$	
6.2	$Fprodvol_{reg}$	-	.	$Fprodvol_{reg}$	
6.12	$Fprodvol_{reg}$	4 [12]	TONNAGEREG	$Fprodvol_{reg}$	
9.4	$Fprodvol_{reg}$	7 [10]	F_{reg}	$Fprodvol_{reg}$	
22.5	Freact	5 [5]	F_{body}	.	reacted
6.12	$Frec_{paper}$	4 [12]	$F_{recycling}$	.	recycling
6.13	$Frec_{paper}$	4 [12]	$F_{recycling}$	.	recycling
2.16	Fred	10 [3.9]	F_{red}	.	reduction
2.17	Fred	10 [3.10]	F_{red}	.	reduction
2.8	Fret	2 [2.5]	F_{ret}	F_{ret}	retention
14.1	Fret	2 [2.5]	F_{ret}	F_{ret}	retention
18.12	Fret	2 [2.5]	F_{ret}	F_{ret}	retention
22.3	$Fret_{arterial}$	5 [4]	$F_{ret,arterial}$	.	retention
22.5	$Fret_{arterial}$	5 [5]	$F_{ret,arterial}$	.	retention
22.3	$Fret_{cavity}$	5 [4]	$F_{ret,cavity}$	.	retention
22.4	$Fret_{arterial}$	5 [2]	$F_{ret,arterial}$	.	retention
22.4	$Fret_{cavity}$	5 [2]	$F_{ret,cavity}$	.	retention
22.5	$Fret_{cavity}$	5 [5]	$F_{ret,cavity}$	.	retention
2.13	Fsan	10 [3.6]	$Fsan_{3,water}$	.	sanitary
21.1	Fship	1 [14]	F_{ship}	F_{ship}	
13.1	Fsuppl	1 [7]	F_{suppl}	F_{suppl}	supplemented
24.1	Fvolat	9 [4.1]	F_{volair}	.	
21.1	Fwater/ship	1 [14]	$R_{w/s}$	$F_{water\text{-}ship}$	(ratio)
8.1	Fwater/soil	1 [9]	$f_{w/s}$	$F_{ws,creos}$	
8.3	Fwater/soil	1 [10]	$f_{w/s}$	$F_{ws,salt}$	
8.5	Fwater/soil	1 [11]	$f_{w/s}$	$F_{ws,drench}$	
8.9	$Fwater_{satsoil}$	2 [2.4]	.	$Fwater_{satsoil}$	
8.10	$Fwater_{satsoil}$	2 [2.5]	.	$Fwater_{satsoil}$	
12.1	Fww1	12 [3.1]	F_{ww1}	.	
12.1	Fww2	12 [3.1]	F_{ww2}	.	

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1) Report number according to the list of Appendix 11 + [Table number]

Numbers and time related variables

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
Number of applications (such as e.g. disinfections)					
8.4	.	1 [10]	.	N_{appl}, $N_{appl,salt}$	
8.6	.	1 [11]	.	N_{appl}, $N_{appl, drench}$	
1.2	Nappl	-	.	.	
1.3	Nappl	-	.	.	
6.1	Nappl	-	.	.	
2.2	Nappl	2 [2.3]	.	N_{appl}	
3.12	Nappl	3 [5]	$T_{emission}$		UNUSED
8.2	Nappl	1 [9]	.	N_{appl}, $N_{appl,creos}$	
8.4	Nappl	1 [10]	.	N_{appl}, $N_{events,salt}$	
8.6	Nappl	1 [11]	.	N_{appl}, $N_{appl,drench}$	
11.1	Nappl	1 [5]	.	N_{appl}, $N_{appl,cooling}$	
11.2	Nappl	1 [5]	.	N_{appl}, $N_{appl,cooling}$	
3.2	Nappl_bioc	3 [1]	$N_{disinfection\ events}$	.	
3.3	Nappl_bioc	3 [1]	$N_{disinfection\ events}$	.	
3.5	Nappl_bioc	3 [1]	$N_{disinfection\ events}$	.	
3.6	Nappl_bioc	3 [2]	$N_{disinfection\ events}$	.	
3.7	Nappl_bioc	3 [2]	$N_{disinfection\ events}$	.	
18.3	Nappl_bioc	11 [6.2]	Napp-bioc	.	
18.6	Nappl_bioc	11 [5.7]	Napp-bioc	.	
3.8	Nappl_inst	3 [3]	$N_{disinfection\ events}$	.	
3.6	Nappl_storage$_{i1}$	3 [2]	.	.	
3.8	Nappl_storage	3 [3]	.	.	
3.8	Nappl_tank	3 [2]	$N_{disinfection\ events}$	.	
3.9	Nappl_transp	3 [4]	$T_{emission}$	.	
3.6	Nd_soil$_i$	3 [2]	.	.	
3.8	Nd_soil$_i$	3 [3]	.	.	
18.3	Nlap_arab	11 [6.2]	Nlap-arab	.	
3.2	Nlap_arab	3 [1]	.	.	
18.3	Nlap_grass	11 [6.2]	Nlap-grass	.	
3.2	Nlap_gras	3 [1]	.	.	
18.9	Nlap$_s$	11 [5.9]	Nlap$_s$	.	

1) Report number according to the list of Appendix 11 + [Table number]

Numbers and time related variables (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Number of …					
3.2	$Nanimal_{i1}$	3 [1]	.	.	animals
3.3	$Nanimal_{i1}$	3 [1]	.	.	animals
3.6	Nanimal	3 [2]	.	.	
3.8	$Nanimal_{i1}$	3 [3]	.	.	
18.3	$Nanimal_{i1}$	11 [6.2]	N_{i1}	.	animals
18.4	$Nanimal_{cat\text{-}subcat}$	11 [6.2]	$Nanimal_{cat\text{-}subcat}$	.	animals
2.17	Nbatch	10 [3.10]	Nb	.	batches
1.5	$Nbeds_{occup}$	-	.	.	beds
1.5	$Nbeds_{pres}$	-	.	.	beds
3.9	Nbox	3 [4]	$A_{boxes/transport}$	.	boxes
3.10	Nbox	3 [4]	$A_{boxes/transport}$	.	boxes
22.5	Ncorpse	5 [5]	N_{corpse}	.	corpses
3.11	$Negg_{total}$	3 [5]	N_{eggs}	.	eggs
3.11	$Negg_{stage}$	3 [5]	A_{eggs}	.	eggs
1.2	Nlocal	-	.	Nlocal	inhabitants for STP
2.7	Nlocal	10 [2.2]	Nlocal	Nlocal	inhabitants for STP
12.3	.	1 [4]	.	$Nlocal_{paper}$	capacity of STP
2.16	Nmach	10 [3.9]	Nm	.	machines
2.14	$Nmax_{mach}$	10 [3.7]	$N_{rep\text{-}max}$	.	machines (max.)
3.6	Nmsp	3 [2]	.	.	
3.8	Nmsp	3 [3]	.	.	
8.8	Npole	1 [13]	P_{numb}	N_{pole}	
3.6	$Nreserv_{i1}$	3 [2]	$N_{reservoirs}$	.	
3.7	$Nreserv_{i1}$	3 [2]	$N_{reservoirs}$	.	
21.1	Nship	1 [14]	N_{ship}	N_{ship}	
2.1	Nvisit	2 [2.2]	N_{visit}	N_{visit}	
6.12	Nwdays	4 [12]	N_d	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Numbers and time related variables (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Number of emission days					
formulation					
2.3	$Temission_2$	TGD	$Temission_i$	$Temission_i$	
6.4	$Temission_2$	TGD	$Temission_i$	$Temission_i$	
6.2	$Temission_i$	TGD	$Temission_i$	$Temission_i$	
processing (industrial use)					
3.2	.	3 [1]	$T_{emission}$	.	not used anymore
3.6	.	3 [2]	$T_{emission}$	.	not used anymore
3.8	.	3 [3]	$T_{emission}$	.	not used anymore
1.4	$Temission_3$	-	.	$Temission_i$	
2.1	$Temission_3$	2 [2.2]		$Temission_{swimw,ac}$	
2.1	$Temission_3$	2 [2.2]		$Temission_{swimw,chr}$	
2.8	$Temission_3$	2 [2.7]		Temission, $Temission_{fogging}$	
2.9	$Temission_3$	2 [2.7]		Temission, $Temission_{fogging}$	
2.12	$Temission_3$	10 [3.5]	$Temission_3$	$Temission_i$	
2.15	$Temission_3$	10 [3.8]	$Temission_3$	$Temission_i$	
6.6	$Temission_3$	TGD	.	$Temission_i$	
8.2	$Temission_3$	1 [9]	.	Temission, $Temission_{creos}$	
8.4	$Temission_3$	1 [10]	.	Temission, $Temission_{salt}$	
8.6	$Temission_3$	1 [11]	.	Temission, $Temission_{drench}$	
12.3	$Temission_3$	1 [4]	.	Temission, $Temission_{paper}$	
13.2	$Temission_3$	1 [7]	.	Temission, $Temission_{pres}$	
14.1	$Temission_3$	2 [2.7]		$Temission_{fogging}$	
14.2	$Temission_3$	2 [2.7]		$Temission_{fogging}$	
18.12	$Temission_3$	2 [2.7]		$Temission_{fogging}$	
18.13	$Temission_3$	2 [2.7]		$Temission_{fogging}$	
private use					
1.1	$Temission_4$	-	.	$Temission_i$	
2.6	$Temission_4$	10 [2.1]	$Temission_4$	$Temission_i$	
2.10	$Temission_4$	-	.	$Temission_i$	
service life					
9.4	$Temission_{service}$	7 [10]	N_d	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Numbers and time related variables (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Time intervals					
2.2	Tint	2 [2.3]	$T_{interval}$	$T_{interval}$	
8.2	Tint	1 [9]	.	$T_{interval}$, $T_{interval,creos}$	
8.4	Tint	1 [10]	.	$T_{interval}$, $T_{interval,salt}$	
8.6	Tint	1 [11]	.	$T_{interval}$, $T_{interval,drench}$	
11.1	Tint	1 [5]	.	$T_{interval}$, $T_{inverval,cooling}$	
11.2	Tint	1 [5]	.	$T_{interval}$, $T_{inverval,cooling}$	
3.2	Tint_ar	3 [1]	.	.	
18.3	Tint_ar	11 [6.2]	Tar-int	.	
3.2	Tint_bioc	3 [1]	.	.	
3.6	Tint_bioc	3 [2]	.	.	
3.8	Tint_bioc	3 [3]	.	.	
18.3	Tint_bioc	11 [6.2]	Tbioc-int	.	
18.6	Tint_bioc	11 [5.7]	Tbioc-int	.	
3.2	Tint_gr	3 [1]	.	.	
18.3	Tint_gr	11 [6.2]	Tgr-int	.	
2.14	$Tint_{repl}$	10 [3.7]	T_{repl}	.	
2.15	$Tint_{repl}$	10 [3.7]	T_{repl}	.	
Residence and retention time					
12.5	Tas	12 [4.2]	Tas	.	
12.5	Tas_h	12 [4.2]	Tas_h	.	
8.8	TAUwway	1 [13]	R_{wway}	TAU_{wway}	
12.5	Tbt	12 [4.2]	Tbt	.	
12.5	Tbt_h	12 [4.2]	Tbt_h	.	
12.5	Tmc	12 [4.2]	Tmc	.	
12.5	Tmc_h	12 [4.2]	Tmc_h	.	
12.5	Tpr	12 [4.2]	Tpr	.	
12.5	Tpr_h	12 [4.2]	Tpr_h	.	
12.5	Tps	12 [4.2]	Tps	.	
12.5	Tps_h	12 [4.2]	Tps_h	.	
12.5	Tss	12 [4.2]	Tss	.	
12.5	Tss_h	12 [4.2]	Tss_h	.	
Other time periods					
18.3	Tcorr	11 [6.2]	Tcorr	.	
18.10	Tcorr	11 [5.7]	Tcorr	.	
8.10	Train	2 [2.5]	T_{rain}	T_{rain}	
9.4	$Tservice_k$	7 [10]	$Tservice_k$	.	
9.5	$Tservice_k$	7 [7]	$Tservice_k$	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Numbers and time related variables (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Other time periods					
3.6	Tstorage	3 [2]	.	.	
3.8	Tstorage	3 [3]	.	.	
24.1	Tutil	9 [4.1]	Tutil	.	
Test duration					
8.8	T_{bird}	1 [13]	.	T_{bird}	
11.1	T_{bird}	1 [5]	.	T_{bird}	
21.1	T_{bird}	1 [14]	.	T_{bird}	
8.8	T_{mammal}	1 [13]	.	T_{bird}	
11.1	T_{mammal}	1 [5]	.	T_{bird}	
21.1	T_{mammal}	1 [14]	.	T_{bird}	

1) Report number according to the list of Appendix 11 + [Table number]

Numbers and time related variables (continued)

Table	Symbol	Report[1]	Symbol	USES 3.0	Remarks
Day numbers of the year, dates					
3.2	Tappl_d$_1$	3 [1]	.	.	
3.5	Tappl_d$_1$	3 [1]	.	.	
18.3	Tappl_d$_1$	11 [6.2]	T-app$_1$	.	
18.3	Tappl_d$_j$	11 [6.2]	T-app$_j$	.	
3.2	Tappl_n$_1$	3 [1]	.	.	
3.5	Tappl_n$_1$	3 [1]	.	.	
18.3	Tappl_n$_1$	11 [5.7]	Tapp$_j$	.	
18.6	Tappl_n$_1$	11 [5.7]	Tapp$_j$	.	
3.2	Tappl_n$_j$	3 [1]	.	.	
3.5	Tappl_n$_j$	3 [1]	.	.	
18.3	Tappl_n$_j$	11 [6.2]	Tapp$_j$	.	
3.2	Tarap$_1$	3 [1]	Tarap$_1$	.	
18.3	Tarap$_1$	11 [6.2]	Tarap$_1$	.	
3.2	Tarap$_j$	3 [1]	.	.	
18.3	Tarap$_j$	11 [6.2]	Tarap$_j$	.	
3.2	Tar_app$_1$	3 [1]	.	.	
18.3	Tar_app$_1$	11 [6.2]	Tar-app$_1$	.	
3.2	Tar_app$_j$	3 [1]	.	.	
18.3	Tar_app$_j$	11 [6.2]	Tar-app$_j$	.	
18.8	Tar_app$_{Nlap\_arab}$	11 [5.10]	Tar-app$_{Nlap\_arab}$	.	
3.2	Tare	3 [1]	.	.	
18.3	Tare	11 [6.2]	Tare	.	
18.8	Tare	11 [5.10]	Tare	.	
3.2	Tars	3 [1]	.	.	
18.3	Tars	11 [6.2]	Tars	.	
18.8	Tars	11 [5.10]	Tars	.	
3.2	Tar_end	3 [1]	.	.	
18.3	Tint_ar	11 [6.2]	Tar-int	.	
3.2	Tar_start	3 [1]	.	.	
18.3	Tar_start	11 [6.2]	Tar-start	.	
18.8	Tar_start	11 [5.10]	Tar-start	.	
18.3	Te	11 [6.2]	Te	.	
18.6	Te	11 [5.7]	Te	.	
18.3	Tend	11 [6.2]	Tend	.	
18.6	Tend	11 [5.7]	Tend	.	
24.1	Tfinal_top	9 [24.1]	.	.	
3.2	Tgrap$_1$	3 [1]	.	.	
18.3	Tgrap$_1$	11 [6.2]	Tgrap$_1$	.	
3.2	Tgrap$_j$	3 [1]	.	.	
18.3	Tgrap$_j$	11 [6.2]	Tgrap$_j$	.	

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[1] Report number according to the list of Appendix 11 + [Table number]

Numbers and time related variables (continued)

Table	Symbol	Report[1]	Symbol	USES 3.0	Remarks
Day numbers of the year, dates					
3.2	Tgr_app$_1$	3 [1]	.	.	
18.3	Tgr_app$_1$	11 [6.2]	Tgr-app$_1$	.	
3.2	Tgr_app$_j$	3 [1]	.	.	
18.3	Tgr_app$_j$	11 [6.2]	Tgr-app$_j$	.	
18.8	Tgr_app$_{Nlap\_grass}$	11 [5.10]	Tgr-app$_{Nlap\_grass}$	.	
3.2	Tgre	3 [1]	.	.	
18.3	Tgre	11 [6.2]	Tgre	.	
18.8	Tgre	11 [5.10]	Tgre	.	
3.2	Tgr_end	11 [6.2]	Tgr-end	.	
18.3	Tgr_end	3 [1]	.	.	
3.2	Tgrs	3 [1]	.	.	
18.3	Tgrs	11 [6.2]	Tgrs	.	
18.8	Tgrs	11 [5.10]	Tgrs	.	
3.2	Tgr_start	3 [1]	.	.	
18.3	Tgr_start	11 [6.2]	Tgr-start	.	
18.8	Tgr_start	11 [5.10]	Tgr-start	.	
18.3	Ts	11 [6.2]	Ts	.	
18.6	Ts	11 [5.7]	Ts	.	
18.3	Tstart	11 [6.2]	Tstart	.	
18.6	Tstart	11 [5.7]	Tstart	.	

[1] Report number according to the list of Appendix 11 + [Table number]

Concentrations

Table	Symbol	Report[1]	Symbol	USES 3.0	Remarks
Concentration of the substance in a product (formulation)					
1.2	Cform$_{volume}$	-	.	.	
1.2	Cform$_{weight}$	-	.	.	
1.5	Cform	-	.	.	
2.7	Cform	10 [2.2]	C$_{product}$	.	
2.16	Cform	10 [3.9]	C$_{disinf1}$	.	
2.17	Cform	10 [3.10]	C$_{disinf2}$	.	
3.2	Cform	3 [1]	C$_{a.i.}$	.	
3.6	Cform	3 [2]	C$_{a.i.}$	.	
3.8	Cform	3 [3]	C$_{a.i.}$	.	
3.9	Cform	3 [4]	C$_{a.i.}$	.	
3.10	Cform	3 [4]	C$_{a.i.}$	.	
6.8	Cform	4 [10]	.	.	
6.10	Cform	4 [11]	.	.	

[1] Report number according to the list of Appendix 9 + [Table number]

Concentrations (continued)

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
Concentration of the substance in a product (formulation)					
6.14	Cform_i	7 [9]	.	.	
6.15	Cform_i	6 [7]	.	.	
7.2	Cform_{solid}	4 [10]	.	.	
7.2	Cform_{liquid}	4 [10]	.	.	
7.3	Cform_{solid}	4 [11]	.	.	
7.3	Cform_{liquid}	4 [11]	.	.	
9.6	Cform_i	6 [7]	.	.	
9.7	Cform	4 [10]	.	.	
9.8	Cform	4 [11]	.	.	
12.1	Cform	12 [3.1]	CONTENT	.	
22.3	$\mathrm{Cform}_{arterial}$	5 [4]	$C_{arterial}$	.	
22.5	$\mathrm{Cform}_{arterial}$	5 [5]	$C_{arterial}$	.	
22.3	Cform_{cavity}	5 [4]	C_{cavity}	.	
22.5	Cform_{cavity}	5 [5]	C_{cavity}	.	
Concentration of the substance in the process, process liquid, etc.					
2.1	Cproc	2 [2.2]	C_{swimw}	C_{swimw}	
2.2	Cproc	2 [2.2]	C_{swimw}	C_{swimw}	
2.13	Cproc_{obj}	10 [3.6]	C_{obj}	.	objects
2.13	Cproc_{san}	10 [3.6]	C_{obj}	.	sanitary
2.14	Cproc	10 [3.7]	C_{disinf}	.	
2.14	$\mathrm{Cproc}_{carry\_over}$	10 [3.7]	$C_{c\text{-}over}$	.	
2.14	Cproc_{repl}	10 [3.7]	C_{repl}		replacement
11.1	Cproc	1 [5]	C_{ai}	$C_{ai,cooling}$	
12.1	Cproc	12 [3.1]	$C_{prescribed}$	.	
12.5	Cinf	12 [4.1]	C_{paper}	.	
Concentration of the substance in a material (wood, textile, fabrics, etc.)					
3.2	.	3 [1]	$\mathrm{Cdirect}_{manure\ storage}$	.	not used anymore
3.2	.	3 [1]	C_{sludge}	.	not used anymore
3.6	.	3 [2]	C_{sludge}	.	not used anymore
3.8	.	3 [3]	C_{sludge}	.	not used anymore
9.1	Cmat	7 [8]	C_{active}	.	
24.1	$\mathrm{Corg}_{landfill}$	9 [4.1]	Corg_{landf}	.	
24.1	$\mathrm{Csubst\_landf}_0$	9 [4.1]	$C_{subst\text{-}Lwaste\ 0}$	.	
24.2	$\mathrm{Csubst\_landf}_0$	9 [*7.3*]	$C_{subst\text{-}Lwaste\ 0}$	.	
24.1	$\mathrm{Csubst\_landf}_i$	9 [4.1]	$C_{subst\text{-}Lwaste\ i}$	.	
24.1	$\mathrm{Csubst\_perc}_i$	9 [4.1]	$C_{subst\text{-}perc\ i}$	.	
24.1	$\mathrm{Csubst\_gas}_i$	9 [4.1]	$C_{subst\text{-}volat\ i}$	.	

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1) Report number according to the list of Appendix 11 + [Table number]

Concentrations (continued)

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
Concentration of the substance in water (influent, effluent, surface water, etc.)					
12.2	.	1 [4]	C_{surf}	.	
12.5	Cacid	12 [4.2]	Cacid	.	
12.5	$Cacid_{AS}$	12 [4.2]	$Cacid_{AS}$	.	
12.5	$Cacid_{BT}$	12 [4.2]	$Cacid_{BT}$	.	
12.5	$Cacid_{CM}$	12 [4.2]	$Cacid_{CM}$	.	
12.5	Calkal	12 [4.2]	Calkal	.	
12.5	$Calkal_{AS}$	12 [4.2]	$Calkal_{AS}$	.	
12.5	$Calkal_{BT}$	12 [4.2]	$Calkal_{BT}$	.	
12.5	$Calkal_{CM}$	12 [4.2]	$Calkal_{CM}$	.	
8.9	Cgrw	2 [2.4]	Cgrndw	$Cgrw_{pest}$	
12.1	Cinf	12 [3.1]	C_{paper}	C_{paper}	
12.2	Cinf	1 [4]	$C_{a.i.}$	C_{paper}	
2.18	$Clocal_{eff}$	-	.	$Clocal_{eff}$	
2.18	$Clocal_{water}$	-	.	$Clocal_{water}$	
12.5	Cneutr	12 [4.2]	Cneutr	.	
12.5	$Cneutr_{AS}$	12 [4.2]	$Cneutr_{AS}$	.	
12.5	$Cneutr_{BT}$	12 [4.2]	$Cneutr_{BT}$	.	
12.5	$Cneutr_{CM}$	12 [4.2]	$Cneutr_{CM}$	.	
8.9	Cporew	2 [2.4]	.	C_{porew}	
8.10	Cporew	2 [2.5]	.	C_{porew}	
22.5	$Cporew\_av_{cem}$	5 [5]	$Ccemetery_{porew}$	C_{porew}	
8.8	$Cwater_{pest-0}$	1 [13]	.	$Cwater_{pest-0}$	
8.8	$Cwater_{pest-T}$	1 [13]	.	$Cwater_{pest-T}$	
11.1	$Cwater_{pest-0}$	1 [5]	C_{surf}	$Cwater_{pest-0}$	
11.1	$Cwater_{pest-T}$	1 [5]	C_{surf}	$Cwater_{pest-T}$	
21.1	$Cwater_{pest-0}$	1 [14]	C_{water}	$Cwater_{pest-0}$	
21.1	$Cwater_{pest-T}$	1 [14]	C_{water}	$Cwater_{pest-T}$	
8.8	Cwway	1 [13]	C_{wway}	C_{wway}	
8.8	SUSPwater	1 [13]	.	$SUSP_{water}$	
11.1	SUSPwater	1 [5]	.	$SUSP_{water}$	
21.1	SUSPwater	1 [14]	.	$SUSP_{water}$	
Concentration of the substance in soil					
8.9	$Csoil_{pest-0}$	2 [2.4]	.	$Csoil_{pest-0}$	
8.10	$Csoil_{pest-0}$	2 [2.5]	.	$Csoil_{pest-0}$	
22.5	$Csoil\_av_{cem}$	5 [5]	$Ccemetery_{soil}$	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Concentrations (continued)

Table	Symbol	Report1)	Symbol	USES 3.0	Remarks
Concentration of the substance in air					
3.2	-	3 [1]	$Cdirect_{air}$	.	not used anymore
3.2	-	3 [1]	$Cstd_{air}$	.	not used anymore
3.6	-	3 [2]	$Cdirect_{air}$	.	not used anymore
3.6	-	3 [2]	$Cstd_{air}$	.	not used anymore
Predicted environmental concentrations					
12.5	PEC_{ASstp_acid}	12 [4.2]	PEC_{ASstp_acid}	.	
12.5	PEC_{ASstp_alkal}	12 [4.2]	PEC_{ASstp_alkal}	.	
12.5	PEC_{ASstp_neutr}	12 [4.2]	PEC_{ASstp_neutr}	.	
12.5	PEC_{BTstp_acid}	12 [4.2]	PEC_{BTstp_acid}	.	
12.5	PEC_{BTstp_alkal}	12 [4.2]	PEC_{BTstp_alkal}	.	
12.5	PEC_{BTstp_neutr}	12 [4.2]	PEC_{BTstp_neutr}	.	
12.5	$PEClocal_{AS\_water\_acid}$	12 [4.2]	$PEClocal_{AS\_water\_acid}$	.	
12.5	$PEClocal_{AS\_water\_alkal}$	12 [4.2]	$PEClocal_{AS\_water\_alkal}$	.	
12.5	$PEClocal_{AS\_water\_neutr}$	12 [4.2]	$PEClocal_{AS\_water\_neutr}$	.	
12.5	$PEClocal_{BT\_water\_acid}$	12 [4.2]	$PEClocal_{BT\_water\_acid}$	.	
12.5	$PEClocal_{BT\_water\_alkal}$	12 [4.2]	$PEClocal_{BT\_water\_alkaline}$	.	
12.5	$PEClocal_{BT\_water\_neutr}$	12 [4.2]	$PEClocal_{BT\_water\_neutr}$	.	
12.5	$PEClocal_{CM\_water\_acid}$	12 [4.2]	$PEClocal_{CM\_water\_acid}$	.	
12.5	$PEClocal_{CM\_water\_alkal}$	12 [4.2]	$PEClocal_{CM\_water\_alkaline}$	.	
12.5	$PEClocal_{CM\_water\_neutr}$	12 [4.2]	$PEClocal_{CM\_water\_neutr}$	.	
3.2	$PIECars\_N_{i1,i2,i3}$	3 [1]	.	.	
3.6	$PIECars\_N_{i1,i2,i3}$	3 [2]	.	.	
3.8	$PIECars\_N_{i1,i3}$	3 [3]	.	.	
18.3	$PIECars\_N_{i1,i2,i3,i4}$	11 [6.2]	$PIECars\_N_{i1,i2,i3,i4}$	.	
3.2	$PIECars\_P2O5_{i1,i2,i3}$	3 [1]	.	.	
3.6	$PIECars\_P2O5_{i1,i2,i3}$	3 [2]	.	.	
3.8	$PIECars\_P2O5_{i1,i3}$	3 [3]	.	.	
18.3	$PIECars\_P2O5_{i1,i2,i3,i4}$	11 [6.2]	$PIECars\_P2O5_{i1,i2,i3,i4}$	.	
3.2	$PIECgrs\_N_{i1,i2,i3}$	3 [1]	.	.	
3.6	$PIECgrs\_N_{i1,i2,i3}$	3 [2]	.	.	
3.8	$PIECgrs\_N_{i1,i3}$	3 [3]	.	.	
18.3	$PIECgrs\_N_{i1,i2,i3,i4}$	11 [6.2]	$PIECgrs\_N_{i1,i2,i3,i4}$	.	
3.2	$PIECgrs\_P2O5_{i1,i2,i3}$	3 [1]	.	.	
3.6	$PIECgrs\_P2O5_{i1,i2,i3}$	3 [2]	.	.	
3.8	$PIECgrs\_P2O5_{i1,i3}$	3 [3]	.	.	
18.3	$PIECgrs\_P2O5_{i1,i2,i3,i4}$	11 [6.2]	$PIECgrs\_P2O5_{i1,i2,i3,i4}$	.	

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1) Report number according to the list of Appendix 11 + [Table number]

Dilution, speed, flows and fluxes

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
2.2	DILUTION	2 [2.3]	F_{dilut}	$DILUTION_{private}$	
2.2	DILUTION	2 [2.3]	F_{dilut}	$DILUTION_{public}$	
2.18	DILUTION	-	.	DILUTION	
11.1	DILUTION	1 [5]	F_{dilut}	$DILUTION_{cooling}$	
12.2	.	1 [4]	F_{dilut}	DILUTION, $DILUTION_{paper}$	
12.3	DILUTION	1 [4]	F_{dilut}	$DILUTION_{paper}$	
12.5	DILUTION	12 [4.2]	$DILUTION_{paper}$	.	
8.8	FLUXsubst	1 [13]	F_{comp}	$FLUX_{avg}$	
8.9	FLUXsubst	2 [2.4]	F_{comp}	$FLUX_{comp}$	
8.10	FLUXsubst	2 [2.5]	F_{comp}	$FLUX_{fence}$	
21.1	FLUXsubst	1 [14]	F_{anti}	$FLUX_{anti}$	
24.1	RAINRATE	9 [4.1]	RAINRATE	RAINRATE	

[1)] Report number according to the list of Appendix 11 + [Table number]

Various/Others

Table	Symbol	Report[1)]	Symbol	USES 3.0	Remarks
8.8	a	1 [13]	a	a	
12.1	APPL	12 [3.1]	APPL	.	
3.1	appway	3 []	.	.	
3.2	appway	3 []	.	.	
18.1	appway	11 [5.1]	appway	.	
18.3	appway	11 [6.2]	appway	.	
8.8	b	1 [13]	b	b	
18.1	bioctype	11 [5.1]	bioctype	.	
18.3	bioctype	11 [6.2]	bioctype	.	
3.1	cat-subcat	3 []	.	.	
3.2	cat-subcat	3 []	.	.	
18.1	cat-subcat	11 [5.1]	cat-subcat	.	
18.3	cat-subcat	11 [6.2]	cat-subcat	.	
12.1	CONN	12 [3.1]	CONN		
8.9	CONVsatsoil	2 [2.4]	.	$CONV_{soil}$	
8.10	CONVpest	2 [2.5]	.	$CONV_{soil}$	
8.1	Dstorage	1 [9]	D_{wood}	$D_{wood,creos}$	
8.3	Dstorage	1 [10]	d_{wood}	$D_{wood,salt}$	
8.5	Dstorage	1 [11]	D_{wood}	$D_{wood,drench}$	
2.3	HPVC	-	.	HPVC	
6.2	HPVC	-	.	HPVC	
8.4	MIX	1 [9]	.	MIX	
8.2	MIX	1 [9]	.	MIX	
8.6	MIX	1 [9]	.	MIX	
11.2	MIX	1 [5]	.	MIX	
2.2	POOLTYPE	2 [2.3]	.	POOLTYPE	
3.1	stream	3 []	.	.	
18.1	stream	11 [5.1]	stream	.	
24.1	WS_{bare}	9 [4.1]	WS_{bar}	.	
24.1	WS_{veg}	9 [4.1]	$WS_{top-veg}$	.	
24.1	WS_{final}	9 [4.1]	$WS_{top-final}$	.	

[1)] Report number according to the list of Appendix 11 + [Table number]

Appendix 10 Symbols of parameters and variables (II. by table number)

This appendix deals with the symbols for each table of the report

Product-type 1: Human hygiene biocidal products

Table 1.1 Emission scenario for calculating the releases of disinfectants used in human hygiene biocidal products based on the annual tonnage applied

This report	Original report No. -	USES 3.0
$Elocal_{4,water}$	-	$Elocal_{i,j}$
$F_{4,water}$	-	$F_{i,j}$
$Fmainsource_4$	-	$Fmainsource_i$
$Fprodvol_{reg}$	-	$Fprodvol_{reg}$
$Temission_4$	-	$Temission_i$
TONNAGE	-	TONNAGE
TONNAGEreg	-	TONNAGE

Table 1.2 Emission scenario for calculating the releases of disinfectants used in human hygiene biocidal products based on an average consumption for k products$^{3)}$ with the biocide considered

This report	Original report No. -	USES 3.0	
$Cform_{volume}$	-	.	
$Cform_{weight}$	-	.	
$Elocal_{4,water}$	-	$Elocal_{i,j}$	
$F_{4,water}$	-	$F_{i,j}$	
Finh	-	.	
Fpenetr	-	.	
Nappl	-	.	
Nlocal	-	Nlocal	for STP
$Qform_{appl}$	-	.	
$Qform_{inh}$	-	.	
RHOform	-	.	
$Vform_{appl}$	-	.	
$Vform_{inh}$	-	.	

Table 1.3 Pick-list for average consumptions per inhabitant per day, $Vform_{inh}$ (ml.d^{-1}) & $Qform_{inh}$ (g.d^{-1}), per application, $Vform_{appl}$ (ml) & $Qform_{appl}$ (g), number of applications, Nappl (d^{-1}), and the fraction of inhabitants using the product, Finh [-]

This report	Original report No. -	USES 3.0
Finh	-	
Nappl	-	
$Qform_{appl}$	-	.
$Qform_{inh}$	-	.
$Vform_{appl}$	-	.
$Vform_{inh}$	-	.

Table 1.4 Emission scenario for calculating the releases of disinfectants used for skin and hand application in hospitals based on the annual tonnage applied

This report	Original report No. -	USES 3.0
$Elocal_{3,water}$	-	$Elocal_{i,j}$
$F_{3,water}$	-	$F_{i,\,j}$
$Fmainsource_3$	-	$Fmainsource_i$
$Fprodvol_{reg}$	-	$Fprodvol_{reg}$
$Temission_3$	-	$Temission_i$
TONNAGE	-	TONNAGE
TONNAGEreg	-	TONNAGEreg

Table 1.5 Emission scenario for calculating the releases of disinfectants used for skin and hand application in hospitals based on an average consumption

This report	Original report No. -	USES 3.0
Cform	- .	.
$Elocal_{3,water}$	- .	$Elocal_{i,j}$
$F_{3,water}$	- .	$F_{i,\,j}$
Foccup	- .	.
$Nbeds_{occup}$	- .	.
$Nbeds_{pres}$	- .	.
$Qsubst_{occup\_bed}$	- .	.
$Qsubst_{pres\ \_bed}$	- .	.

Table 1.6 Pick-list for the average use of disinfectant for professional use ($Qsubst_{pres\text{-}bed}$) per hospital bed ($g.d^{-1}$) for beds present (I) and $Qsubst_{occup\text{-}bed}$ for occupied beds (II)

This report	Original report No. -	USES 3.0
$Qsubst_{occup\_bed}$	-	.
$Qsubst_{pres\ \_bed}$	-	.

Product-type 2: Private area and public health area disinfectants and other biocidal products

Table 2.1 Discharge of swimming water by public swimming pools into the sewage system for the acute and chronic situation

This report	Original report No. 2 table 2.2	USES 3.0
AREAswimw	L_{surf}	$AREA_{swimw}$
Cproc	C_{swimw}	C_{swimw}
DEPTHswimw	W_{depth}	$DEPTH_{swimw}$
$Elocal_{3,water}$	C_{surfI}	$Elocal_{water}$
$Elocal_{3,water}$	C_{surfII}	$Elocal_{water}$
Nvisit	N_{visit}	N_{visit}
$Temission_3$	.	$Temission_{swimw,chr}$
$Temission_3$	.	$Temission_{swimw,ac}$
Vrepl	Q_{repl}	Qrepl

Table 2.2 Discharge of swimming water by public and private swimming pools into the surface water for the acute situation

This report	Original report No. 2 table 2.3	USES 3.0
Cproc	C_{swimw}	C_{swimw}
DEPTHditch	W_{depth}	$DEPTH_{ditch}$
DILUTION	F_{dilut}	$DILUTION_{private}$
DILUTION	F_{dilut}	$DILUTION_{public}$
Fdrift	.	F_{drift}
Nappl	.	N_{appl}
POOLTYPE	.	POOLTYPE
Tint	$T_{interval}$	$T_{interval}$

Table 2.3 Emission scenario for calculating the releases of disinfectants used for sanitary purposes based on the annual tonnage applied

This report	Original report TGD	USES 3.0
$Elocal_{2,air}$	$Elocal_{air}$	$Elocal_{i,j}$
$Elocal_{2,water}$	$Elocal_{water}$	$Elocal_{i,j}$
$F_{2,air}$	$F_{i, j}$	$F_{i, j}$
$F_{2,water}$.	$F_{i, j}$	$F_{i, j}$
$Fmainsource_2$	$Fmainsource_i$	$Fmainsource_i$
$Fprodvol_{reg}$	-	$Fprodvol_{reg}$
HPVC	-	HPVC
$Temission_2$	$Temission_i$	$Temission_i$
TONNAGE	TONNAGE	TONNAGE
TONNAGEreg	-	TONNAGEreg

Table 2.4 Emission factors to air, $F_{2,air}$ (-), and wastewater, $F_{2,water}$ (-), for the formulation of general purpose and lavotary cleaners (liquid formulations)

This report	Original report TGD	USES 3.0
$F_{2,air}$	$F_{i, j}$	$F_{i, j}$
$F_{2,water}$.	$F_{i, j}$	$F_{i, j}$

Table 2.5 Fraction of the main source, $Fmainsource_2$ (-), and number of emission days, $Temission_2$ (d), for the formulation stage of general purpose and lavotary cleaners based on the corrected regional tonnage, $TONNAGEreg_{form}$ (tonnes.yr^{-1}), of the biocide

This report	Original report TGD	USES 3.0
$Fmainsource_2$	$Fmainsource_i$	$Fmainsource_i$
HPVC	-	HPVC
$Temission_2$	$Temission_i$	$Temission_i$
$TONNAGEreg_{form}$	-	$TONNAGEreg_{form}$

Table 2.6 Emission scenario for calculating the releases of disinfectants used for sanitary purposes based on the annual tonnage applied

This report	Original report No. 10 table 2.1	USES 3.0
$Elocal_{4,water}$	$Elocal_{4,water}$	$Elocal_{i,j}$
$F_{4,water}$	$F_{4,water}$	$F_{i,j}$
$Fmainsource_4$	$Fmainsource_{water}$	$Fmainsource_i$
$Fprodvol_{reg}$	Fl_{reg}	$Fprodvol_{reg}$
$Temission_4$	$Temission_4$	$Temission_i$
TONNAGE	TONNAGE	TONNAGE
TONNAGEreg	TONNAGEREG	TONNAGEreg

Table 2.7 Emission scenario for calculating the releases of disinfectants used for sanitary purposes based on an average consumption

This report	Original report No. 10 table 2.2	USES 3.0
Cform	$C_{product}$	.
$Elocal_{4,water}$	$Elocal_{4,water}$	$Elocal_{i,j}$
$F_{4,water}$	$F_{4,water}$	$F_{i,j}$
Fpenetr	F_{penetr}	.
Nlocal	Nlocal	Nlocal
Vform	$Q_{product}$.	.

Table 2.8 Emission scenario for calculating the releases of disinfectants used for fogging at disinfection of greenhouses in agriculture

This report	Original report No. 2 table 2.7	USES 3.0
$Elocal_{3,air}$	Q_{emis}	$Elocal_{i,j}$
Fdisin	F_{disin}	F_{disin}
Fret	F_{ret}	F_{ret}
Qsubst	Q_{subst}	Q_{subst}
$Temission_3$	.	Temission, $Temission_{fogging}$

Table 2.9 Default values of parameters required for distribution models of USES 3.0

This report	Original report No. 2 table 2.7	USES 3.0
$Temission_3$	.	Temission, $Temission_{fogging}$

Table 2.10 Emission scenario for calculating the releases of disinfectants used for tiles and surface in both private and industrial uses

This report	Original report No. -	USES 3.0
$Elocal_{4,water}$	-	$Elocal_{i,j}$
$F_{4,water}$	-	$F_{i,\,j}$
$Fmainsource_4$	-	$Fmainsource_i$
$Fprodvol_{reg}$	-	$Fprodvol_{reg}$
$Temission_4$	-	$Temission_i$
TONNAGE	-	TONNAGE
TONNAGEreg	-	TONNAGE

Table 2.12 Emission scenario for calculating the releases of disinfectants used for sanitary purposes in hospitals based on the annual tonnage applied

This report	Original report No.10 table 3.5	USES 3.0
$Elocal_{3,water}$	$Elocal_{3,water}$	$Elocal_{i,j}$
$F_{3,water}$	$F_{3,water}$	$F_{i,\,j}$
Fhospital	$F_{hospital}$	.
$Fprodvol_{reg}$	Fl_{reg}	$Fprodvol_{reg}$
$Temission_3$	.	$Temission_i$
TONNAGE	TONNAGE	TONNAGE
TONNAGEreg	TONNAGEREG	TONNAGEreg

Table 2.13 Emission scenario for calculating of the releases of disinfectants used for sanitary purposes in hospitals based on the amount of solution of disinfectant used on a day

This report	Original report No. 10 table 3.6	USES 3.0
$Cproc_{obj}$	C_{obj}	.
$Cproc_{san}$	C_{obj}	.
$Elocal_{3,water}$	$Elocal_{3,water}$	$Elocal_{i,j}$
Fobj	$Fobj_{3,water}$	.
Fsan	$Fsan_{3,water}$	.
$Vcons_{obj}$	Q_{water_obj}	.
$Vcons_{san}$	Q_{water_san}	.

Table 2.14 Emission scenario for calculating the release of disinfectants used in hospitals for disinfection of scopes and other articles in washers/disinfectors

This report	Original report No.10 table 3.7	USES 3.0
Cproc	C_{disinf}	.
$Cproc_{carry\_over}$	$C_{c\text{-}over}$	.
$Cproc_{repl}$	C_{repl}	.
$Elocal_{3,water}$	$Elocal_{3,water}$	$Elocal_{i,j}$
Fcarry_over	Fcarry-over	.
$kdeg_{disinf}$	$kdeg_{disinf}$	.
$Nmax_{mach}$	$N_{rep\text{-}max}$	.
$Tint_{repl}$	T_{repl}	.
Vproc	$Q_{machine}$	.

Table 2.15 Emission scenario for calculating the releases of disinfectants used in hospitals for disinfection of contaminated instruments

This report	Original report No. 10 table 3.8	USES 3.0
$Elocal_{3,water}$	$Elocal_{3,water}$	$Elocal_{i,j}$
$kdeg_{disinf}$	$kdeg_{disinf}$	.
Qsubst	$Qyear_{disinf}$	.
$Temission_{3}$	$Temission_{3}$	$Temission_{i}$
$Tint_{repl}$	T_{repl}	.

Table 2.16 Emission scenario for calculating the release of disinfectants used for doing biologically contaminated laundry from hospitals in washing streets

This report	Original report No. 10 table 3.9	USES 3.0
Cform	$C_{disinfl}$	.
$Elocal_{3,water}$	$Elocal_{3,water}$	$Elocal_{i,j}$
Fred	F_{red}	.
Nmach	Nm	.
Qmat	Cap	.
$Vform_{weight}$	$V_{product}$	.

Table 2.17 Emission scenario for calculating the release of disinfectants used for doing biologically contaminated laundry from hospitals in tumbler washing machines

This report	Original report No.10 table 3.10	USES 3.0
Cform	$C_{disinf2}$	.
$Elocal_{3,water}$	$Elocal_{3,water}$	$Elocal_{i,j}$
Fred	F_{red}	.
Nbatch	Nb	.
Qmat	Cap	.
$Vform_{weight}$	$V_{product}$	.

Table 2.18 Emission scenario for calculating the concentration in receiving surface water of disinfectants used for disinfection of effluent from the standard STP of EUSES

This report	Original report No. -	USES 3.0
$Clocal_{eff}$	-	$Clocal_{eff}$
$Clocal_{water}$	-	$Clocal_{water}$
DILUTION	-	DILUTION

Product-type 3: Veterinary hygiene biocidal products

Table 3.1 Pick list for the subcript names based on the users intructions; the names are representing indices in various parameters involved in the model

This report	Original report No. 3	USES 3.0
appway	.	.
cat-subcat	.	.
stream	.	.

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors.

This report	Original report No.3 table 1	USES 3.0
-	$Cdirect_{air}$	.
-	$Cdirect_{manure\ storage}$	.
-	C_{sludge}	.
-	$Cstd_{air}$	.
-	$Q_{a.i.}$	.
-	$Q_{application\ manure}$	.
-	$APPL_{sludge}$	.
.	DOSE	.
.	$Edirect_{manure\ storage}$	.
.	F_{dis}	.
.	Q_{manure}	.
.	$T_{emission}$	.
appway (i2)	.	.
$AREAhousing_{i1}$	$A_{housing}$.	
cat-subcat (i1)	.	.
Cform	$C_{a.i.}$	.
$DEPTHmix_{arable}$	.	.
$DEPTHmix_{grass}$	.	$DEPTH_{grassland}$
$DT50bio_{slurry}$	.	.
$DT50bio_{soil}$	.	.
$Elocal_{3,air}$	$Edirect_{air}$	$Elocal_{i,j}$
$Elocal_{3,water}$	$Elocal_{3,water}$	$Elocal_{i,j}$
$F_{3,air,i1,i2}$	F_{air}	.
$F_{3,waste,i1,i2,i3}$	$F_{manure\ storage}$	.
$F_{3,water,i1,i2,i3}$	.	.
Fadd	.	.
$kdeg_{slurry}$	.	.
$kdeg_{soil}$	.	$kdeg_{soil}$
$Nanimal_{i1}$	.	.
Nappl_bioc	$N_{disinfection\ events}$	.
Nlap_arab	.	.
Nlap_grass	.	.
$PIECars\_N_{i1,i2,i3}$	.	.
$PIECars\_P2O5_{i1,i2,i3}$	.	.
$PIECgrs\_N_{i1,i2,i3}$	.	.
$PIECgrs\_P2O5_{i1,i2,i3}$	.	.
$Qnitrog\ \_excr_{i1}$	.	.

Table 3.2 Emission scenario for calculating the release of disinfectants used in animal housing for disinfection of walls and floors (continued)

This report	Original report No.3 table 1	USES 3.0
$Qnitrog\_\ is_{arable}$	.	.
$Qnitrog\_is_{grass}$	.	.
$Qnitrog\_total_{i1,i2,i3,i4}$	.	.
$Qphosph\_\ is_{arable}$	.	.
$Qphosph\_excr_{i1}$	.	.
$Qphosph\_is_{grass}$	.	.
$Qphosph\_total_{i1,i2,i3,i4}$	.	.
$Qsubst\_arab_{i1,i2,i3,i4}$	.	.
$Qsubst\_grass_{i1,i2,i3,i4}$	.	.
RHOsoil	.	RHO_{soil}
$Tappl\_d_1$	.	.
$Tappl\_d_i$	.	.
$Tappl\_n_1$	.	.
Tar_app_1	.	.
Tar_app_j	.	.
Tar_end	.	.
Tar_start	.	.
$Tarap_1$	.	.
$Tarap_j$	.	.
Tare	.	.
Tars	.	.
Tgr_app_1	.	.
Tgr_app_j	.	.
Tgr_end	.	.
Tgr_start	.	.
$Tgrap_1$	.	.
$Tgrap_j$	.	
Tgre	.	.
Tgrs	.	.
Tint_ar	.	.
Tint_bioc	.	.
Tint_gr	.	.
$Vform\_area_{i1,i2}$	$Q_{disinfectant}$	.
$Vform\_vol_{i1,i2}$	$Q_{disinfectant}$	.
$Vhousing_{i1}$	.	.

Table 3.3 Pick-list for the emission model parameters for calculating the releases of disinfectant used in disinfection of housings, for various types of animals: treated surface area (floor area for poultry and unknown), $AREAhousing_{i1}$, for an average housing (m^2), number of animals, $Nanimal_{i1}$, in a housing (-), phosphate generation, $Qphosph\_excr_{i1}$, ($kg.d^{-1}$) and nitrogen generation, $Qnitrog\_excr_{i1}$, ($kg.d^{-1}$), number of disinfection events per storage period, $Nappl\_storage_{i1}$, (-) for emissions to manure and for the emissions to air, $Nappl\_yr_{i1}$ (-)

This report	Original report No. 3 table 1	USES 3.0
$AREAhousing_{i1}$	$A_{housing}$	.
$Nanimal_{i1}$	.	.
Nappl_bioc	$N_{disinfection\ events}$	.
$Qnitrog\ \_excr_{i1}$	.	.
$Qphosph\_excr_{i1}$	.	.
$Vhousing_{i1}$	.	.

Table 3.4 Defaults for the emission factors for air, $F_{3,air,i1,i2}$, and the manure storage, $F_{3,waste,i1,i2,i3}$, for various animal species and application methods; also defaults for the application rates of the biocidal product are presented for both the area, $Vform\_area_{i1,i2}$ ($l.m^{-2}$), and volume, $Vform\_vol_{i1,i2}$ ($l.100m^{-32}$) of a housing

This report	Original report No. 3 table 1	USES 3.0
$F_{3,air,i1,i2}$	F_{air}	.
$F_{3,waste,i1,i2,i3}$	$F_{manure\ storage}$	.
$F_{3,water,i1,i2,i3}$	.	.
$Vform\_area_{i1,i2}$	$Q_{disinfectant}$	.
$Vform\_vol_{i1,i2}$	$Q_{disinfectant}$	.

Table 3.5 Defaults for date ($Tappl\_d_1$) and day number ($Tappl\_n_1$) of first disinfection depending on the number of applications per year (Nappl_bioc)

This report	Original report No. 3 table 1	USES 3.0
Nappl_bioc	$N_{disinfection\ events}$	.
$Tappl\ \_d_1$	.	.
$Tappl\ \_n_1$	.	.

Table 3.6 Emission scenario for calculating the release of disinfectants used in disinfection of footwear and animals' feet

This report	Original report No. 3 table 2	USES 3.0
-	$APPL_{sludge}$	.
-	$Cdirect_{air}$	.
-	C_{sludge}	.
-	$Cstd_{air}$	.
-	$Q_{a.i.}$	.
-	$Q_{application\ manure}$	.
.	DOSE	.
.	$Edirec_{manure\ storage}$	.
.	Q_{manure}	.
.	$T_{emission}$	.
Cform	$C_{a.i.}$	.
$DEPTHmix_{arable}$	.	.
$DEPTHmix_{grass}$	.	$DEPTH_{grassland}$
$DT50bio_{slurry}$	.	.
$DT50bio_{soil}$	.	.
$Elocal_{3,air}$	$Edirect_{air}$	$Elocal_{i,j}$
$Elocal_{3,water}$	.	$Elocal_{i,j}$
$F_{3,air,i1,i2,i3}$	F_{air}	.
$F_{3,waste,i1,i2,i3}$	$F_{manure\ storage}$	.
$F_{3,water,i1,i2,i3}$	.	.
Fadd	.	.
$Fdeg_{int}$	.	.
$kdeg_{slurry}$	.	.
$kdeg_{soil}$	.	.
$Nanimal_{i1}$	.	.
Nappl_bioc	$N_{disinfection\ events}$	.
$Nappl\_storage_{i1}$	.	.
Nd_soil_{i}	.	.
Nmsp	.	.
$Nreserv_{i1}$	$xN_{reservoirs}$	.
$PIECars\_N_{i1,i2,i3}$	.	.
$PIECars\_P2O5_{i1,i2,i3}$	.	.
$PIECgrs\_N_{i1,i2,i3}$	.	.
$PIECgrs\_P2O5_{i1,i2,i3}$	.	.
$Qnitrog\_excr_{i1}$	.	.
$Qnitrog\_is_{arable}$	.	.
$Qnitrog\_is_{grass}$	.	.

Table 3.6 Emission scenario for calculating the release of disinfectants used in disinfection of footwear and animals' feet (continued)

Qnitrog_total$_{i1}$	.	.
Qphosph_excr$_{i1}$	.	.
Qphosph_is$_{arable}$	.	.
Qphosph_is$_{grass}$	.	.
Qphosph_total$_{i1}$	.	.
Qsubst_arab$_{i1,i2,i3}$	.	.
Qsubst_grass$_{i1,i2,i3}$	.	.
Qsubst_stream$_{i1,i2,i3}$	.	.
RHOsoil	.	RHO_{soil}
Tint_bioc	.	.
Tstorage	.	.
Vreserv$_{i1}$	$Q_{disinfectant}$	.

Table 3.7 Pick-list of emission model parameters for calculating the release of disinfectants used in disinfection of footwear and animals'feet: Number of disinfections per year, Nappl_bioc (-), number of reservoirs, Nreserv$_{i1}$ (-), volume of disinfectant in one reservoir, Vreserv$_{i1}$ (l), emission factor to air, $F_{3,air,i1,i2,i3}$ (-),emission factor to wastewater, $F_{3,water,i1,i2,i3}$ (-),and emission factor to manure, $F_{3,waste,i1}$ (-)

This report	Original report No. 3 table 2	USES 3.0
$F_{3,air,i2}$	F_{air}	.
$F_{3,waste,i1}$	$F_{manure\ storage}$	.
$F_{3,water,i1,i2,i3}$	.	.
Nanimal$_{i1}$	.	.
Nappl_bioc	$N_{disinfection\ events}$	.
Nappl_storage$_{i1}$	.	.
Nreserv$_{i1}$	$N_{reservoirs}$	.
Qnitrog_excr$_{i1}$	.	.
Qphosph_excr$_{i1}$	.	.
Vreserv$_{i1}$	$Q_{disinfectant}$	.

Table 3.8 Emission scenario for calculating the release of disinfectants used for disinfection of milk extraction systems

This report	Original report No. 3 table 3	USES 3.0
-	$APPL_{sludge}$	.
-	$Q_{application\ manure}$	.
-	C_{sludge}	.
-	$Q_{a.i.}$	.
.	DOSE	.
.	$T_{emission}$	.
Cform	$C_{a.i.}$	.
$DEPTHmix_{arable}$	.	
$DEPTHmix_{grass}$	.	$DEPTH_{grassland}$
$DT50bio_{slurry}$	.	.
$DT50bio_{soil}$	.	$DT50bio_{soil}$
$F_{3,waste}$	$F_{manure\ storage}$	.
$Fdeg_{int}$	.	.
$kdeg_{slurry}$	.	.
$kdeg_{slurry}$	.	.
$kdeg_{soil}$	.	$kdeg_{soil}$
Nanimal	.	.
Nappl_inst	$N_{disinfection\ events}$	.
Nappl_storage	.	.
Nappl_tank	$N_{disinfection\ events}$	.
Nd_soil	.	.
Nmsp	.	.
$PIECars\_N_{i1,i3}$	.	.
$PIECars\_P2O5_{i1,i3}$	.	.
$PIECgrs\_N_{i1,i3}$	.	.
$PIECgrs\_P2O5_{i1,i3}$	.	.
Qnitrog_excr	.	.
$Qnitrog\_is_{arable}$	.	.
$Qnitrog\_is_{grass}$	.	.
Qnitrog_total	.	.
Qphosph_excr	.	.
$Qphosph\_is_{arable}$	.	.
$Qphosph\_is_{grass}$	.	.
Qphosph_total	.	.
Qsubst_arab	.	.
Qsubst_grass	.	.
Qsubst_stream	.	.
$Qsubst_{day}$	.	.

Table 3.8 Emission scenario for calculating the release of disinfectants used for disinfection of milk extraction systems (continued)

This report	Original report No. 3 table 3	USES 3.0
RHOsoil	.	RHO_{soil}
Tint_bioc	.	.
Tstorage	.	.
$Vform_{inst}$	V_{inst}	.
$Vform_{tank}$	V_{inst}	.

Table 3.9 Emission scenario for calculating the release of disinfectants used in animal transport

This report	Original report No. 3 table 4	USES 3.0
-	$Q_{a.i.}$	.
AREAtransp	$A_{boxes/transport}$	.
Cform	$C_{a.i.}$	.
$Elocal_{3,water}$	$Edirect_{water}$	$Elocal_{i,j}$
$F_{3,water}$	F_{water}	$F_{i, j}$
Nappl_transp	$T_{emission}$	.
Nbox	$A_{boxes/transport}$	.
$Vform\_area_{i1}$	$Q_{disinfectant}$	.
$Vform\_box_{i1}$	$Q_{disinfectant}$	.

Table 3.10 Pick-list for the amount of disinfectant used for cleaning a square meter, $Vform\_area_{i1}$ ($l \cdot m^{-2}$), and a box, $Vform\_box_{i1}$ (l), and the total surface area, AREAtransp (m^2), and number of boxes, Nbox (-), to be cleaned

This report	Original report No. 3 table 4	USES 3.0
AREAtransp	$A_{boxes/transport}$	.
Nbox	$A_{boxes/transport}$	.
$Vform\_ box_{i1}$	$Q_{disinfectant}$	.
$Vform\_area_{i1}$	$Q_{disinfectant}$	.

Table 3.11 Emission scenario for calculating the release of disinfectants used in hatcheries

This report	Original report No.3 table 5	USES 3.0
$Elocal_{3,water}$	$Edirect_{water}$	$Elocal_{i,j}$
(Nappl)	$T_{emission}$	.
$Elocal_{3,air}$	$Edirect_{air}$	$Elocal_{i,j}$
$F_{3,air}$	F_{air}	$F_{i,j}$
$F_{3,water}$	F_{water}	$F_{i,j}$
$Negg_{stage}$	A_{eggs}	.
$Negg_{total}$	N_{eggs}	.
Qsubst	$Q_{disinfectant}$	.

Table 3.12 Pick-list for the amount of active ingredient Qsubst ($g.m^{-3}$) used for disinfection of hatcheries used as defaults for various types of disinfectants (see also Appendix 4)

This report	Original report No. 3 table 5	USES 3.0
Qsubst	$Q_{disinfectant}$	.

Product-type 4: Food and feed area disinfectants

Product-type 5: Drinking water disinfectants

Product-type 6: In-can preservatives

Table 6.1 Pick-list for average consumption per inhabitant per day, $Vform_{inh}$ ($ml.d^{-1}$) & $Qform_{inh}$ ($g.d^{-1}$), and per application ($Vform_{appl}$ (ml) & $Qform_{appl}$ (g), number of applications, Nappl (d^{-1}) and the fraction of inhabitants using the product (Finh)

This report	Original report No. -	USES 3.0
Finh	-	.
Nappl	-	.
$Qform_{appl}$	-	.
$Qform_{inh}$	-	.
$Vform_{appl}$	-	.
$Vform_{inh}$	-	.

Table 6.2 Emission scenario for new and existing substances that is used for calculating the releases of preservatives used in paints at the stage of (paint) formulation[2] based on the annual tonnage applied

This report	Original report ESD IC-14 TGD[1]	USES 3.0
$Elocal_{2,air}$	$Elocal_{air}$	$Elocal_{i,j}$
$Elocal_{2,water}$	$Elocal_{water}$	$Elocal_{i,j}$
$F_{i,j}$	$F_{i,j}$	$F_{i,j}$
$Fmainsource_i$	$Fmainsource_i$	$Fmainsource_i$
$Fprodvol_{reg}$	- .	$Fprodvol_{reg}$
HPVC	- .	HPVC
$Temission_i$	$Temission_i$	$Temission_i$
TONNAGE	TONNAGE	TONNAGE
TONNAGEreg	-	TONNAGEreg

Table 6.3 Emission factors to air ($F_{2,air}$) and (waste)water ($F_{2,water}$) for the formulation of some types of paint and coating products that are likely to contain in-can preservatives. I = volatile, II = non-volatile & water soluble and III = non-volatile & non-water soluble

This report	Original report ESD IC-14 TGD[1]	USES 3.0
$F_{2,air}$	.	$F_{i,j}$
$F_{2,water}$	.	$F_{i,j}$

[1] Emission scenario document IC-14 Paints, lacquers and varnishes

Table 6.4 Fraction of the main source, $Fmainsource_2$ (-), and number of number of emission days, $Temission_2$ (d), for paints and coatings with in-can preservatives based on the corrected regional tonnage, $TONNAGEreg_{form}$ (tonnes.yr^{-1}), of the biocide

This report	Original report B-tables TGD[1]	USES 3.0
$Fmainsource_2$	.	$Fmainsource_i$
$Temission_2$	.	$Temission_i$
$TONNAGEreg_{form}$	.	$TONNAGEreg_{form}$

[1] Tables 2.10 and (for high production volume chemicals) 2.3 of the Technical Guidance Document

Table 6.5 Emission factors to air, $F_{3,air}$ (-), and (waste)water, $F_{3,water}$ (-), for the application of some types of paint and coating products that are likely to contain in-can preservatives. I = volatile, II = non-volatile & water soluble and III = non-volatile & non-water soluble

This report	Original report A-table TGD[1)]	USES 3.0
$F_{3,air}$	.	$F_{i,j}$
$F_{3,water}$	.	$F_{i,j}$

[1)] Emission scenario document IC-14 Paints, lacquers and varnishes

Table 6.6 Fraction of the main source, $Fmainsource_3$ (-), and number of number of emission days, $Temission_3$ (d), for paints and coatings with in-can preservatives based on the corrected regional tonnage, $TONNAGEreg_{form}$ (tonnes.yr^{-1}), of the biocide

This report	Original report B-tables TGD[1)]	USES 3.0
$Fmainsource_3$	.	$Fmainsource_i$
$Temission_3$	.	$Temission_i$
$TONNAGEreg_{form}$	.	$TONNAGEreg_{form}$

[1)] Table 3.13 of the Technical Guidance Document

Table 6.7 Default settings for the input parameters of the model for preservatives applied in waterborne coatings at landfilling

This report	Original report No. 9 section 7.3	USES 3.0
$Fdeg_i$	F_{degri}	.
$Fdiff_i$	F_{diffi}	.
$Flandf_i$	$F_{landfill\,i}$	.
$Flandf_{total}$	F_{twl}	.
$Fpenetr_i$	$F_{penetri}$	.
$Fpres\_prod_i$	$F_{prodpres\,i}$	.
$Fsubst\_prod_i$	$F_{subst\text{-}prod\,i}$	.
$Qreg\_prod_i$	$Qreg_{prod\ i}$	.

Table 6.8 Emission scenario for calculating the releases from drying sections after size-pressing and coating for product type 6 biocides

This report	Original report No.4 table 10	USES 3.0
Cform	.	.
$Elocal_{3,air}$	$Elocal_{air}$	$Elocal_{i,j}$
Fdecomp	F_{decomp}	.
Fevap	F_{evap}	.
Qpaper	Q_{paper}	.
Qsubst	Q_{active}	.
Vform	.	.

Table 6.9 Pick-list for the daily production volumes, Qpaper (tonnes.d^{-1}), used as defaults for the model site for various types of paper (Böhm et al., 1997)

This report	Original report No. 4 table 3	USES 3.0
Qpaper	Q_{paper}	.

Table 6.10 Emission scenario for calculating the releases from "broke" for product type 6 biocides

This report	Original report No. 4 table 11	USES 3.0
Cform	.	.
$Elocal_{3,water}$	$Elocal_{water}$	$Elocal_{i,j}$
Fbroke	F_{broke}	.
Fclosure	$F_{closure}$	.
Ffix	F_{fix}	.
Qpaper	Q_{paper}	.
Qsubst	Q_{active}	.
Vform	.	.

Table 6.11 Pick-list for the degree of closure of the water system, Fclosure, (-) used as defaults for various types of paper [1)]

This report	Original report No. 4 table 6	USES 3.0
Fclosure	$F_{closure}$	.

Table 6.12 Emission scenario for calculating the releases from paper recycling

This report	Original report No. 4 table 12	USES 3.0
$Elocal_{5,water}$	$Elocal_{water}$	$Elocal_{i,j}$
Fdecomp	F_{decomp}	.
Fdeink	$F_{deinking}$	.
$Fmainsource_5$	f	$Fmainsource_i$
Fprelim	$F_{preliminary}$	.
$Fprodvol_{reg}$	TONNAGEREG	$Fprodvol_{reg}$
$Frec_{paper}$	$F_{recycling}$	.
Nwdays	N_d	.
TONNAGE	TONNAGE	TONNAGE
TONNAGEreg	TONNAGEREG	TONNAGEreg

Table 6.13 Pick-list for the fraction of recycled paper, $Frec_{paper}$, (-), used as defaults for various types of paper

This report	Original report No. 4 table 12	USES 3.0
$Frec_{paper}$	$F_{recycling}$	.

Table 6.14 Emission scenario for calculating releases from fluids with in-can preservatives used in textile production

This report	Original report No. 7 table 9	USES 3.0
.	Q_{prod}	.
$Cform_i$	.	.
$Elocal\_water_i$	$Elocal_{x,water}$	$Elocal_{i,j}$
$Elocal_{3,water}$	$Elocal_{tot,water}$	$Elocal_{i,j}$
Ffix	F_{fix}	.
Qfibres	Q_{fibres}	.
$Qsubst_i$	Q_{x_active}	.
$Vform_i$	.	.

Table 6.15 Emission scenario for calculating releases from fluids with in-can preservatives used in leather production

This report	Original report No. 6 table 7	USES 3.0
.	Q_{prod}	.
$Cform_i$	.	.
$Elocal\_water_i$	$Elocal_{x,water}$	$Elocal_{i,j}$
$Elocal_{3,water}$	$Elocal_{tot,water}$	$Elocal_{i,j}$
Ffix	F_{fix}	.
Qleather	$Q_{leather}$	.
$Qsubst_i$	Q_{active}	.
$Vform_i$	.	.

Table 6.16 Pick-list for the quantity of biocide used per tonne of leather, $Qsubst_i$ ($kg.tonne^{-1}$) for relevant process steps in leather production

This report	Original report No. 6 table 7	USES 3.0
$Qsubst_i$	Q_{active}	.

Product-type 7: Film preservatives

Table 7.1 Default settings for the input parameters of the model for preservatives applied in adhesives (I = water-based adhesives, II = dispersion adhesives) at landfilling

This report	Original report No. 9 section 7.3	USES 3.0
$Fdeg_i$	F_{degri}	.
$Fdiff_i$	F_{diffi}	.
$Flandf_i$	$F_{landfilli}$	.
$Flandf_{total}$	F_{twl}	.
$Fpenetr_i$	$F_{penetri}$	.
$Fpres\_prod_i$	$F_{prodpresi}$	.
$Fsubst\_prod_i$	$F_{subst-prodi}$	.
$Qreg\_prod_i$	$Qreg_{prodi}$	.

Table 7.2 Emission scenario for calculating the releases from drying sections after size-pressing and coating for product type 7 biocides

This report	Original report No. 4 table 10	USES 3.0
$Cform_{liquid}$	.	.
$Cform_{solid}$	.	.
$Elocal_{3,air}$	$Elocal_{air}$	$Elocal_{i,j}$
Fdecomp	F_{decomp}	.
Fevap	F_{evap}	.
Qform	.	.
Qpaper	Q_{paper}	.
Qsubst	Q_{active}	.
Vform	.	.

Table 7.3 Emission scenario for calculating the releases from "broke" for product type 9 biocides

This report	Original report No.4 table 11	USES 3.0
$Cform_{liquid}$	.	.
$Cform_{solid}$	.	.
$Elocal_{3,water}$	$Elocal_{water}$	$Elocal_{i,j}$
Fbroke	F_{broke}	.
Fclosure	$F_{closure}$	.
Ffix	F_{fix}	.
Qform	.	.
Qpaper	Q_{paper}	.
Qsubst	Q_{active}	.
Vform	.	.

Product-type 8: Wood preservatives

Table 8.1 Emission scenario for calculating the releases at wood impregnation with creosote (Luttik et al., 1993)

This report	Original report No. 1 table 9	USES 3.0
$DOSE_{pest}$	D_{soil}	$DOSE_{pest}$
Dstorage	D_{wood}	$D_{wood,creos}$
$Elocal_{3,air}$	L_{air}	$Elocal_{i,j}$
$Elocal_{3,water}$	L_{wwt}	$Elocal_{i,j}$
$F_{3,air}$	f_a	$F_{a,creos}$
$F_{3,soil}$	f_s	$F_{s,creos}$
$F_{3,water}$	f_w	$F_{w,creos}$
Fcreos	F_{creos}	F_{creos}
Fwater/soil	$f_{w/s}$	$F_{ws,creos}$
Qform	Q_{creos}	Q_{creos}
Qwood	Q_{mater}	$Q_{mater,creos}$

Table 8.2 Default values of parameters required for distribution models of USES 3.0

This report	Original report No. 1 table 9	USES 3.0
Fsoil	.	F_{soil}
MIX	.	MIX
Nappl	.	N_{appl}, $N_{appl,creos}$
$Temission_3$	.	Temission, $Temission_{creos}$
Tint	.	$T_{interval}$, $T_{interval,creos}$

Table 8.3 Emission scenario for calculating the releases at wood impregnation with salts (Luttik et al., 1993)

This report	Original report No. 1 table 10	USES 3.0
$DOSE_{pest}$	D_{soil}	$DOSE_{pest}$
Dstorage	d_{wood}	$D_{wood,salt}$
$Elocal_{3,water}$	L_{wwt}	$Elocal_{i,j}$
$F_{3,soil}$	f_s	$F_{s,salt}$
$F_{3,water}$	f_w	$F_{w,salt}$
Fwater/soil	$f_{w/s}$	$F_{ws,salt}$
Qsubst	Q_{salt}	Q_{salt}
Qwood	Q_{mater}	$Q_{mater,salt}$

Table 8.4 Default values of parameters required for distribution models of USES 3.0

This report	Original report No.1 table 10	USES 3.0
Fsoil	.	F_{soil}
$Temission_3$	.	Temission, $Temission_{salt}$
MIX	.	MIX
Nappl	.	N_{appl}, $N_{events,salt}$
Tint	.	$T_{interval}$, $T_{interval,salt}$

Table 8.5 Emission scenario for calculating the releases at drenching and dipping (Luttik et al., 1993)

This report	Original report No. 1 table 11	USES 3.0
$DOSE_{pest}$	D_{soil}	$DOSE_{pest}$
Dstorage	D_{wood}	$D_{wood,drench}$
$Elocal_{3,air}$	L_{air}	$Elocal_{i,j}$
$Elocal_{3,water}$	L_{wwt}	$Elocal_{i,j}$
$F_{3,air}$	f_a	$F_{a,drench}$
$F_{3,soil}$	f_s	$F_{s,drench}$
$F_{3,water}$	f_w	$F_{w,drench}$
Fwater/soil	$f_{w/s}$	$F_{ws,drench}$
Qsubst	$Q_{a.i.}$	$Q_{ai,drench}$
Qwood	Q_{mater}	$Q_{mater,drench}$

Table 8.6 Default values of parameters required for distribution models of USES 3.0

This report	Original report No. 1 table 11	USES 3.0
Fsoil	.	F_{soil}
MIX	.	MIX
Nappl	.	N_{appl}, $N_{appl,drench}$
$Temission_3$	.	Temission, $Temission_{drench}$
Tint	.	$T_{interval}$, $T_{interval,drench}$

Table 8.7 Emission scenario for calculating the releases at remedial timber treatment in buildings (Luttik et al., 1993)

This report	Original report No. 1 table 12	USES 3.0
Fform	$f_{a.i.}$	$F_{ai,remed}$
Qform	A_{solid}	$APPl_{solid}$
Qsubst	Q_{wood}	$DOSE_{wood}$
RHOform	R_{den}	RHO_{form}
Vform	A_{fluid}	$APPl_{fluid}$

Table 8.8 Emission scenario for calculating the releases at leaching from poles to surface water

This report	Original report No. 1 table 13	USES 3.0
.	.	$Fdiss_{ditch}$
a	a	a
AREAleach	L_{surf}	$AREA_{leach}$
b	b	b
$Cwater_{pest-0}$	.	$Cwater_{pest-0}$
$Cwater_{pest-T}$	.	$Cwater_{pest-T}$
Cwway	C_{wway}	C_{wway}
DEPTHwway	W_{depth}	$DEPTH_{wway}$
DIAMpole	P_{diam}	$DIAM_{pole}$
FLUXsubst	F_{comp}	$FLUX_{avg}$
Kp_{susp}	.	Kp_{susp}
Npole	P_{numb}	N_{pole}
SUSPwater	.	$SUSP_{water}$
TAUwway	R_{wway}	TAU_{wway}
T_{bird}	.	T_{bird}
T_{mammal}	.	T_{bird}
WIDTHwway	W_{width}	$WIDTH_{wway}$

Table 8.9 Emission scenario for calculating the releases at leaching from poles to sandy soils and groundwater

This report	Original report No.2 table 2.4	USES 3.0	Remarks
AREAleach	.	$AREA_{leach}$	
Cgrw	Cgrndw	$Cgrw_{pest}$	
CONVsatsoil	.		USES 4.0: $CONV_{soil}$
Cporew	.	C_{porew}	
$Csoil_{pest-0}$	.	$Csoil_{pest-0}$	
DEPTHpole	.	$DEPTH_{pole}$	
Finfluence	.	$F_{influence}$	
FLUXsubst	F_{comp}	$FLUX_{comp}$	
$Fwater_{satsoil}$	.	$Fwater_{satsoil}$	
Kp_{soil}	.	Kp_{soil}	
Qsoil	.	M_{soil}	
$Qsubst_{leach}$	.	Q_{pole}	
RADpole	.	RAD_{pole}	
RADsoil	.	RAD_{soil}	
RHOsatsoil	.	RHO_{soil}	USES 4.0: $RHO_{satsoil}$
Vporew	.	V_{pore}	
Vsoil	.	V_{pore}	

Table 8.10 Emission scenario for calculating the releases at leaching from poles to soil

This report	Original report No. 2 table 2.5	USES 3.0	Remarks
AREAleach	L_{surf}	$AREA_{fence}$	
CONVpest	.	$CONV_{soil}$	USES 4.0:$CONV_{pest}$
Cporew	.	C_{porew}	
$Csoil_{pest-0}$	.	$Csoil_{pest-0}$	
DEPTHfence	W_{depth}	$DEPTH_{fence}$	
FLUXsubst	F_{comp}	$FLUX_{fence}$	
$Fwater_{satsoil}$	.	$Fwater_{satsoil}$	
HEIGHTfence	W_{hight}	$HEIGHT_{fence}$	
Kp_{soil}	.	Kp_{soil}	
LENGTHfence	.	$LENGTH_{fence}$	
Qsoil	.	M_{soil}	
$Qsubst_{leach}$	L_{comp}	Q_{fence}	
RHOpest	.	RHO_{soil}	USES 4.0: RHO_{pest}
Train	T_{rain}	T_{rain}	
Vporew	.	V_{pore}	
Vsoil	.	V_{pore}	
WIDTHfence	W_{width}	$WIDTH_{fence}$	

Table 8.11 Default settings for the input parameters of the model for wood preservatives at landfilling

This report	Original report No. 9 table 8.7	USES 3.0
$Flandf_i$	$F_{landfill i}$	.
$Flandf_{total}$	F_{twl}	.
$Fpenetr_i$	$F_{penetr i}$	.
Fsubst	F_{creos}	.
$Qsubst\_prep_i$	$Qreg_{subst-prep i}$	.
$Qsubst\_reg_i$	$Qreg_{subst-prod i}$	.

Table 8.12 Default settings for the input parameters of the model for wood preservatives in products for general-use surface protection at landfilling

This report	Original report No. 9 table 8.8	USES 3.0
$Fdiff_i$	F_{diff}	.
$Flandf_i$	$F_{landfilli}$	.
$Flandf_{total}$	F_{twl}	.
$Fpenetr_i$	$F_{penetri}$	.
$Fsubst\_prod_i$	F_{creos}	.
$Qreg\_prod_i$	$Qreg_{subst-prodi}$ 1)	.

1) Error in original report; should have been $Qreg_{prodi}$

Product-type 9: Fibre, leather, rubber and polymerised materials preservatives

Table 9.1 Emission scenario for calculating the releases from the biocide that is present in imported material

This report	Original report No. 7 table 8	USES 3.0
Cmat	C_{active}	.
$Eimport_{water}$	$Elocal_{i,water}$	.
$Elocal_{3,water}$	.	$Elocal_{i,j}$
Qfibres	Q_{fibres}	.

Table 9.2 Emission scenario for calculating the releases from the different application steps p = 1 to m of biocide

This report	Original report No. 7 table 9	USES 3.0
$Eimport_{water}$	$Elocal_{i,water}$	.
$Elocal\_water_i$	$Elocal_{x,water}$	.
$Elocal_{3,water}$	$Elocal_{tot,water}$	$Elocal_i$
Ffix	F_{fix}	.
Qfibres	Q_{fibres}	.
$Qsubst_i$	Q_{active}	.

Table 9.3 Pick-list with defaults for the daily production, Qfibres (tonnes.d^{-1}), of the model textile production site (according to Tissier, Chesnais and Migné (2001))

This report	Original report No. 7 table 3	USES 3.0
Qfibres	Q_{fibres}	.

Table 9.4 Emission scenario for calculating the releases from articles during their service life

This report	Original report No. 7 table 10	USES 3.0
.	F_{cont}	.
.	$RELEASEcont_k$	.
.	$RELEASEtot_{k,j}$	.
$Elocal_{service,water}$	.	.
$Fmainsource_{service}$	F_{reg}	.
$Fprodvol_{reg}$	F_{reg}	$Fprodvol_{reg}$
$F_{service,j}$	F_j	.
$Qsubst\_tot_k$	$Qtot_k$	.
$RELEASEreg_{k,service,j}$	$RELEASEreg_{k,j}$	.
$RELEASEreg_{service,j}$	.	.
$Temission_{service}$	N_d	.
$Tservice_k$	$Tservice_k$	.

Table 9.5 Service life, $Tservice_k$, of some articles, $Tservice_k$, according to (Tissier, Chesnais and Migné (2001)); some values are the averages of the ranges presented in the emission scenario document.

This report	Original report No. 7 table 7	USES 3.0
$Tservice_k$	$Tservice_k$	.

Table 9.6 Emission scenario for calculating the releases biocides used as preservatives in the leather industry

This report	Original report No. 6 table 7	USES 3.0
Ffix	F_{fix}	.
$Cform_i$	.	.
Elocal_water	$Elocal_{x,water}$	.
$Elocal_{3,water}$	$Elocal_{tot,water}$	$Elocal_{i,j}$
Qleather	$Q_{leather}$	.
$Qsubst_i$	Q_{active}	.
$Vform_i$	.	.

Table 9.7 Emission scenario for calculating the releases from drying sections after size-pressing and coating for product type 9 biocides

This report	Original report No. 4 table 10	USES 3.0
Cform	.	.
$Elocal_{3,air}$	$Elocal_{air}$	$Elocal_{i,j}$
Fdecomp	F_{decomp}	.
Fevap	F_{evap}	.
Qpaper	Q_{paper}	.
Qsubst	Q_{active}	.
Vform	.	.

Table 9.8 Emission scenario for calculating the releases from "broke" for product type 9 biocides

This report	Original report No. 4 table 11	USES 3.0
Fbroke	F_{broke}	.
Ffix	F_{fix}	.
$Cform_i$	.	.
$Elocal_{3,water}$	$Elocal_{water}$	$Elocal_{i,j}$
Fclosure	$F_{closure}$	.
Qpaper	Q_{paper}	.
Qsubst	Q_{active}	.
$Vform_i$	.	.

Product-type 10: Masonry preservatives

Product-type 11: Preservatives for liquid-cooling and processing systems

Table 11.1 Emission scenario for calculating the releases from biocides used in process and cooling-water installations

This report	Original report No. 1 table 5	USES 3.0
AREAdepos	A_{soil}	$AREA_{soil,cooling}$
Cproc	C_{ai}	$C_{ai,cooling}$
$Cwater_{pest\text{-}0}$	C_{surf}	$Cwater_{pest\text{-}0}$
$Cwater_{pest\text{-}T}$	C_{surf}	$Cwater_{pest\text{-}T}$
DILUTION	F_{dilut}	$DILUTION_{cooling}$
$DOSE_{pest}$	D_{soil}	$DOSE_{pest}$
Fdepos	W_{depos}	F_{depos}
Kp_{susp}	.	Kp_{susp}
Nappl	.	N_{appl}, $N_{appl,cooling}$
Qcirc	Q_{circ}	Q_{circ}
SUSPwater	.	$SUSP_{water}$
T_{bird}	.	T_{bird}
Tint	.	$T_{interval}$, $T_{inverval,cooling}$
T_{mammal}	.	T_{bird}

Table 11.2 Default values of parameters required for distribution models of USES 3.0

This report	Original report No. 1 table 5	USES 3.0
Fsoil	.	F_{soil}
MIX	.	MIX
Nappl	.	N_{appl}, $N_{appl,cooling}$
Tint	.	$T_{interval}$, $T_{inverval,cooling}$

Product-type 12: Slimicides

Table 12.1 Common part of the models for the calculation of the theoretical average concentration (i.e. assuming that no degradation occurs) before wastewater treatment, depending on the way the dosage is expressed in the user's instructions; concentration reduction due to degradation in process water is presented in Tables 12.3 and 12.4.

This report	Original report No. 12 table 3.1	USES 3.0
APPL	APPL	.
Cform	CONTENT	.
Cinf	C_{paper}	C_{paper}
CONN	CONN	.
Cproc	$C_{prescribed}$	.
Fww1	F_{ww1}	.
Fww2	F_{ww2}	.
Qform_uins	Q_{prod_uins}	.
Qsubst	$DOSE_{ai}$	.
RHOform	RHOprod	.
Vww	WW	.

Table 12.2 Model for the calculation of the daily release to the STP excluding biodegradation.

This report	Original report No. 1 table 4	USES 3.0
.	C_{surf}	.
.	Q_{water}	.
Cinf	$C_{a.i.}$	C_{paper}
$EFFLUENT_{stp}$	Q_{STP}	$EFFLUENTlocal_{stp,paper}$
$Elocal_{3,water}$	L_{wwt}	$Elocal_{water}$, $Elocal_{i,j}$

Table 12.3 Default values of parameters required for distribution models of USES 3.0

This report	Original report No. 1 table 4	USES 3.0
.	.	Nlocal, $Nlocal_{paper}$
DILUTION	F_{dilut}	DILUTION, $DILUTION_{paper}$
$Temission_3$	.	Temission, $Temission_{paper}$

Table 12.4 Common part for the emission scenarios for calculating the release of slimicides in paper mills taking biodegradation and degradation due to hydrolysis and photolysis into account

This report	Original report No. 12 table 4.1	USES 3.0
$DT50bio_{stp}$	$DT50bio_{stp}$	$DT50bio_{stp}$
$DT50bio_{water}$	$DT50bio_{water}$	$DT50bio_{water}$
$DT50hydr_{acid}$	$DT50hydr_{acid}$	.
$DT50hydr_{alkal}$	$DT50hydr_{alkal}$	.
$DT50hydr_{water}$	$DT50hydr_{water}$	$DT50hydr_{water}$
$DT50photo_{water}$	$DT50photo_{water}$	$DT50photo_{water}$
$kbiotot_{stp}$	$kbiotot_{stp}$	.
$kbiotot_{water}$	$kbiotot_{water}$	.
$kbio_{water}$	$kbio_{water}$	$kbio_{water}$
$khydr_{acid}$	$khydr_{acid}$	.
$khydr_{alkal}$	$khydr_{alkal}$	.
$khydr_{water}$	$khydr_{water}$	$khydr_{water}$
$kphototot_{water}$		.
$kphoto_{water}$		$kphoto_{water}$

Table 12.5 Model for the calculation of the relevant PECs depending on the user's instructions: [A] amount of biocide per tonne of product and [B/C] amount of biocide per m^3 of water at the wire part of the paper machine.

This report	Original report No. 12 table 4.2	USES 3.0
Cacid	Cacid	.
$Cacid_{AS}$	$Cacid_{AS}$	.
$Cacid_{BT}$	$Cacid_{BT}$	.
$Cacid_{CM}$	$Cacid_{CM}$	.
Calkal	Calkal	.
$Calkal_{AS}$	$Calkal_{AS}$	.
$Calkal_{BT}$	$Calkal_{BT}$	.
$Calkal_{CM}$	$Calkal_{CM}$	.
Cinf	C_{paper}	.
Cneutr	Cneutr	.
$Cneutr_{AS}$	$Cneutr_{AS}$	.
$Cneutr_{BT}$	$Cneutr_{BT}$	.
$Cneutr_{CM}$	$Cneutr_{CM}$	.
DILUTION	$DILUTION_{paper}$	.

Table 12.5 Model for the calculation of the relevant PECs depending on the user's instructions: [A] amount of biocide per tonne of product and [B/C] amount of biocide per m^3 of water at the wire part of the paper machine (continued)

This report	Original report No. 12 table 4.2	USES 3.0
PEC_{ASstp_acid}	PEC_{ASstp_acid}	.
PEC_{ASstp_alkal}	PEC_{ASstp_alkal}	.
PEC_{ASstp_neutr}	PEC_{ASstp_neutr}	.
PEC_{BTstp_acid}	PEC_{BTstp_acid}	.
PEC_{BTstp_alkal}	PEC_{BTstp_alkal}	.
PEC_{BTstp_neutr}	PEC_{BTstp_neutr}	.
$PEClocal_{AS\_water\_acid}$	$PEClocal_{AS\_water\_acid}$	.
$PEClocal_{AS\_water\_alkal}$	$PEClocal_{AS\_water\_alkal}$	.
$PEClocal_{AS\_water\_neutr}$	$PEClocal_{AS\_water\_neutr}$	.
$PEClocal_{BT\_water\_acid}$	$PEClocal_{BT\_water\_acid}$	.
$PEClocal_{BT\_water\_alkal}$	$PEClocal_{BT\_water\_alkaline}$	.
$PEClocal_{BT\_water\_neutr}$	$PEClocal_{BT\_water\_neutr}$	.
$PEClocal_{CM\_water\_acid}$	$PEClocal_{CM\_water\_acid}$	.
$PEClocal_{CM\_water\_alkal}$	$PEClocal_{CM\_water\_alkaline}$	.
$PEClocal_{CM\_water\_neutr}$	$PEClocal_{CM\_water\_neutr}$	.
Tas	Tas	.
Tas_h	Tas_h	.
Tbt	Tbt	.
Tbt_h	Tbt_h	.
Tmc	Tmc	.
Tmc_h	Tmc_h	.
Tpr	Tpr	.
Tpr_h	Tpr_h	.
Tps	Tps	.
Tps_h	Tps_h	.
Tss	Tss	.
Tss_h	Tss_h	.

Product-type 13: Metalworking-fluid preservatives

Table 13.1 Emission scenario for calculating the releases from preservatives used in metalworking fluids

This report	Original report No. 1 table 7	USES 3.0
$Elocal_{3,water}$	$Elocal_{water}$	$Elocal_{i,j}$
Fproc	F_{ai}	$F_{ai,pres}$
Fsuppl	F_{suppl}	F_{suppl}
Qsyst	Q_{syst}	Q_{pres}

Table 13.2 Default values of parameters required for distribution models of USES 3.0

This report	Original report No.1 table 7	USES 3.0
$Temission_3$	.	Temission, $Temission_{pres}$

Table 14.1 Emission scenario for calculating the releases from rodenticides used for fogging of buildings, silos, etc.

This report	Original report No. 2 table 2.7	USES 3.0
$Elocal_{3,air}$	Q_{emis}	$Elocal_{i,j}$
Fdisin	F_{disin}	F_{disin}
Fret	F_{ret}	F_{ret}
Qsubst	Q_{subst}	Q_{subst}
$Temission_3$	.	$Temission_{fogging}$

Product-type 14: Rodenticides

Table 14.2 Default values of parameters required for distribution models of USES 3.0

This report	Original report No. 2 table 2.7	USES 3.0
$Temission_3$	.	Temission, $Temission_{fogging}$

Product-type 15: Avicides

Product-type 16: Molluscicides

Product-type 17: Piscicides

Product-type 18: Insecticides, acaricides and products to control other arthropods

Table 18.1 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.

This report	Original report No. 11 table 5.1	USES 3.0
appway	appway	.
bioctype	bioctype	.
cat-subcat	cat-subcat	.
stream	stream	.

Table 18.2 General part of the emission scenarios for all situations of insecticide application in animal housings and at manure storage systems

This report	Original report No. [table]	USES 3.0
$DT50bio_{slurry}$	11 [6.2] $DT50bio_{slurry}$	.
$DT50bio_{soil}$	11 [6.2] $DT50bio_{soil}$	$DT50bio_{soil}$
$kdeg_{slurry}$	11 [6.1] $kdeg_{slurry}$.	.
$kdeg_{soil}$	11 [6.1] $kdeg_{soil}$.	$kdeg_{soil}$
RHOsoil	11 [5.5] RHOsoil	RHOsoil

Table 18.3 Emission scenarios for insecticide application in animal housings and at manure storage systems

This report	Original report No. 11 table 6.2	USES 3.0
appway	appway	.
$AREAtarget_{i1}$	$AREA_{i1}$	.
$AREAuins_{i1}$	$AREAui_{i1}$	.
bioctype	bioctype	.
cat-subcat	cat-subcat	.
$DEPTHmix_{arable}$	$DEPTH_{arable\_land}$	.
$DEPTHmix_{grass}$	$DEPTH_{grassland}$	.
$Elocal_{3,water}$	$Qai_{i1,i2,i3,i4}$	$Elocal_{i,j}$
Fadd	Fadd	.
$Fform_{\%}$	Fbioc%	.
$Fform_{vol}$	Fbioc	.
$F_{i1,i2,i3,i4}$	$F_{i1,i2,i3,i4}$	.
$kdeg_{slurry}$	$kdeg_{slurry}$	.
$kdeg_{soil}$	$kdeg_{soil}$	$kdeg_{soil}$
Nappl_bioc	Napp-bioc	.
$Nanimal_{i1}$	N_{i1}	.
Nlap_arab	Nlap-arab	.
Nlap_grass	Nlap-grass	.
$PIECars\_N_{i1,i2,i3}$	$PIECars\_N_{i1,i2,i3}$	.
$PIECars\_P2O5_{i1,i2,i3}$	$PIECars\_P2O5_{i1,i2,i3}$	.
$PIECgrs\_N_{i1,i2,i3}$	$PIECgrs\_N_{i1,i2,i3}$	.
$PIECgrs\_P2O5_{i1,i2,i3}$	$PIECgrs\_P2O5_{i1,i2,i3}$	.
$Qform\_uins_{i1,i2,i3}$	$Qprod\text{-}uins_{i1,i2,i3}$	.
$Qnitrog\_excr_{i1}$	$Qnitrog_{i1}$	.
$Qnitrog\_is_{arable}$	$Q_{N,arable\_land}$	.
$Qnitrog\_is_{grass}$	$Q_{N,grassland}$	.
$Qnitrog\_total_{i1,i4}$	$Qnitrog\_total_{i1,i4}$	.
$Qphosph\_excr_{i1}$	$Qphosp_{i1}$	.
$Qphosph\_is_{arable}$	$Q_{P2O5,arable\_land}$	.
$Qphosph\_is_{grass}$	$Q_{P2O5,grassland}$	.
$Qphosph\_total_{i1,i4}$	$Qphosph\_total_{i1,i4}$	.
$Qsubst\_arab_{i1,i2,i3,i4}$	$Qai\text{-}arab_{i1,i2,i3,i4}$	.
$Qsubst\_grass_{i1,i2,i3,i4}$	$Qai\text{-}grass_{i1,i2,i3,i4}$	.
$Qsubst\_prescr_{i1,i2,i3}$	$Qsubst\_prescr_{i1,i2,i3}$	.
$Qsubst\_stream_{i1,i2,i3,i4}$	$Qai_{i1,i2,i3,i4}$	.
$Qsubst_{aer}$	Qaerosol	.
RHOsoil	RHOsoil	RHO_{soil}
$Tappl\_d_{l}$	$T\text{-}app_{l}$	.

Table 18.3 Emission scor insecticide application in animal housings and at manure storage systems (continued)

This report	Original report No. 11 table 6.2	USES 3.0
T-appl_d$_j$	T-app$_j$	.
Tappl_n$_1$	Tapp$_1$	.
Tappl_n$_j$	Tapp$_j$	.
Tar_app$_1$	Tar-app$_1$	.
Tar_app$_j$	Tar-app$_j$	.
Tar_end	Tar-end	.
Tar_start	Tar-start	.
Tarap$_1$	Tarap$_1$	.
Tarap$_j$	Tarap$_j$	.
Tare	Tare	.
Tars	Tars	.
Tcorr	Tcorr	.
Te	Te	.
Tend	Tend	.
Tgr_app$_1$	Tgr-app$_1$	.
Tgr_app$_j$	Tgr-app$_j$	.
Tgr_end	Tgr-end	.
Tgr_start	Tgr-start	.
Tgrap$_1$	Tgrap$_1$	.
Tgrap$_j$	Tgrap$_j$	.
Tgre	Tgre	.
Tgrs	Tgrs	.
Tint_ar	Tar-int	.
Tint_bioc	Tbioc-int	.
Tint_gr	Tgr-int	.
Ts	Ts	.
Tstart	Tstart	.
Vform_uins$_{i1,i2,i3}$	Vprod-uins$_{i1i2,13}$	.

Table 18.4 Defaults for floor surfaces of animal housings and the surface areas of manure storage systems, $AREAtarget_{cat\text{-}subcat}$ (m^2), with the numbers of animals present, $Nanimal_{cat\text{-}subcat}$ (-); the subscript cat-subcat presents the animal (sub)category and for poultry the type of housing, or the type of manure storage (see Table 18.1).

This report	Original report No. 11 table 5.2	USES 3.0
$AREAtarget_{cat\text{-}subcat}$	$AREA_{cat\text{-}subcat}$	.
$Nanimal_{cat\text{-}subcat}$	$N_{cat\text{-}subcat}$	

Table 18.5 Estimates for the fraction of active ingredient released to the relevant streams ($F_{cat\text{-}subcat,bioctype,appway,stream}$), for animal (sub)category and housing (variable cat-subcat), type of insecticide (variable bioctype), way of application (variable appway) and stream where the biocide is emitted to (variable stream); • = not applicable.

This report	Original report No. 11 table 5.3	USES 3.0
$F_{cat\text{-}subcat,bioctype,appway,stream}$	$F_{cat\text{-}subcat,bioctype,appway,stream}$	.

Table 18.6 Defaults for the insecticide application period as 1) start and end dates Tstart (-) and Tend (-) and 2) start day Ts (d) and end day Te (d) numbers, first application date as 1) first date $Tappl\_d_1$ (-) and 2) first application day $Tappl\_n_1$ (d), application interval Tint_bioc (d) and maximum number of applications Nappl_bioc (-) for all biocide types (index i2) and − if appropriate − category/subcategory (index i1)

This report	Original report No. 11 table 5.7	USES 3.0
Nappl_bioc	Napp-bioc	.
$Tappl\_d_1$	$T\text{-}app_1$	.
Tappl_n	$Tapp_1$	.
Te	Te	.
Tend	Tend	.
Tint_bioc	Tbioc-int	.
Ts	Ts	.
Tstart	Tstart	

Table 18.8 Default values for the periods of land application by target field as start dates (Tgr_start and Tar_start), end dates ($Tgr\_app_{Nlap\_grass}$ and $Tar\_app_{Nlap\_arab}$), start day numbers (Tgrs and Tars), and end day numbers (Tgre and Tare).

This report	Original report No. 11 table 5.10	USES 3.0
$Tar\_app_{Nlap\_arab}$	$Tar\text{-}app_{Nlap\text{-}arab}$	.
Tar_start	Tar_start	.
Tare	Tare	.
Tars	Tars	.
$Tgr\_app_{Nlap\_grass}$	$Tgr\text{-}app_{Nlap\text{-}grass}$	.
Tgr_start	Tgr-start	.
Tgre	Tgre	.
Tgrs	Tgrs	.

Table 18.9 Default values for the number of land applications per year, $Nlap_s$ (yr^{-1}), the phosphate immission standards, $Qphosph_s$ ($kg.ha^{-1}.yr^{-1}$), the nitrogen immission standards, $Qnitrog_s$ ($kg.ha^{-1}.yr^{-1}$), and the mixing depth with soil, $DEPTHmix_s$ (m), where the subscript "s" stands for the target soil: grassland or arable_land ("grass"and "arable")

This report	Original report No. 11 table 5.9	USES 3.0
$DEPTHmix_s$	$DEPTH_s$	.
$Nlap_s$	$Nlap_s$	.
$Qnitrog\_is_s$	$Q_{N,s}$	.
$Qphosph\_is_s$	$Q_{P2O5,s}$	.

Table 18.10 Default value for two additional parameters

This report	Original report No. 11 section 5.9	USES 3.0
Fadd	Fadd	.
Tcorr	Tcorr	.

Table 18.11 Defaults for the average amounts of liquid waste, $Qlwaste_{cat\text{-}subcat}$ (kg.animal^{-1}.d^{-1}) in relevant cases, phosphate, $Qphosph\_excr_{cat\text{-}subcat}$ (kg.animal^{-1}.d^{-1}) and nitrogen, $Qnitrog\_excr_{cat\text{-}subcat}$ (kg.animal^{-1}.d^{-1}) per animal (sub)category i1.

This report	Original report No. 11 section 5.9	USES 3.0
.	$Qlwaste_{cat\text{-}subcat}$	.
$Qnitrog\_excr_{cat\text{-}subcat}$	$Qnitrog_{cat\text{-}subcat}$	.
$Qphosph\_excr_{cat\text{-}subcat}$	$Qphosph_{cat\text{-}subcat}$	.

Table 18.12 Emission scenario for calculating the releases from insecticides used for fogging of buildings, silos, etc.

This report	Original report No. 2 table 2.7	USES 3.0
$Temission_3$		$Temission_{fogging}$
Fdisin	F_{disin}	F_{disin}
Fret	F_{ret}	F_{ret}
Qsubst	Q_{subst}	Q_{subst}
$Elocal_{3,air}$	Q_{emis}	$Elocal_{i,j}$

Table 18.13 Default values of parameters required for distribution models of USES 3.0

This report	Original report No. 2 table 2.7	USES 3.0
$Temission_3$	.	Temission, $Temission_{fogging}$

Product-type 19: Repellents and attractants

Product-type 20: Preservatives for food or feedstocks

Product-type 21: Antifouling products

Table 21.1 Emission scenario for calculating the releases of antifoulings from ships in a harbour

This report	Original report No. 1 table 14	USES 3.0
.	K_{ow}	K_{ow}
AREAanti	A_{surf}	$AREA_{anti}$
AREAdeck	$AREA_{deck}$	$AREA_{deck}$
$AREAlitre_{anti}$	C_{anti}	$AREA_{litre}$
AREAship	A_{ship}	$AREA_{ship}$
$Cwater_{pest\text{-}0}$	C_{water}	$Cwater_{pest\text{-}0}$
$Cwater_{pest\text{-}T}$	C_{water}	$Cwater_{pest\text{-}T}$
DEPTHbasin	$D_{y\text{-}b}$	$DEPTH_{basin}$
$DT50advec_{basin}$	$DT50_{a}$	$DT50_{advec,basin}$
FLUXsubst	F_{anti}	$FLUX_{anti}$
Fpres	$F_{s/ns}$	$F_{s\text{-}ns}$
Fship	F_{ship}	F_{ship}
Fwater/ship	$R_{w/s}$	$F_{water\text{-}ship}$
$kadvec_{basin}$	k_{a}	$k_{advec,basin}$
$kdeg_{water}$	k_{1}	$kdeg_{water}$
Kp_{susp}	.	Kp_{susp}
$krem_{basin}$	k	k_{basin}
Nship	N_{ship}	N_{ship}
SUSPwater	.	$SUSP_{water}$
T_{bird}	.	T_{bird}
T_{mammal}	.	T_{bird}
Vbasin	V_{basin}	V_{basin}
Vform	V_{anti}	V_{anti}

Product-type 22: Embalming and taxidermist fluids

Table 22.1 Emission scenario for calculating the releases of biocides used in taxidermy

This report	Original report No.5 table 3		USES 3.0
$Elocal\_water_{i}$	5 [3]	$Elocal_{x,water}$	.
$Elocal_{3,water}$	5 [3]	$Elocal_{tot,water}$	$Elocal_{i,j}$
Ffix	5 [3]	F_{fix}	.
Qskin	5 [3]	Q_{skin}	.
Qsubst	5 [3]	Q_{active}	.

Table 22.2 Pick-list for the quantity of active ingredient applied per kg of drained skin Qsubst (kg.kg^{-1})

This report	Original report No. 5 table 1	USES 3.0
Qsubst	Q_{active}	.

Table 22.3 Emission scenario for calculating the releases of biocides used in the embalming process

This report	Original report No. 5 table 4	USES 3.0
$Cform_{arterial}$	$C_{arterial}$	.
$Cform_{cavity}$	C_{cavity}	.
$Elocal_{3,water}$	$Elocal_{3,water}$	$Elocal_{i,j}$
$Fret_{arterial}$	$F_{ret,arterial}$	.
$Fret_{cavity}$	$F_{ret,cavity}$	.
RHOform	$RHO_{solution}$	.
$Vform_{arterial}$	$Q_{arterial}$	.
$Vform_{cavity}$	Q_{cavity}	.

Table 22.4 Pick-list for amounts of biocide solution used for one embalming, $Vform_{arterial}$ and $Vform_{cavity}$ (-), and fixation fraction according to the type of preservation, $Fret_{arterial}$ and $Fret_{cavity}$ (-)

This report	Original report No. 5 table 2	USES 3.0
$Fret_{arterial}$	$F_{ret,arterial}$	.
$Fret_{cavity}$	$F_{ret,cavity}$	.
$Vform_{arterial}$	$Q_{arterial}$	.
$Vform_{cavity}$	Q_{cavity}	.

Table 22.5 Emission scenario for calculating the releases in cemeteries

This report	Original report No.5 table 5	USES 3.0	
$Cform_{arterial}$	$C_{arterial}$	.	
$Cform_{cavity}$	C_{cavity}	.	
$Cporew\_av_{cem}$	$Ccemetery_{porew}$	C_{porew}	
$Csoil\_av_{cem}$	$Ccemetery_{soil}$	.	
$DEPTHmix_{cem\_soil}$	$DEPTH_{soil}$	$DEPTH_{soil}$	
$Elocal_{3,soil}$	$Ecemetery_{soil}$	.	
Freact	F_{body}	.	
$Fret_{arterial}$	$F_{ret,arterial}$	.	
$Fret_{cavity}$	$F_{ret,cavity}$	.	
$krem_{soil}$	k	.	
$K_{soil-water}$	$K_{soil-water}$	$K_{soil-water}$	
LENGTHcem	$LENGTH_{cem}$	.	
Ncorpse	N_{corpse}	.	corpses
RHOform	$RHO_{solution}$	.	
RHOsoil	RHO_{soil}	RHO_{soil}	
$Vform_{arterial}$	$Q_{arterial}$	.	
$Vform_{cavity}$	Q_{cavity}	.	
WIDTHcem	$WIDTH_{cem}$	.	

Product-type 23: Control of other vertebrates

Chapter 24: Waste module (landfill model)

Table 24.1 *Sanitary landfill model*

This report	Original report No. 9 table 4.1	USES 3.0
AREAlandf	AREAlandf	.
$Csubst\_landf_0$	$C_{subst\text{-}Lwaste\ 0}$	.
$Csubst\_landf_i$	$C_{subst\text{-}Lwaste\ i}$	.
$Corg_{landf}$	Corg	.
$Csubst\_gas_i$	$C_{subst\text{-}volat\ i}$	.
$Csubst\_perc_i$	$C_{subst\text{-}perc\ i}$	.
DEPTHwaste	DEPTHwaste	.
$Fgas_{formation}$	Fform	.
$Fleach_{subsoil}$	F_{subst}	.
Fvolat	F_{volair}	.
$K_{air\text{-}water}$	$K_{air\text{-}water}$	$K_{air\text{-}water}$
$kasl_{air}$	$kasl_{air}$	$kasl_{air}$
$kasl_{soil\text{-}air}$	$kasl_{soil\text{-}air}$	$kasl_{soilair}$
$kasl_{soil\text{-}water}$	$kasl_{soil\text{-}water}$	$kasl_{soilwater}$
$kdeg_{waste\_orgC}$	$kdeg_{waste}$	.
$kdeg_{waste\_subst}$	$kdeg_{subst}$	.
$kleach_{bare}$	$kbar_{leach\ waste}$	.
$kleach_{veg}$	$kveg_{leach\ waste}$	.
$kleach_{final}$	$kfin_{leach\ waste}$	.
$krem_{bare}$	$k_{removal\ 1}$	.
$krem_{veg}$	$k_{removal\ 2}$	.
$krem_{final}$	$k_{removal\ 3}$	.
$kvolat_{waste}$	$k_{volat\ waste}$	.
$K_{soil\text{-}water}$	$K_{soil\text{-}water}$	$K_{soil\text{-}water}$
$Qleach\_landf_i$	$Q_{subst\text{-}leach\ i}$	.
$Qleach\_sec_i$	$Q_{subst\text{-}leachtot\ i}$	.
$Qrem\_sec_i$	$Q_{removed\ i}$	.
$Qsubst\_air_i$	$Q_{subst\text{-}air\ i}$	.
$Qsubst\_soil_i$	$Q_{subst\text{-}soil\ i}$	.
$Qsubst\_STP_i$	$Q_{subst\text{-}STP\ i}$	.
$Qvolat\_landf_i$	$Q_{subst\text{-}volat\ i}$	.
$Qvolat\_sec_i$	$Q_{subst\text{-}volattot\ i}$	.
$Qwaste_{landf}$	Massw	.
RAINRATE	RAINRATE	RAINRATE

Table 24.1 *Sanitary landfill model (continued)*

This report	Original report No. 9 table 4.1	USES 3.0
RHOwaste	RHOwaste	.
Tfinal_top	.	.
Tutil	Tutil	.
$Vgas_{orgC}$	$Q_{gas\ orgC}$	.
$Vgas\_landf_i$	$Q_{gas\ i}$	.
Vlandf	Vlandf	.
$Vwater\_percol_i$	$Q_{percol\ i}$	.
$Vwater_{dump}$	$Q_{water\text{-}dump}$	.
$Vwater_{final}$	$Q_{water\text{-}final}$	.
$Vwater_{open}$	$Q_{water\text{-}open}$	.
$Vwater_{produced}$	$Q_{water\text{-}prod}$	.
$Vwater_{veg}$	$Q_{water\text{-}veg}$	.
WS_{bare}	WS_{bar}	.
WS_{veg}	$WS_{top\text{-}veg}$	.
WS_{final}	$WS_{top\text{-}final}$	.

Table 24.2 Model for calculating the concentration of biocides in waste landfilled and incinerated

This report	Original report No. 9 section 7.3	USES 3.0	remark
$Fdiff_i$	F_{diff}	.	
$Fincin_i$	$F_{incineri}$	.	not used
$Flandf_i$	$F_{landfill}$	.	
$Flandf_{total}$	F_{twl}	.	
$Fpenetr_i$	F_{penetr}	.	
$Fpres\_prod_i$	$F_{prodpres}$	.	
$Fsubst\_prod_i$	$F_{subst\text{-}prodi}$	.	
$Qreg\_prod_i$	$Qreg_{prodi}$	.	
Qwaste_reg	$Qreg_{waste}$	.	

Appendix 11 List of original reports

1 Luttik, R., H.J.B. Emans, P. v.d. Poel and J.B.H.J. Linders (1993)
EVALUATION SYSTEM FOR PESTICIDES (ESPE), 2. Non-agricultural pesticides; to be incorporated into the Uniform System for the Evaluation of Substances (USES)
RIVM report no. 679102021, Bilthoven, the Netherlands

2 Luttik, R., P. v.d. Poel and M.A.G.T. van den Hoop (1995)
Supplement to the methodology for risk evaluation of non-agricultural pesticides (ESPE) 2., incorporated in the Uniform System for the Evaluation of Substances (USES)
RIVM report no. 679102028, Bilthoven, the Netherlands

3 Montfoort, J.A., P. van der Poel and R. Luttik (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, Bilthoven, the Netherlands

4 Tissier, Chr. and V. Migné (2001a)
Supplement to the methodology for risk evaluation of biocides. Emission scenario document for biocides used in paper coating and finishing (Product type 6, 7 & 9)
INERIS report INERIS-DRC-01-25582-ECOT-CTi/VMi-n°01DR0183, Verneuil-en-Halatte, France

5 Tissier, Chr. and V. Migné (2001b)
Supplement to the methodology for risk evaluation of biocides. Emission scenario document for biocides used in taxidermy and embalming processes (Product type 22)
INERIS report INERIS-DRC-01-25582-ECOT-CTi/VMi-n°01DR0175, Verneuil-en-Halatte, France

6 Tissier, Chr. and M. Chesnais (2001)
Supplement to the methodology for risk evaluation of biocides. Emission scenario document for biocides used as preservatives in the leather industry (Product type 9)
INERIS report INERIS-DRC-01-25582-ECOT-CTi-n°01DR0165, Verneuil-en-Halatte, France

7 Tissier, Chr., M. Chesnais, V. Migné (2001)
Supplement to the methodology for risk evaluation of biocides. Emission scenario document for biocides used as preservatives in the textile industry (Product type 9 & 18)
INERIS report INERIS-DRC-01-25582-ECOT-CTi/VMi-n°01DR0176, Verneuil-en-Halatte, France

8 Van der Poel, P. (1999a)
Supplement to the methodology for risk evaluation of biocides (I) Emission scenarios to be incorporated into the Uniform System for the Evaluation of Substances (USES)
RIVM report no. 601450002, Bilthoven, the Netherlands

9 Van der Poel, P. (1999b)
Supplement to the Uniform System for the Evaluation of Substances (USES). Emission scenarios for waste treatment (elaborated for biocides)
RIVM report no. 601450003, Bilthoven, the Netherlands

10 Van der Poel, P. (2001) (IN PRINT)
Supplement to the methodology for risk evaluation of biocides. Emission Scenarios Document for Product Type 2: Private and public health area disinfectants and other biocidal products (sanitary and medical sector)
RIVM report no. 601450008, Bilthoven, the Netherlands

11 Van der Poel, P. (2001)
Emission scenario document for biocides: Product type 18 "Insecticides" (animal housings and manure storage systems)
RIVM report no. 601450011, Bilthoven, the Netherlands (DRAFT)

12 Van der Poel, P. and H. Braunschweiler (2001)
Supplement to the methodology for risk evaluation. Emission scenario document for product type 12 "Slimicides"
RIVM report no. 601450009, Bilthoven, the Netherlands (DRAFT)

List of abbreviations and acronyms

CEFIC	Conseil Européen des Fédérations de l'Industrie Chimique European Chemical Industry Foundation (European Council of Chemical Manufacturers' Federations)
CSHPF	Conseil supérieur d'hygiène publique de France
D	Default value (used in the tables presenting emission scenarios)
DEPA	Danish Environmental Protection Agency
EC	European Commission
EU	European Union
EUBEES	EU working group supervising the project 'Gathering, review and development of environmental emission scenarios for biocides'
EUSES	European Union System for the Evaluation of Substances
FEI	Finnish Environmental Insitute
HPVC	High Production Volume Chemical
O	Output (output of previous calculation in USES)
OECD	Organisation for Economic Co-operation and Development
P	Pick-list
PEC	Predicted Environmental Concentration
PIEC	Predicted Initial Environmental Concentration
RIVM	Rijks Instituut voor Volksgezondheid en Milieu (National Institute for Public Health and the Environment)
RTI	Relative Toxicity Index
S	Set value (set by the user of an emission scenario; used in the tables presenting emission scenarios)
STP	Sewage Treatment Plant
TGD	Technical Guidance Document
USES	Uniform System for the Evaluation of Substances
VROM	Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (Ministry of Housing, Spatial Planning and the Environment)
WWF	World Wildlife Fund