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RIVM report 601450 007

Supplement to the methodology for risk evaluation

Proposal for the formats of names, parameters, variables, units and symbols to be used in emission scenario documents

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This report has been developed in the context of the EU project entitled "Gathering, review and development of environmental emission scenarios for biocides" (EUBEES).
The contents have been discussed and agreed by the EUBEES working group, consisting of representatives of some Member States, CEFIC and Commission. The Commissions financial support of the project is gratefully acknowledged (Grant SUBV 99/134534).

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Samenvatting

Dit rapport bevat een voorstel om tot een uniforme manier van naamgeving en het gebruik van symbolen te komen, die aansluit bij de lijsten met symbolen van EUSES en USES (Appendix II van EUSES en USES) en is een product van de EU werkgroep voor het verzamelen, beoordelen en ontwikkelen van emissie scenario's voor biociden (EUBEES). Door toepassing van dezelfde manier van naamgeving en symbolen wordt de leesbaarheid en vergelijkbaarheid van emissie scenario documenten verbeterd en zal implementatie in EUSES en USES vergemakkelijkt worden. Derhalve is het wenselijk dat in nieuwe emissie scenario documenten reeds bestaande symbolen voor dezelfde parameters en variabelen gebruikt worden, terwijl voor nieuwe parameters wordt aangesloten bij de werkwijze van EUSES en USES, zoals aangegeven in dit rapport.
De verschillende typen parameters die gebruikt worden op het vlak van blootstelling en veelvuldig in emissie scenario documenten voorkomen, zijn in hoofdgroepen gerangschikt. Per hoofdgroep wordt een korte beschrijving gegeven van de voorkomende naamgeving in EUSES (European Union System for the Evaluation of Substances), USES (Uniform System for the Evaluation of Substances) en reeds uitgebrachte RIVM documenten met emissie scenario's, de gebruikte symbolen en eenheden. Aan de hand hiervan kan op uniforme wijze naamgeving voor en toekenning van symbolen aan nieuwe parameters in toekomstige (en in de te herziene) emissie scenario documenten worden gerealiseerd.

Summary

This report is produced in the framework of EUBEES (EU working group on Gathering, Review and Development of Environmental Emission Scenarios for Biocides). It contains a proposal that is aimed at obtaining a uniform definition of symbols, in order to make emission scenario documents (ESDs) better readable and comparable. It fits in with the lists of symbols as present in EUSES and USES (in both cases Appendix II). Furthermore, the implementation in EUSES will become easier. In the European Union System for the Evaluation of Substances (EUSES) and the Dutch Uniform System for the Evaluation of Substances (USES) hundreds of symbols are used for all parameters and variables. In the ESDs (Emission Scenario Documents) that have been developed in the European Union so far, also many parameters and variables occur. These parameters and variables are often specific for one scenario, while others occur in EUSES, USES or other ESDs. The symbols used in the ESDs differ in many cases from document to document. Therefore, it is desirable that new ESDs should use the variable names and units already existing. For new parameters the same formats should be used as described in this report. The parameters have been divided in several types which are treated in separate chapters.

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Inleiding

Dit rapport bevat een voorstel om tot een uniforme manier van naamgeving en het gebruik van symbolen te komen, die aansluit bij de lijsten met symbolen van EUSES en USES (Appendix II van EUSES en USES) en is een product van de EU werkgroep voor het verzamelen, beoordelen en ontwikkelen van emissie scenario's voor biociden (EUBEES). In EUSES (European Union System for the Evaluation of Substances) en USES (Uniform System for the Evaluation of Substances) worden honderden symbolen gebruikt voor alle parameters en variabelen die gebruikt worden. In de emissie scenario documenten die tot nu toe ontwikkeld zijn binnen de Europese Unie komen eveneens veel parameters en variabelen voor. Sommige zijn nieuw, andere komen reeds voor in EUSES, USES of andere emissie scenario documenten. De symbolen die voor deze parameters gebruikt worden verschillen van document tot document. Door toepassing van dezelfde manier van naamgeving en symbolen wordt de leesbaarheid en vergelijkbaarheid van emissie scenario documenten verbeterd en zal implementatie in EUSES en USES vergemakkelijkt worden. Derhalve is het wenselijk dat in nieuwe emissie scenario documenten reeds bestaande symbolen voor dezelfde parameters en variabelen gebruikt worden, terwijl voor niewe parameters wordt aangesloten bij de werkwijze van EUSES en USES, zoals aangegeven in dit rapport.
Het rapport begint met een hoofdstuk over enkele algemene aspecten. Vervolgens worden de verschillende typen parameters en variabelen in afzonderlijke hoofdtukken behandeld en voorbeelden gepresenteerd:

Hoofdstuk	Type parameters en variabelen
1	Algemene aspecten
2	Fysisch-chemische eigenschappen en verwante zaken
3	Verdelingscoëfficienten
4	Constanten voor omzettingssnelheid
5	Massa-overdrachtscoefficiënten
6	Halfwaardetijden
7	Dimensies
8	Hoeveelheden en doseringen
9	Emissies
10	Fracties en percentages
11	Aantallen en tijd gerelateerde variabelen
12	Voorspelde milieuconcentraties (PECs)
13	Verdunning, snelheid, stromen en fluxen

In de hoofdstukken 2 tot en met 13 worden voorbeelden gegeven in tabellen samen met een korte beschrijving. In de kolom "Used in" wordt de herkomst aangegeven. Dit kan zijn EUSES, USES of Ref.# (Ref.# geeft het nummer van de referentie aan die in het hoofdstuk "References" vermeld staat). In de tabellen worden de eenheden aangegeven zoals die intern door de computerprogramma's van EUSES en USES gebruikt worden (kolom: Units internal) en de eenheden zoals die op het beeldscherm verschijnen (kolom: On-screen units). De

eenheden van het beeldscherm zijn de standaardeenheden voor in- en uitvoer voor het beeldscherm (EUSES en USES bieden de gebruiker de gelegenheid te kiezen uit verschillende logische eenheden voor bepaalde parameters, indien mogelijk). Intern worden alle parameters naar SI-eenheden omgezet. Er wordt op gewezen dat voor liter de kleine letter "l" gebruikt wordt en niet de hoofdletter "L", zoals steeds meer in zwang komt. Indien gerefereerd wordt aan een ESD (emissie scenario document) dat nog niet in EUSES of USES ge-implementeerd is, staat in de kolom "On-screen units"een punt (.).

Derhalve wordt dus geadviseerd voor nieuwe parameters dezelfde "vaste namen" (fixed names) te gebruiken, zie ook hoofdstuk 1, en op uniforme wijze symbolen toe te kennen. Tot slot dient opgemerkt te worden dat vrijwel uitsluitend parameters van belang voor de blootstelling behandeld worden en dat de tabellen niet uitputtend zijn, doch een aantal voorbeelden bevatten. Doel is immers harmonisatie van systematiek.

Introduction

This report is produced in the framework of EUBEES (EU working group on Gathering, Review and Development of Environmental Emission Scenarios for Biocides). It contains a proposal that is aimed at obtaining a uniform definition of symbols, in order to make emission scenario documents (ESDs) better readable and comparable. It fits in with the lists of symbols as present in EUSES and USES (in both cases Appendix II). Furthermore, the implementation in EUSES will become easier. In the European Union System for the Evaluation of Substances (EUSES) and the Dutch Uniform System for the Evaluation of Substances (USES) hundreds of symbols are used for all parameters and variables. In the ESDs (Emission Scenario Documents) that have been developed in the European Union so far, also many parameters and variables occur. These parameters and variables are often specific for one scenario, while others occur in EUSES, USES or other ESDs. The symbols used in the ESDs differ in many cases from document to document. Therefore, it is desirable that new ESDs should use the variable names and units already existing. For new parameters the same formats should be used as described in this report.

The report consists of a chapter on the general aspects and chapters for specific types of parameters and variables:

Chapter	Subject
1.	General aspects
2.	Physico-chemical properties and allied items
3.	Partition coefficients
4.	Rate constants
5.	Mass transfer coefficients
6.	Half-life times
7.	Dimensions
8.	Quantities, doses and amounts (by weight)
9.	Releases and emissions
10.	Fractions and percentages
11.	Numbers and time related variables
12.	Predicted Environmental Concentrations
13.	Dilution, speed, flows and fluxes

In chapters 2 through 13 tables with examples are given for symbols together with a short explanation. In the column “Used in” the origin where they are specified is given. This may be EUSES, USES or Ref. # (where # specifies the number of the reference in the Chapter References). In the tables the units used internally in the computer program (column: Units internal) and the units as used on the monitor (column: On-screen units) are given also. The on-screen units are the standard units used for input and output to screen (EUSES and USES allow the user to choose between different logical units for several parameters, if appropriate). Internally, all parameters are converted to SI units. It should be noted that for litres the small

letter “l” is used and not the capital “L”. In the cases where a reference is given to an ESDs which is not incorporated in EUSES or USES a dot (.) is placed in the column "On-screen units".

So, new parameters should be formatted in the same way and preferably use the same “fixed names” (see also Chapter 1: General aspects). It should be noted that only symbols used for parameters for exposure are treated, but not for effects. Furthermore, the tables do not comprise all parameters used so far; just relevant examples are presented.

In every section a proposal for symbols to be used is given with a short explanation, the unit used internally in EUSES or USES and eventually the unit to be used in the emission scenario document.

1 General aspects

Symbols used for parameters and variables should be self-explanatory as far as possible. Frequently occurring parameters like concentrations and densities have to be described by a standard term, where needed with a "specification" for further clarification of the parameter name and/or "subscripts" (indicated as *subs* in the remainder of this document). Fixed parameter names are presented in capitals and a specification is added directly to the name in lower case and *subs* are directly added in subscript. However, there is an exception for the fixed name for rate constants and mass transfer coefficients; these have a small “k” instead of the capital “K” as this name has been reserved for partition coefficients.
Thus, the general appearance may be presented as:

$$\text{FIXED-NAME}\,\text{specification}_{sub1,sub2}$$

Below, two examples have been worked out to give an idea for the parameters concentration and density:

Symbol	Explanation
C	(Fixed parameter name for concentration)
Cstp	Concentration in sewage treatment plant (unclear in which compartment)
$Cstp_{air}$	Concentration in the air at sewage treatment plant
RHO	(Fixed parameter name for density)
RHOsolids	Density of solids

Specifications occurring regularly are "reg" for regional and "local".
Table 1 presents some frequently used subs applied in EUSES and USES, or occurring in RIVM reports on emission scenarios.

Table 1 Some common subscripts used in EUSES/USES and/or RIVM reports (including some suggestions for new subscripts)

related to compartments	
agric	agricultural soil
air	air
comp*i*	compartment *i*
drai	drainage water
drw	drinking water
grw	groundwater
ind	industrial [1]
indsoil	industrial soil [1]
nat	natural [2]
natsoil	natural soil [2]
porew	porewater
sed	sediment
soil	(equal for all soils/not specified)
substrate	substrate (e.g. soil)
surf	surface water
water	water (general, not specified)
related to streams	
effl	effluent from STP
infl	influent from STP
mat	material
sludge	STP sludge
related to systems	
aqua	aquatic ecosystem
terr	terrestrial ecosystem
related to exposure	
der	dermal
oral	oral
inh	inhalatory
related to chemicals & formulations	
ai	active ingredient
bioc	biocide
chem	chemical
disinf	disinfectant
disinf*i*	disinfectant in process *i*
form	formulation
ins	insecticide
pres	preservative
prod	product
subst	substance
life cycle	
form	formulation
proc	processing
priv	private use
prod	product
rec	recycling
serv	service life [3]
waste	waste treatment [4]
various	
ass_{aer}	aerosol-bound (associated with aerosol)
biodeg	through biodegradation [5]
cont	continental
deg	degradation (general)
diss	dissolved
gas	gaseous
max	apparent maximum
oc	organic carbon
om	organic matter
ow	octanol-water (in Kow)
p	solid-water (in Kp)
phot	through photodegradation
plant	plant (crops and grass)
pred	predators
reg	regional
solid	solids
ssurf	at the soil surface
std	standard
STP	sewage treatment plant
susp	suspended solids
tot	total (broad, wherever applicable)
volat	through volatilisation [6]

[1] This is a deviation from EUSES/USES, where ind = industrial soil
[2] This is a deviation from EUSES/USES, where nat = natural soil
[3] This is the life cycle stage that is not considered yet in EUSES for the use of treated articles (see also Chapter 9)
[4] This is the life cycle stage that is not considered yet in EUSES for the treatment of waste containing treated articles (see also Chapter 9)
[5] This is a deviation from EUSES/USES, where bio = through biodegradation
[6] This is a deviation from EUSES/USES, where vol = through volatilisation

2 Physico-chemical properties and allied items

The fixed names used for the various parameters are presented in table 2.1.

Table 2.1 Physico-chemical parameters with a fixed name

Symbol	Explanation	Units internal	On-screen units	Used in	
MOLW	Molecular weight	$kg.mol^{-1}$	$kg.mol^{-1}$	EUSES	
SOL	Water solubility	$kg.m^{-3}$	$kg.m^{-3}$	EUSES	
VP	Vapour pressure	Pa	Pa	EUSES	
TEMP	Temperature				1)
R	Gas constant	$Pa.m^3.mol^{-1}.K^{-1}$	$Pa.m^3.mol^{-1}.K^{-1}$	EUSES	
HENRY	Henry's law constant	$Pa.m^3.mol^{-1}$	$Pa.m^3.mol^{-1}$	EUSES	2)

1) Not used as such, but in combination with specification (e.g. to denote boiling point, see also Table 2.2).
2) For the non-dimensional Henry's Law constant see Chapter 3.

Often, some of the fixed names are used with a specification (type: **FIXED-NAMEspecification**) or subscript to denote a specific property. Some examples are presented in table 2.2.

Table 2.2 Physico-chemical parameters with a fixed name

Symbol	Explanation	Units internal	On-screen units	Used in
Type: FIXED-NAMEspecification				
Kow	Octanol-water partition coefficient	-	-	EUSES
RHOwater	Density of water phase	$kg.m^{-3}$	$kg.l^{-1}$	EUSES
RHOwaste	Density of waste	$kg.m^{-3}$	.	Ref. 5
TEMPboil	Boiling point	K	K	EUSES
TEMPmelt	Melting point	K	K	EUSES
Type: FIXED-NAME$_{sub}$				
RHO	**Density (Fixed parameter name), Examples:**			
$K_{air\text{-}water}$	non-dimensional Henry's law constant (air-water partition coefficient)	-		EUSES
RHO_{form}	Density of formulation	$kg.m^{-3}$	$kg.l^{-1}$	Ref. 1 & 6
VP_L	Sub-cooled liquid vapour pressure	Pa	Pa	EUSES

Note: For the density (fixed name = RHO) both the types FIXED-NAMEspecification and FIXED-NAME$_{sub}$ occur.

3 Partition coefficients

Partition coefficients have the fixed name "K" and occur in three forms. Some examples are presented in Table 3.1

Table 3.1 Examples of symbols for partition coefficients

Symbol	Explanation	Units internal	On-screen units	Used in
Type: Kspecification				
Koc	Organic carbon-water partition coefficient	$m^3.kg^{-1}$	$l.kg^{-1}$	EUSES
Kom	Organic matter-water partition coefficient	$m^3.kg^{-1}$	$l.kg^{-1}$	USES
Kow	Octanol-water partition coefficient	-	-	EUSES
Type: K_{sub}				
$K_{air-water}$	Air-water partition coefficient	$m^{-3}.m^{-3}$	$m^{-3}.m^{-3}$	EUSES
$K_{soil-water}$	Soil-water partition coefficient	$m^{-3}.m^{-3}$	$m^{-3}.m^{-3}$	EUSES
Type: $Kspecification_{sub}$				
Kp_{susp}	Solids-water partition coefficient in suspended matter	$m^3.kg^{-1}$	$l.kg^{-1}$	EUSES

4 Rate constants

Rate constants have the fixed name “k” (lower case!) and may have several forms. The first form for process "proc*p*" and compartment *i*" looks like:

$$kproc p_{comp i}$$

The other form for process "proc*p*" and compartment *i*" looks like:

$$k_{proc p\ i}$$

Other forms with (one or) two subscripts are:

$$k_{sub}$$

$$K_{sub1,sub2}$$

$$kprocp_{sub1,sub2}$$

Some examples are presented in Table 4.1.

Table 4.1 Examples of symbols for partition coefficients

Symbol	Explanation	Units internal	On-screen units	Used in
Type: kprocp_{compi}				
$kdeg_{air}$	Rate constant for degradation in air	d^{-1}	d^{-1}	EUSES
$kdeg_{soil}$	Total rate constant for degradation in bulk soil	d^{-1}	d^{-1}	EUSES
$kdeg_{water}$	Total rate constant for biodegradation in surface water	d^{-1}	d^{-1}	EUSES
$khydr_{water}$	Rate constant for hydrolysis in water	d^{-1}	d^{-1}	EUSES
$khydr_{acid}$	Rate constant for hydrolysis in water at acid conditions (pH 5)	d^{-1}	d^{-1}	Ref. 7
$khydr_{alkal}$	Rate constant for hydrolysis in water at alkaline conditions (pH 8)	d^{-1}	d^{-1}	Ref. 7
$kphoto_{water}$	Rate constant for photolysis in water	d^{-1}	d^{-1}	EUSES
Type: $k_{procp\ i}$				
$k_{volat\ i}$	Rate constant for volatilisation from comp i	d^{-1}	d^{-1}	EUSES
$k_{leach\ i}$	Rate constant for leaching from comp i	d^{-1}	d^{-1}	EUSES
Type: k_{sub}				
k_l	liquid-phase exchange coefficient	.	.	Ref. 4
k_g	gas-phase exchange coefficient	.	.	Ref. 4
Type: $k_{sub1,sub2}$				
$k_{volat,temp}$	Temperature dependent first order rate constant for volatilisation in ditch	d^{-1}	d^{-1}	USES
Type: kproc$p_{sub1,sub2}$				
$kdeg_{water,temp}$	Temperature dependent rate constant for degradation in water	d^{-1}	d^{-1}	USES

5 Mass transfer coefficients

Mass transfer coefficients also have the fixed name “k” (lower case!) and have the form kspecification$_{sub}$. Some examples are presented in Table 5.1.

Table 5.1 Examples of symbols for mass transfer coefficients

Symbol	Explanation	Units internal	On-screen units	Used in
$kasl_{air}$	Air-film partial mass transfer coefficient (air-soil interface)	$m.d^{-1}$	$m.d^{-1}$	EUSES
kaw_{air}	Air-film partial mass transfer coefficient (air-water interface)	$m.d^{-1}$	$m.d^{-1}$	EUSES
kaw_{water}	Water-film partial mass transfer coefficient (air-water interface)	$m.d^{-1}$	$m.d^{-1}$	EUSES
$kasl_{soilair}$	Soil-air partial mass transfer coefficient (air-soil interface)	$m.d^{-1}$	$m.d^{-1}$	EUSES
$kasl_{soilwater}$	Soilwater-film partial mass transfer coefficient (air-soil interface)	$m.d^{-1}$	$m.d^{-1}$	EUSES
kws_{water}	Water-film partial mass transfer (coefficient sediment-water interface)	$m.d^{-1}$	$m.d^{-1}$	EUSES
kws_{sed}	Pore water partial mass transfer coefficient (sediment-water interface)	$m.d^{-1}$	$m.d^{-1}$	EUSES

6 Half-life times

Half-life times have the fixed name DT50 and have the following forms in EUSES and USES:

$DT50_{sub}$

$DT50_{sub1,sub2}$

$DT50specification_{sub}$

Some examples are presented in Table 6.1.

Table 6.1 Examples of symbols for half-life times

Symbol	Explanation	Units internal	On-screen units	Used in
Type: $DT50_{sub}$				
$DT50_{water}$	Half-life time for degradation in water (under test conditions)	d	d	USES
Type: $DT50_{sub1,sub2}$				
$DT50_{water,temp}$	Half-life time for degradation in water corrected for temperature	d	d	USES
Type: $DT50specification_{sub}$				
$DT50bio_{soil}$	Half-life for biodegradation in bulk soil	d	d	EUSES
$DT50bio_{water}$	Half-life for biodegradation in bulk surface water	d	d	EUSES
$DT50hydr_{water}$	Half-life for hydrolysis in water	d	d	EUSES
$DT50photo_{water}$	Half-life for photolysis in water			

7 Dimensions

The names are given as shown in examples in Table 7.1 for all dimensions occurring in EUSES/USES, and may have the forms:

Type	Dimensions
FIXED_NAMEspecification	Two and three
FIXED_NAMEspecification$_{sub}$	Two
FIXED_NAME$_{sub}$	One, two and three
FIXED_NAME$_{sub1,sub2}$	Two

Table 7.1 Examples of symbols for dimensions

Symbol	Explanation	Units internal	On-screen units	Used in
One dimensional				
$DEPTH_{wway}$	Waterway depth	m	m	USES
$DIAM_{pole}$	Diameter of poles	m	m	USES
$HEIGHT_{fence}$	Height of the fence	m	m	USES
$LENGTH_{fence}$	Length of the fence	m	m	USES
RAD_{soil}	Radius of soil area	m	m	USES
TH_{art}	Thickness of substance in article	m	m	EUSES
Two dimensional				
AREA	Area of system	m^2	km^2	EUSES
AREAlandf	Bottom surface of the landfill	m^2	.	Ref. 5
$AREAtreat_L$	Treated area of pavements in model town (Lelystad)	m^2	m^2	USES
$AREA_{swimw}$	Water surface of swimming pool	m^2	m^2	USES
$AREA_{der,worker}$	Area of contact between substance and skin	m^2	m^2	EUSES
Three dimensional				
Vlandf	Total volume of the landfill	m^3	.	Ref. 5
$V_{prod-uins}$	Volume of (undiluted) product to be used for a specified area of surface according to the user's instructions	ml	.	Ref. 4
Examples of names used so far in some ESDs (to be avoided in new emission scenario documents):[1)]				
$Q_{machine}$	Volume of solution in machine *(=quantity by volume)*	m^3	.	Ref. 4
$Q_{gas\ i}$	Total amount of gas produced for year i = 1...Tutil+5	$m^3.yr^{-1}$	.	Ref. 5

[1)] The fixed name "Q" should only be used for quantities by weight (see Chapter 8).

Note: In one case the fixed name is used, i.e. AREA for the parameter "Area of system" in EUSES.

8 Quantities, doses and amounts (by weight)

A large variety of names have been used already in EUSES/USES and RIVM reports. In Table 8.1 examples from the various sources are presented. The most used name is "Q" with one or two subscripts. Other names occurring are "DOSE", "APPL" and some others. This is confusing and it is proposed here to find a solution by looking at the subject of the quantity.

Quantities may be related to:

1. Water, air, gas, soil (type Q_{sub}).
2. Materials (or waste, products, etc.) treated or contaminated with biocides (type Q_{sub}).
3. Chemicals (type Q_{sub}).
4. Chemical present in water, gas, etc. (type $Q_{sub1,sub2}$).
5. Chemical present in materials (or streams of waste or products) (type $Q_{sub1,sub2}$).
6. Chemicals in a process (type $Q_{sub1,sub2}$).
7. Sometimes the quantity is related to a specific situation, as for example when the amount of a certain product - such as adhesives – has to be named for calculations at the stage of waste treatment (type $Qspecification_{sub1,sub2}$).
8. Quantities that are complex to name when several situations have to be addressed (type $Qspecification_{sub1,sub2}$).

The following naming is suggested for these 8 categories:

1. $\mathbf{Q_{sub}}$, with sub ϵ {water, wwat, drai, surf, soil}. It should be noted that the name for the calculated amount of waste water produced by the inhabitants is "WASTEW", and the amount of water coming from the STP "EFFLUENT".
2. $\mathbf{Q_{sub}}$ or $\mathbf{Q_{sub1,subs2}}$, where sub/sub1 can be wood treated with wood preservatives, manure from deep-pit housing for chickens, etc. Appropriate descriptive terms should be used (preferably short). So far, the naming as Q_{sub} has not been used. The other type is used instead, where sub2 ϵ {ai, bioc, subst}; other subscripts are also used, see example in table 8.1.
3. $\mathbf{Q_{sub}}$, with sub ϵ {ai, bioc, subst}; other subscripts may be defined if needed (e.g. ins for insecticide, disinf for disinfectant).
4. $\mathbf{Q_{sub1,subs2}}$, with sub1 ϵ {ai, bioc, subst} and sub2 ϵ {water, wwat, drai, surf, soil} (see bullets 3 and 1 respectively).
5. $\mathbf{Q_{sub1,subs2}}$, with sub1 ϵ {ai, bioc, subst} and sub2 as described at bullet 2.
6. $\mathbf{Q_{sub1,subs2}}$, with sub1 ϵ {ai, bioc, subst} **or** where sub depicts the material/product and where proc*p* stands for the process where the quantity is related to; this process may be disinfection of hospital equipment or the impregnation of wood.
   It should be noted that in the case that this concerns the quantity of a substance (biocide) released from a certain process, the name "E" is used instead of "Q" (see Chapter 9 "Releases & emissions").
7. $\mathbf{Qspecification_{sub1,subs2}}$, where the specification may be "reg" or "local". In Table 8.1 some examples are presented.
8. $\mathbf{Qspecification_{sub1,subs2}}$, e.g. the amount of an active ingredient present in a manure to be spread and where it has to be clear form what animal species and what housing type the manure is coming from. The specification then may be the same as normally for a subscript, in this case "ai", see the examples in table 8.1.

In USES for pesticides in four cases the fixed name "DOSE" is applied and in EUSES three times in the locally defined symbols in indirect exposure sub-module and one time in the global variables for indirect human exposure. So far, it has only be used in the additional module for the calculation of the dose of active ingredient used as a slimicide in paper

production depending on the data present in the user's instructions (Ref. 7). It may be used in other modules with the same problem, and has the format **DOSE$_{sub}$**, where the subscript will be ai or bioc (other possibilities may be disinf, ins and pres).

Table 8.1 Examples of symbols for quantities, doses and amounts

Symbol	Explanation	Units internal	On-screen units	Used in
Type Q_{sub} - Bullet 1				
Q_{repl}	Water volume replaced per visitor	m^{-3}	m^{-3}	USES
$Q_{machine}$	Volume of solution in machine	m^3	.	Ref. 4
Specific parameters:				
$EFFLUENT_{stp}$	Effluent discharge rate of STP	$m^{-3}.d^{-1}$	$m^{-3}.d^{-1}$	EUSES
WASTEW	Wastewater produced by inhabitants system	$m^{-3}.d^{-1}$	$m^{-3}.d^{-1}$	EUSES
1 Type Q_{sub} - Bullet 2				
not used so far				
2 Type Q_{sub} - Bullet 3				
Q_{disinf}	Amount of active substance	$kg.yr^{-1}$	.	Ref. 4
Q_{creos}	Quantity of creosote per m^3 of wood	$kg.m^{-3}$	$kg.m^{-3}$	USES
3 Type $Q_{sub1,sub2}$ - Bullet 2				
$Q_{mater,creosote}$	Quantity of wood impregnated with creosote per day	$m^3.d^{-1}$	$m^3.d^{-1}$	USES
4 Type $Q_{sub1,sub2}$ - Bullet 4				
not used so far				
5 Type $Q_{sub1,sub2}$ - Bullet 5				
$Q_{ai,text}$	Quantity of active ingredient per kg material (textile)	$kg.kg^{-1}$	$kg.kg^{-1}$	USES
6 Type $Q_{sub1,sub2}$ - Bullet 6				
$Q_{mater,text}$	Quantity of material treated (impregnated) per day	$kg.d^{-1}$	$kg.kg^{-1}$	USES
7 Type $Qspecification_{sub1,sub2}$ - Bullet 7				
$Qreg_{prodi}$	Quantity of product i in the region	$ktonne.yr^{-1}$	.	Ref. 5
8 Type $Qspecification_{sub1,sub2}$ - Bullet 8				
Qai_{m,cat_subcat}	Amount of active ingredient present in stream *m* at spreading (manure from a certain type of housing for an animal species sub-category, e.g. broilers)	kg	.	Ref. 6

9 Releases and emissions

The environmental releases ("emissions") for the regional and continental scales in EUSES and USES have the fixed name RELEASE together with a specification and two subscripts:

$$\text{RELEASEspecification}_{\text{sub1,sub2}},$$

with: **specification** is reg or cont
sub1 is $i \in$ {prod, form, proc, priv, rec}
sub2 is $j \in$ {air, water, ind, surf, agric}

Ad sub1:
The subscript *i* refers to the stage of the life cycle and has the following values and meanings:

i	Life cycle stage
1	Production
2	Formulation
3	Processing (= industrial application/use)
4	Private use
5	Recycling

It should be noted that a revision of the naming and numbering would be favourable. Stage 3 "Processing" should be "Industrial application" or "Industrial use". Stage 5 should be reserved for the stage that has not been considered in EUSES so far, i.e. the service life. Service life is the average period that articles treated with a substance are in service. Another stage that has to be added is waste treatment. For this stage a first report has been produced (Ref. 5).

Ad sub2:
The subscript *j* refers to the receiving compartment:

j	Compartment
1	Air
2	Wastewater
3	Industrial soil
4	Surface water
5	Agricultural soil

Table 9.1 presents the two symbols used in (E)USES for releases

Table 9.1 Examples of symbols for quantities, doses and amounts

Symbol	Explanation	Units internal	On-screen units	Used in
$\text{RELEASEcont}_{i,j}$	Continental release during life cycle stage *i* to compartment *j*	$kg.d^{-1}$	$kg.d^{-1}$	(E)USES
$\text{RELEASEreg}_{i,j}$	Regional release during life cycle stage *i* to compartment *j*	$kg.d^{-1}$	$kg.d^{-1}$	(E)USES

The emissions also have the fixed name “E” and are of the following types:

1 E_{sub}
2 $E_{sub1,sub2}$
3 $Especification_{sub}$
4 $Especification_{sub1,sub2}$

In Table 9.2 some examples are given.

Table 9.2 Examples of symbols for emissions

Symbol	Explanation	Units internal	On-screen units	Used in
1 Type E_{sub}				
$E_{washout}$	Quantity of active ingredient released from washout	$kg.d^{-1}$	$kg.d^{-1}$	USES
2 Type $E_{sub1,sub2}$				
$E_{localwaste\_water,processing}$	Effluent discharge to STP for paper plant	$kg.d^{-1}$	.	Ref. 6
3 Type $Especification_{sub}$				
$Ereg_j$	Total regional emission to compartment *j*	$kg.d^{-1}$	$kg.d^{-1}$	EUSES
4 Type $Especification_{sub}$				
$Elocal_{i,j}$	Local emission during episode to compartment *j* during stage *i*	$kg.d^{-1}$	$kg.d^{-1}$	EUSES
$Elocal_{3,water}$	Emission rate to waste water at stage 3 "processing"	$kg.d^{-1}$	.	Ref. 4

Note: The use of the subscripts for life cycle stage as *i* and for receiving compartment as *j* simplifies formulas. On the other hand, replacement in reports may give a direct indication of the situation. So, in the case of the fourth example - $Especification_{sub1,sub2}$ - assuming that the emission for the stage at processing to wastewater is considered for the local situation the following notations are valid:
$Elocal_{i,j}$ (general symbol)
$Elocal_{3,2}$
$Elocal_{proc,water}$
And even:
$Elocal_{proc,2}$
$Elocal_{2,water}$

10 Fractions, percentages and emission factors

In many cases parameters representing a multiplication factor in a formula can either be expressed as a fraction or as a percentage. An emission factor specifies how much of a substance is released to a certain compartment, the degree of fixation of e.g. a dye how much is fixed to the fibre, etc. A disadvantage of the use of a percentage is the fact that in formulas a division of the percentage by 100 has to be made. The fixed name is "F" and various types occur. Table 10.1 presents examples of fractions and percentages.

Table 10.1 Examples of symbols for fractions, percentages and emission factors

Symbol	Explanation	Units internal	On-screen units	Used in	
Type E_{sub}					
$E_{washout}$	Quantity of active ingredient released	$kg.d^{-1}$	$kg.d^{-1}$	USES	
$Fprodvol_{reg}$	Fraction of EU production volume for region	-	-	(E)USES	
$F_{i,j}$	Fraction of tonnage released during stage *i* to Compartment *j*	-	-	(E)USES	
$Fmainsource_{i}$	Fraction of the main source during life cycle stage *i*	-	-	(E)USES	
$Fmainsource_{disinf}$	Fraction of the main source	-	-	USES	1)
$Fwater_{soil}$	Volume fraction of water in soil	-	-	(E)USES	
Foc_{soil}	Weight fraction of organic carbon in soil	-	-	(E)USES	
$Fdisinf_{water}$	Fraction released to wastewater	-	-	USES	1)
F_{washw}	Fraction of a.i. transferred to wash water	-	-	(E)USES	2)
F_{depos}	Fraction of water lost due to spray and wind drift	-	-	(E)USES	3)
F_{suppl}	Fraction of fluid supplemented per day	d^{-1}	d^{-1}	USES	4)
F_{ret}	Fraction of retention in goods	-	-	USES	5)
F_{creos}	Fraction of substance in creosote	-	-	USES	6)
$F_{a,creos}$	Fraction released to air	-	-	USES	6)
F_{ship}	Fraction ships in water	-	-	USES	7)
F_{ww1}	Fraction of the total wastewater flow coming from the short circulation of the wire part	%	.	Ref. 7	

1) Scenario disinfectants in accommodations
2) Scenario biocides in the textile industry
3) Scenario biocides in process and cooling-water installations
4) Scenario preservatives in metal industry
5) Scenario products used for fogging
6) Scenario for creosote impregnation of wood
7) Scenario antifoulings

11 Numbers and time related variables

For numbers of articles, animals, events, applications, etc. the following type of naming should be used:

I N_{sub} ,

where *sub* can be anything, e.g. articles, animals, etc., **or**:

II $N_{sub1,sub2}$,

where *sub1* may be applications and *sub2* a description for the specific process.

For numbers with a time relation, e.g. the number of days with emissions, the following naming should be used:

III $Tspecification_{sub}$,

where *sub* represents a process or substance; the specification usually is "emission" and in one case is missing (see 1st example in Table 11.1).
Time/application intervals for biocides may be in the forms:

IV T_{sub}
V $T_{sub1,sub2}$,

where *sub* and *sub1* give a description like "interval" or "storage", and *sub2* describes a process or substance, see examples in Table 11.1).

Averaging times have the form:

VI T_{sub} ,

where *sub* stands for the compartment (e.g. soil, agric, etc.) (see Table 11.1).

So far, in one case - landfill sites – the period that the process giving are going on for a longer time (i.e. longer than one year), the following form is used:

VII Tspecification ,

which is presented in the table below.

Residence times are represented as:

VIII TAU_{sub} ,

where *sub* specifies the compartment (see Table 11.1).

Table 11.1 Examples of symbols for numbers and time related variables

Symbol	Explanation	Units internal	On-screen units	Used in
Numbers, Type I - N_{sub}				
N_{appl}	Number of applications in one year	-	-	USES
N_{visit}	Number of visitors per day (swimming - pool)	-	USES	
N_{pole}	Number of poles per meter (both sides)	m^{-1}	m^{-1}	USES
N_{ship}	Number of ships in yacht-basin	-	-	USES
Numbers, Type II - $N_{sub1,sub2}$				
$N_{appl,cooling}$	Number of applications in one year (in cooling water)	-	-	USES
$N_{appl,creos}$	Number of applications in one year for creosote impregnation	-	-	USES
Numbers – Time related, Type III - $Tspecification_{sub}$				
T_{rain}	Number of days with leaching	d	d	USES
$Temission_{disinf}$	Number of emission days for disinfectants used in accommodations	d	d	USES
$Temission_{paper}$	Number of emission days p. year for a paper plant	d	d	USES
$Temission_{pres}$	Number of emission days for preservative	d	d	USES
$Temission_{fogging}$	Number of emission days for fogging	d	d	USES
Intervals, Type IV - T_{sub}				
$T_{interval}$	Application interval	d	d	USES
$T_{contact}$	Duration of exposure or contact	d	d	USES
$T_{storage}$	Storage time stream *m*	d	.	Ref. 6
Intervals, Type V - $T_{sub1,sub2}$				
$T_{interval,cooling}$	Time period between two emission events (at cooling water installations)	d	d	USES
$T_{interval,drench}$	Application interval for drenching (wood preservation)	d	d	USES
Averaging times, Type VI - T_{sub}				
T_{soil}	Averaging time soil	d	d	USES
T_{agric}	Averaging time agricultural soil	d	d	USES
$T_{grassland}$	Averaging time grassland	d	d	USES
Long periods, TypeVII - Tspecification ,				
Tutil	Utilisation period	yr^{-1}	.	Ref. 5
Residence times, TypeVIII - TAU_{sub}				
TAU_{wway}	Residence time in waterway	d	d	USES
TAU_{air}	Residence time of air in system	d	d	EUSES
TAU_{water}	Residence time of water in system	d	d	EUSES

12 Concentrations

Predicted environmental concentrations have the fixed name "PEC" and are presented in one of the following ways:

$$\text{PECspecification}_{sub}$$
$$\text{PECspecification}_{sub1,sub2}\ ,$$

where *sub* and *sub1* describe the compartment concerned and *sub2* gives a further specification. The main predicted environmental concentrations are given in Table 12.1.

Table 12.1 Examples of predicted environmental concentrations

Symbol	Explanation	Units internal	On-screen units	Used in
$PECreg_{water}$	Regional PEC in surface water (dissolved)	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES
$PECreg_{air}$	Regional PEC in air (total)	$kg.m^{-3}$	$mg.m^{-3}$	(E)USES
$PECreg_{agric}$	Regional PEC in agricultural soil (total)	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES
$PECreg_{agric,porew}$	Regional PEC in pore water of agricultural soil	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES
$PECreg_{natural}$	Regional PEC in natural soil (total)	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES
$PECreg_{ind}$	Regional PEC in industrial soil (total)	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES
$PECreg_{sed}$	Regional PEC in sediment (total)	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES
$PEClocal_{air,ann}$	Annual average local PEC in air (total)	$kg.m^{-3}$	$mg.m^{-3}$	(E)USES
$PEClocal_{water}$	Local PEC in water during emission episode	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES
$PEClocal_{water,ann}$	Annual average local PEC in surface water (dissolved)	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES
$PEClocal_{sed}$	Local PEC in sediment during emission episode	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES
$PEClocal_{soil}$	Local PEC in agricultural soil (total), averaged over 30 days	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES
$PEClocal_{agric}$	Local PEC in agricultural soil (total), averaged over 180 days	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES
$PEClocal_{grassland}$	Local PEC in grassland (total), averaged over 180 days	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES
$PEClocal_{agric,porew}$	Local PEC in pore water of agricultural soil	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES
$PEClocal_{grassland,porew}$	Local PEC in pore water of grassland	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES
$PEClocal_{grw}$	Local PEC in groundwater under agricultural soil	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES

Local concentrations and other concentrations to be calculated have the fixed name "C" and are presented as several types. Some examples are presented in Table 12.2.

Table 12.2 Examples of various concentrations

Symbol	Explanation	Units internal	On-screen units	Used in	
Sewage treatment:					
$Clocal_{eff}$	Concentration of chemical (total) in the STP effluent	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES	
$Clocal_{inf}$	Concentration in untreated wastewater	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES	
C_{sludge}	Concentration in dry sewage sludge	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES	
Local environmental concentrations:					
$Clocal_{water}$	Local concentration in surface water during emission period	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES	
$Clocal_{water,ann}$	Annual average concentration in surface water	$kg.m^{-3}$	$mg.l^{-1}$	(E)USES	
$Clocal_{soil}$	Local concentration in agricultural soil averaged over 30 days	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES	
Parameters for local distribution:					
$Clocal_{soil}$	Average concentration in soil *i* over T days	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES	
Locally defined symbols in indirect exposure sub-module:					
C_{agric}	Total concentration in soil (wet weight)	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES	
C_{water}	Concentration in surface water (dissolved)	$kg.kg^{-1}$	$mg.kg^{-1}$	(E)USES	
Scenarios for biocides:					
C_{swimw}	Concentration in swimming water	$kg.m^{-3}$	$mg.l^{-1}$	USES	1)
C_{paper}	Concentration of a.i. in process water discharged	$kg.m^{-3}$	$mg.l^{-1}$	USES	2)
$C_{ai,cooling}$	Concentration of a.i. in cooling water	$kg.m^{-3}$	$mg.l^{-1}$	USES	3)

1) Scenario for disinfectants in swimming water, discharged to STP

2) Scenario for biocides in the paper and cardboard industry

Scenario for biocides in process and cooling-water installations

13 Dilution, speed, flows and fluxes

The parameters of this chapter have distinctive fixed names and sometimes a subscript is used. Table 13.1 presents various examples.

Table 13.1 Examples of dilutions, speed, flows and fluxes

Symbol	Explanation	Units internal	On-screen units	Used in
Dilution				
$DILUTION_{AS}$	Dilution factor for stagnant surface water	-	-	USES
$DILUTION_{ls}$	Dilution factor for large surface water with low flow	-	-	USES
$DILUTION_{ditch}$	Dilution factor ditch to surface water	-	-	USES
$DILUTION_{drai}$	Dilution factor for drainage water reaching the surface water	-	-	USES
$DILUTION_{public}$	Dilution factor of receiving surface water for public pools	-	-	USES
$DILUTION_{private}$	Dilution factor of receiving surface water for private pools	-	-	USES
$DILUTION_{paper}$	Dilution factor in receiving surface water for paper plant effluent	-	-	USES
$DILUTION_{cooling}$	Dilution factor in receiving surface water for cooling water installation	-	-	USES
DILUTION	Dilution factor	-	-	EUSES
Speed				
WINDSPEED	Wind speed in the system	$m.d^{-1}$	$m.s^{-1}$	EUSES
WINDSPEED	Air speed above liquid in machine	$m.s^{-1}$	.	Ref. 4
WATERSPEED	Liquid flow velocity in machine	$m.s^{-1}$	.	Ref. 4
Flows				
$FLOW_{water}$	Total water flow through system	$m^3.d^{-1}$	$m^3.d^{-1}$	EUSES
FLOW	Flow rate of the river	$m^3.d^{-1}$	$m^3.d^{-1}$	EUSES
Fluxes				
$FLUX_{avg}$	Mean flux of compound over a certain period	$kg.m^{-2}.d^{-1}$	$mg.m^{-2}.d^{-1}$	USES
$FLUX_{comp}$	Mean flux of compound	$kg.m^{-2}.d^{-1}$	$mg.m^{-2}.d^{-1}$	USES
$FLUX_{anti}$	Mean flux of compound	$kg.m^{-3}.d^{-1}$	$mg.m^{-3}.d^{-1}$	USES
$FLUX_{fence}$	Mean flux of compound over 1 year	$kg.m^{-2}.d^{-1}$	$mg.m^{-2}.d^{-1}$	USES

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