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ENVIRONMENT DIRECTORATE
JOINT MEETING OF THE CHEMICALS COMMITTEE AND
THE WORKING PARTY ON CHEMICALS, PESTICIDES AND BIOTECHNOLOGY

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OECD SERIES ON EMISSION SCENARIO DOCUMENTS
Number 2

Emission Scenario Document for Wood Preservatives
PART4

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Emission Scenario Document for Wood Preservatives

[Part 4]

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APPENDIX 4

APPLICABILITY OF PEARL AND PELMO MODELS FOR CALCULATION OF GROUND WATER CONCENTRATION RESULTING FROM TREATED WOOD EMISSIONS

INTRODUCTION

1. According to recent national and regional legislations[1], the evaluation of ground water exposure to biocides, including wood preservatives, is an integral part of the environmental exposure of a product or of an active ingredient for regulatory purposes.

2. As an example the relevant text from the EU Biocidal Products Directive (EC/98/8) is given:

'The Member State shall not authorise a biocidal product if, under the proposed conditions of use, the foreseeable concentration of the active substance or of any other substance of concern or of relevant metabolites or breakdown or reaction products in groundwater exceeds the lower of the following concentrations:

1. the maximum permissible concentration laid down by Directive 80/778/EEC(i.e. 0,1 $\mu g.l^{-1}$ for both biocides and pesticides) or

2. the maximum concentration as laid down following the procedure for including the active substance in Annex I, IA or IB to this Directive, on the basis of appropriate data, in particular toxicological data

unless it is scientifically demonstrated that under relevant field conditions the lower concentration is not exceeded'.

3. The focus of this document is the estimation of local emissions and local concentrations in the primary receiving environmental compartments. However, it was considered useful to provide some guidance on how local concentrations to ground water, that potentially result from leaching of a wood preservative emission in soil, can be calculated for the relevant emission scenarios described in this document. These scenarios are: storage of industrially treated wood prior to shipment and treated wood-in-service.

4. To this end, the applicability of two European models (i.e. PEARL and PELMO) to the emissions scenarios described in this document is discussed. These models were initially designed for prediction of leaching of agricultural pesticides in soil.

5. In the following sections, it is provided:

a brief description of each model;

a discussion on the applicability of the model in treated wood scenarios. The most critical parameters discussed are the input values that these models need to run, and how the outputs of the calculations proposed in this document (i.e., $Q_{leach,time}$) may comply as inputs for these models. PEARL model

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[1] e.g. the EU Biocides Directive 98/8/EC which coame into force in May 2000. The US EPA draft proposals for antimictobial data requirements (Part 158W) will be published soon in the Federal Register.

2.1 General information on PEARL

Pesticide fate

6. PEARL is a one-dimensional, dynamic, multi-layer model, which describes the fate of a pesticide and relevant transformation products in the soil-plant system. This model is used by the pesticide regulatory authorities in the Netherlands.

7. The most important processes included in PEARL are pesticide application and deposition, convective and dispersive transport in the liquid phase, diffusion through the gas and liquid phases, equilibrium sorption, non-equilibrium sorption, first-order transformation, uptake of pesticides by plant roots, lateral discharge of pesticide with drainage water, and volatilisation of pesticide at the soil surface.

- Pesticide application and deposition

Pesticides can enter the system by direct application or by atmospheric deposition. The application methods described in PEARL are spraying of pesticide on the soil surface, spraying on the crop canopy, incorporation of pesticide into the topsoil (e.g. by rototillage), and injection of pesticide into the topsoil.

- Vertical transport of pesticides

Transport of the pesticide in the liquid phase of the soil is described by an equation including convection, dispersion and diffusion. The dispersion coefficient is taken to be proportional to the soil water flux. The diffusion coefficient is a function of the soil water content. The model contains three options to describe the relative diffusion coefficient. Transport in the gas phase is described by Fick's law. The diffusion coefficient is a function of the volume fraction of the gas phase. The model contains three options to describe the relative diffusion coefficient, including a function derived by Millington and Quirk [Millington and Quirk,1960].

- Lateral discharge of pesticides

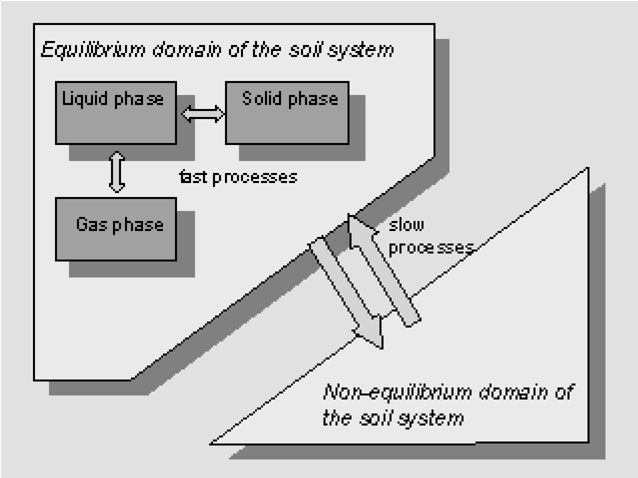
The rate of water discharged by the tile-drainage system is calculated by the hydrological submodel. The lateral discharge of pesticides is taken proportional to the water fluxes discharged by the tile-drainage system. PEARL output can be taken as input for the TOXSWA model [Adriaanse *et al.,* 1996].

- Volatilisation of pesticides

In the current model version, the diffusion of vapour through the soil and a laminar air-boundary layer are the limiting factors for volatilisation [cf. Jury *et al.,* 1990].

- Partitioning of pesticides

PEARL considers a three-phase system. The sorption of pesticide on the solid phase is described with a Freundlich-type equation. In the most common approach, the Freundlich coefficient is calculated on the basis of the coefficient of equilibrium sorption on organic matter, *Kom*. PEARL contains an option of pH dependent sorption. If this option is used, the dissociation constant, pKa, must be specified. The partitioning of the pesticide between the gas phase and the liquid phase is described by Henry's law. Pesticide sorption to the non-equilibrium phase is described by a first-order rate equation. This equation requires a desorption rate coefficient.



- Pesticide transformation

Transformation of pesticides may lead to reaction products (daughters) that may show a certain degree of persistence and mobility in soils. For this reason, the formation and behaviour of the most important daughters is included in PEARL. Transformation of the individual compounds is described with first-order kinetics. The rate of pesticide transformation in soil depends on temperature, soil moisture content and depth in soil. A compound residing in the non-equilibrium domain is not subject to transformation, which implies that the half-life of transformation refers to the equilibrium domain only. An important consequence is that the transformation half-life, which usually refers to the total mass content, should be obtained in a special procedure.

2.2 Applicability of the PEARL model to estimate ground water concentrations resulting from treated wood scenarios (storage or in-service)

2.2.1 Scenarios where wood is exterior and above ground

8. For the above soil scenarios, i.e.:

- *Scenarios for Use Class 3:* Fence, Noise Barrier and House, and
- *Scenarios of Use Class 4a:* upper part of pole in the Transmission Pole scenario and upper part of post in the Fence Post scenario (see Chapter 5 of the main report)

9. The input value that can be used in PEARL is the emission to soil during 3 rain events in <u>one day</u> in kg per ha of soil. For each rain event the default value proposed in this document can be used, i.e. precipitation of 4 $mm.h^{-1}.m^{-2}$ and each rain event lasting 1 hour. This 'dose' can also be in a repeated application once every 3 days to align with the rainfall pattern proposed in the document.

10. The scenarios can be used directly, because the model is 1-dimensional: it calculates the concentration at 1 point below the applied surface. The following points have to be agreed:

- the net dose per day assuming 3 rain events per day is constant
- the number of years over which a calculation should be performed (1, 5, 10 ?)

11. *As an example:* For the house scenario the 'dose' in kg per ha of soil, needed for PEARL, can be calculated based on the calculation of an average emission rate, $E_{soil,leach,time}$ [kg.d^{-1}], for a certain period of assessment. $E_{soil,leach,time}$ [kg.d^{-1}] can be calculated, as follows:

$$E_{soil,leach,time} = \frac{Q_{leach,time}}{TIME} = \frac{\left(AREA_{wood} \cdot Q^{*}_{leach,time}\right)}{TIME} \qquad \text{(A4\_1)}$$

where:

$E_{soil,leach,time}$	=	average emission rate, i.e. the average quantity of an active ingredient (or of any substance of concern in a wood preservative formulation) leached per day from the leachable treated wood area, considered in the relevant scenarios, over a certain assessment period [kg.d^{-1}]
$Q_{leach,time}$	=	cumulative quantity of an active ingredient, emitted to the relevant environmental compartment due to leaching from treated wood, over a certain time period of service, considered for assessment [kg].
$Q^*_{leach,time}$	=	cumulative quantity of an active ingredient leached out of 1 m^2 of treated wood over a certain time period of service, considered for assessment [kg.m^{-2}]. $Q^*_{leach,time}$ is calculated based on the results of a leaching test.
$AREA_{wood}$	=	leachable treated wood area [m^2], proposed in the relevant scenarios
$TIME$	=	time period considered for assessment [d]

12. If, for example, the $E_{soil,leach,time}$ is 0,01 kg.d^{-1}, this 'dose' corresponds to 5 m^2 of adjacent soil area to house, based on the default values of the house scenario (i.e. adjacent soil: 0.1 m distance from the house). To bring this dose to kg.ha^{-1}, a (default) density of houses per hectare should be introduced to convert the dose of 0,01 kg.d^{-1} per 5 m^2 to kg.ha^{-1}. Due to lack of time the Expert Group did not discuss realistic worst-case default values for density of the wooden commodities in the scenarios of Use Class 3 (i.e. House, Fence and Noise barrier).

2.2.2 Scenarios where wood is exterior and in ground contact

13. The relevant below soil scenarios are: the below soil part of Transmission Pole and Fence Post scenarios (both Use Class 4a).

14. For these scenarios, two cases should be distinguished: deep buried (i.e. Transmission pole, 2m) and not deep buried (i.e. Fence post, 0.5 m). The need for this distinction comes from the fact that PEARL (and PELMO as well) simulates leaching concentration at the lowest soil horizon (depth 1.1 m). This concentration is assumed to be the ground water concentration.

- **Fence Post scenario** (below soil part): the emission over a certain time period (f.i. x kg.ha^{-1}.y^{-1}) can be calculated, assuming that emission is delivered in equal parts over each period (decade, year). These are then used as 'application events' in PEARL. A soil profile should also be defined with the upper horizon at the bottom of the post, use the calculated input and assume that it is mixed in the soil. However, conversion of the emission from kg per m^2 soil area to kg.ha^{-1} introduces the need for a default density of fence posts per hectare, as described earlier. However, due to lack of time, the Expert Group did not discuss such a default density.

- **Transmission Pole scenario:** the below soil part is buried deep (to 2m) and therefore PEARL cannot be used . An alternative approach is to calculate the concentration resulting from lateral emission per soil layer of ca. 0,5 m and use this as initial soil concentration in PEARL.

PELMO MODEL

3.1 General information on PELMO

15. PELMO (**Pe**sticide **L**eaching **Mo**del) is applied in Germany for ground water exposure assessment of pesticides. PELMO version 3.2 is one of the four leaching models accepted in the European Union for the authorisation of pesticides[2], which are:

- PEARL/Netherlands
- PELMO/Germany
- PRZM/US EPA
- MACRO/Sweden

These models are described and compared in a report of the FOCUS Groundwater Scenario Workgroup [FOCUS 2000].

16. PELMO needs the following **input data**:

- Amount of pesticide applied per unit area of soil [$kg.ha^{-1}$]
- Frequency and time in year of application
- Plant culture
- Definition of worst case agricultural soil. In Germany it is used a sandy loam soil of Borstel near Hamburg
- Realistic worst case climate data. In Germany it is used use 760 $mm.y^{-1}$ rain
- Soil adsorption coefficient K_{oc} and Freundlich constant 1/n
- Dissociation constant pKa
- Biodegradation half-life in soil: DT_{50}.

17. The input ‘amount of pesticide applied per unit area of soil (mass/area)’, called the ‘effective application rate’ is notified by the applicant (i.e. registrant). PELMO simulation then proceeds with an area and a culture selected. The calculated ground water concentration is then regarded as representative for the ground water concentration under this area.

2 The four models accepted in the European Union for the authorisation of pesticides are :

- PEARL/Netherlands
- PELMO/Germany
- PRZM/US EPA
- MACRO/Sweden

18. The result of the PELMO simulation is a calculated concentration at the lowest soil horizon (depth 1,1 m) that is assumed to be the ground water concentration. This concentration is regarded as representative of the ground water concentration under the area selected.

19. If the pesticide leaches in PELMO the applicant must provide lysimeter studies to demonstrate the leaching behaviour under field conditions.

3.2 Applicability of the PELMO model to estimate ground water concentrations resulted from treated wood scenarios (storage or in-service)

20. In principle, PELMO simulations could also be applied for wood preservative applications. However, the following conditions should be considered.

1. PELMO simulates only organic substances, not metals. Leaching of metals should be assessed by a soil expert.
2. The wood preservative scenario should relate to an area, eventually averaged, e.g. a storage place. Storage places are critical for leaching, because new charges of treated wood are regularly exposed to rain just after treatment, when leaching rates are the highest. A point source like the transmission pole or a linear sources like the fence or house should not be calculated with PELMO, because this area is too small to simulate the ground water situation under it. In addition, the amount emitted from the fence, transmission pole or house scenario may not be high enough to reach ground water in an environmentally relevant concentration.
3. The emission rates of wood preservatives that reach an area of soil must be known. The application rate for pesticides varies between 10 and 1000 g active ingredient per hectare. The approach for estimation of $E_{soil,leach,time}$ [$kg.d^{-1}$], described for the PEARL model under Section 2.2.1 may also apply here.
4. A soil should be chosen that is representative for wood preservative applications. The agricultural soil is probably not the best choice.
5. A climate should be chosen that is representative for wood preservative applications. The default scenario for rainfall proposed in this document can be used i.e. 3 rain events, lasting ca. 1 hour each, every third day, with a precipitation of 4 $mm.h^{-1}.m^{-2}$.
6. The result of the ground water concentration should be relevant for authorisation purposes. The trigger value of 0.1 $\mu g.l^{-1}$ for a substance concentration in groundwater, set by Directive 80/778/EEC, applies to both biocides and pesticides, for regulatory purposes.

21. The experience in Germany with PELMO shows that a substance with:

- $K_{oc} < 500\ l.kg^{-1}$ and
- $DT_{50} > 21\ d^{-1}$

may leach to ground water or a substance with a higher K_{oc} and a lower DT_{50} value does not leach to ground water.

APPENDIX 5

EXAMPLES OF EMISSION CALCULATIONS

1. EXAMPLES OF CALCULATION OF LOCAL EMISSION RATES FOR INDUSTRIAL PREVENTIVE TREATMENTS

22. The examples given below concern the calculation of $Elocal_{air}$ and $Elocal_{facilitydrain}$ for two scenarios of industrial preventive treatments:

- Automated spraying scenario (Section 4.2.1, Chapter 4)
- Dipping/Immersion scenario (Section 4.2.2, Chapter 4)

23. The calculations were made with the software MathCad 99: http://www.mathsoft.com which accounts for changes in dimensions.

Emission Scenario: Automated spraying

$d := 86400 s$

$g := 10^{-3} \cdot kg$

Input

Wood area treated per day [$m^2 * d^{-1}$] 200 m² for small plants 20000 m² for big plants	$AREA_{wood\_treated} := 2000 \cdot m^2 \cdot d^{-1}$	D
Application rate of product (fluid) [$L*m^{-2}$]	$Q_{product\_fluid} := 2 \cdot L \cdot m^{-2}$	A
Application rate product (solid) [$kg*m^{-2}$]	$Q_{product\_solid} := 2 \cdot kg \cdot m^{-2}$	A
Concentration of a.i. in product [%]	$C_{ai} := 5 \cdot \%$	A
Density of liquid product [$kg*m^{-3}$]	$RHO_{product} := 1.2 \cdot kg \cdot L^{-1}$	A
Fraction released to waste water [--]	$F_{wastewater} := 0.0001$	D

*solubility in water [µg*L $^{-1}$]*

< 0.25	-	*0.0001*
0.25 - < 1	-	*0.0015*
1 - < 50	-	*0.003*
50 - < 100	-	*0.015*
> 100	-	*0.03*

Fraction released to air [--] — $F_{air} := 0.001$ — D

Vapour pressure at 20°C[Pa]

<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*

Fraction of spray drift depostion [--] — $F_{drift} := 0.001$ — D

Output

Application rate : quantity of a.i. applied per 1 m^2 of wood area [kg*m^{-2}]

Fluid:

$$Q_{ai\_f} := \frac{Q_{product\_fluid} \cdot RHO_{product} \cdot C_{ai}}{100 \cdot \%}$$

$$Q_{ai\_f} = 0.12 \cdot kg \cdot m^{-2}$$

Solid:

$$Q_{ai\_s} := \frac{Q_{product\_solid} \cdot C_{ai}}{100\,\%}$$

$$Q_{ai\_s} = 0.1 \cdot kg \cdot m^{-2}$$

Plant: Emission to local air [kg*d^{-1}]

$$Elocal_{air\_f} := AREA_{wood\_treated} \cdot Q_{ai\_f} \cdot \left(F_{air} + F_{drift}\right)$$

$$Elocal_{air\_f} = 0.48 \cdot kg \cdot d^{-1}$$

$$Elocal_{air\_s} := AREA_{wood\_treated} \cdot Q_{ai\_s} \cdot \left(F_{air} + F_{drift}\right)$$

$$Elocal_{air\_s} = 0.4 \cdot kg \cdot d^{-1}$$

Plant: Emissions to facility waste water [kg*d^{-1}]

$$Elocal_{wastewater\_f} := AREA_{wood\_treated} \cdot Q_{ai\_f} \cdot F_{wastewater}$$

$$Elocal_{wastewater\_f} = 0.024 \cdot kg \cdot d^{-1}$$

$$Elocal_{wastewater\_s} := AREA_{wood\_treated} \cdot Q_{ai\_s} \cdot F_{wastewater}$$

$$Elocal_{wastewater\_s} = 0.02 \cdot kg \cdot d^{-1}$$

Emission Scenario: Dipping / Immersion Process

$d := 86400 s$

$g := 10^{-3} \cdot kg$

Input

Volume of wood treated per day [m^3*d^{-1}]	$VOLUME_{wood\_treated} := 100 \cdot m^3 \cdot d^{-1}$	D
Application rate: quantity of a.i. applied per m³ wood [kg*m-3]	$Q_{ai} := 1 \cdot kg \cdot m^{-3}$	A
Fraction released to waste water [--]	$F_{wastewater} := 0.0001$	D

*solubility in water [mg*l $^{-1}$]*

< 0.25	-	*0.0001*
0.25 - < 1	-	*0.0015*
1 - < 50	-	*0.003*
50 - < 100	-	*0.015*
> 100	-	*0.03*

Fraction released to air [--] — $F_{air} := 0.001$ — D

Vapour pressure at 20°C [Pa]

<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*

Output

Plant: Emission to local air [kg*d^{-1}]

$$Elocal_{air} := VOLUME_{wood\_treated} \cdot Q_{ai} \cdot F_{air}$$

$$Elocal_{air} = 0.1 \, kg \cdot d^{-1}$$

Plant: Emission to facility waste water [kg*d^{-1}]

$$Elocal_{wastewater} := VOLUME_{wood\_treated} \cdot Q_{ai} \cdot F_{wastewater}$$

$$Elocal_{wastewater} = 0.01 \, kg \cdot d^{-1}$$

2. EXAMPLES OF CALCULATION OF LOCAL CONCENTRATIONS OR EMISSION RATES RESULTING FROM EMISSIONS FROM TREATED WOOD DURING STORAGE (CHAPTER 4) OR DURING THE SERVICE LIFE (CHAPTER 5)

24. The following sections provide numeric examples of calculations of local concentrations in soil or of emission rates in adjacent surface water, resulting from emissions from treated wood, for the following scenarios:

- storage of wood, industrially treated by spraying, prior to shipment
- treated wood-in-service: Use Class 3: House and Fence scenarios

25. The calculations are made according to the methodologies proposed in Chapter 4 (Storage Scenarios) and Chapter 5 (Wood-in-service). These methodologies are thoroughly explained in Appendix 2. Removal processes are not taken into account.

26. The calculations are presented in **three steps:**

• **Step 1:**	presents the experimental results of a leaching test with wood in direct contact with water. These experimental data will then be used for the calculations in both, the storage scenario and the wood-in-service scenarios.
• **Step 2**	explains how the experimental $FLUX(\Delta t)\text{-}t$ curves are fitted according to the model proposed in Appendix 2.
• **Step 3:**	presents the calculation of cumulative quantity leached ($Q_{leach,time}$) and subsequently of local concentrations in soil ($Clocal_{soil}$) and of emission rates to (adjacent) surface water ($Elocal_{surfacewater}$) for a certain assessment period.

STEP 1 : EXPERIMENTAL RESULTS FROM A LEACHING TEST

27. The following Table A5_1 presents results of a laboratory leaching test with wood in direct water contact. According to Section 4.1.5 of Chapter 4 of the main report, the *FLUX* (i.e. quantity of an active ingredient that is leached out of 1 $m^2$of treated wood per day, $kg.m^{-2}.d^{-1}$), determined by such a test is considered a worst case compared to *FLUX* due to rainfall, and can be used in the scenarios where a leaching test with simulated rainfall would in principle be required i.e.:

- all storage scenarios after industrial preventive treatments
- all ‘ wood in service’ scenarios of Use Class 3:
  - ***Fence*** *(used in the these examples)*
  - Noise barrier
  - ***House*** *(used in the these examples)*
  - Bridge
- above water parts of the:
  - Jetty in lake scenario (Use Class 4b); in the Sheet piling scenario of the same Use Class all the treated wood is in direct contact with water.
  - Wharf scenario (Use Class 5)

Table A5_1: Differential [Qd (Δt), (mg.m^{-2})] and Cumulative [Qc(t), (mg.m^{-2})] quantities leached and average daily fluxes [FLUX(Δt), (kg m^{-2} d^{-1})] over time.

Notes:

$V_{leachate}$ [l] = Volume of leachate solution sampled at each sampling/measurement time point

$AREA^{exp}_{wood}$ [m^2] = Area of wood specimen in contact with the leachate solution

Raw data			Calculations							
Wood Specimen	$V_{leachate}$ [l]	$AREA^{exp}_{wood}$ [m^2]								
	8.333	0.0620								
Component 1: Cu										
Sampling time point [d]	C [mg. l^{-1}]	Standard deviation	Time interval [d]	Mean Δt/2 [d]	Q_d(Δt) [mg]	Q_d(Δt) [mg.m^{-2}wood]	Q_c(t) [mg]	Q_c(t) [mg.m^{-2}wood]	FLUX(Δt) [mg.m^{-2}.d^{-1}]	FLUX(Δt) [kg.m^{-2}.d^{-1}]
0,25	0,197	0,103	0 – 0,25	0,125	1,642	26,484	1,642	26,484	105,910	1,06 10^{-4}
1	0,227	0,193	0,25 – 1	0,625	1,892	30,516	3,533	56,984	40,679	4,07 10^{-5}
2,25	0,243	0,217	1 – 2,25	1,625	2,025	32,661	5,558	89,645	26,128	2,61 10^{-5}
4	0,25	0,233	2,25 – 4	3,125	2,083	33,597	7,641	123,242	19,200	1,92 10^{-5}
9	0,197	0,055	4 – 9	6,5	1,642	26,484	9,283	149,726	5,295	5,29 10^{-6}
16	0,19	0,099	9 – 16	12,5	1,583	25,532	10,866	175,258	3,648	3,65 10^{-6}
36	0,28	0,126	16 – 36	26	2,333	37,629	13,199	212,887	1,882	1,88 10^{-6}
Component 2: Cr										
0,25	0,11	0,054	0 - 0,25	0,125	0,917	14,790	0,917	14,790	59,137	5,91 10^{-5}
1	0,18	0,078	0,25 – 1	0,625	1,500	24,194	2,417	38,984	32,257	3,23 10^{-5}
2,25	0,177	0,033	1 – 2,25	1,625	1,475	23,790	3,892	62,774	19,031	1,90 10^{-5}
4	0,163	0,101	2,25 – 4	3,125	1,358	21,903	5,250	84,677	12,519	1,25 10^{-5}
9	0,223	0,122	4 - 9	6,5	1,858	29,968	7,108	114,645	5,994	5,99 10^{-6}
16	0,11	0,014	9 - 16	12,5	0,917	14,790	8,025	129,435	2,112	2,11 10^{-6}
36	0,11	0,014	16 - 36	26	0,917	14,790	8,941	144,210	0,739	7,39 10^{-7}
Component 3: As										
0,25	0,006	0	0 - 0,25	0,125	0,050	0,807	0,050	0,807	3,226	3,23 10^{-6}
1	0,011	0,005	0,25 – 1	0,625	0,092	1,484	0,142	2,290	1,971	1,97 10^{-6}
2,25	0,011	0,003	1 – 2,25	1,625	0,092	1,484	0,233	3,758	1,183	1,18 10^{-6}
4	0,012	0,004	2,25 – 4	3,125	0,100	1,613	0,333	5,371	0,922	9,22 10^{-7}
9	0,029	0,005	4 - 9	6,5	0,242	3,903	0,575	9,274	0,780	7,80 10^{-7}
16	0,039	0,009	9 - 16	12,5	0,325	5,242	0,900	14,516	0,749	7,49 10^{-7}
36	0,098	0,023	16 - 36	26	0,817	13,177	1,717	27,694	0,659	6,59 10^{-7}
64	0,125	0,03	36 – 64	50	1,042	16,806	2,758	44,484	0,600	6,0 10^{-7}

STEP 2 : FITTING THE EXPERIMENTAL *FLUX(ΔT)-T* CURVES USING THE EQUATION:

$\log_{10}$ FLUX(t) = a +b.log10(t) + c.log10(t)^2

Component (Substance)	$\log_{10}$FLUX (t) = a +b.$\log_{10}$(t) + c.$\log_{10}$(t)^2			
	a	b	c	r
Cu	1.506 ± 0.05	-0.690 ± 0.07	-0.112 ± 0.06	0.991
Cr	1.447 ± 0.02	-0.631 ± 0.03	-0.328 ± 0.03	0.999
As	0.153 ± 0.02	-0.350 ± 0.02	0.0758 ± 0.02	0.992

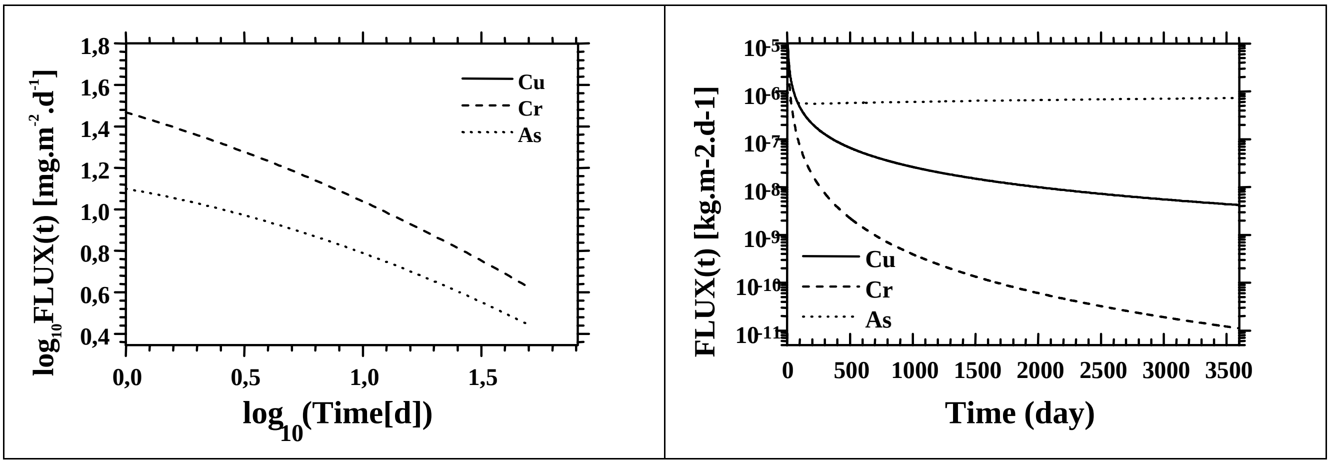


Table A5_2: Calculated *FLUX(t)* values based on the fitted $\log_{10}$FLUX(t)=f($\log_{10}$t) curve

Time [d]	Cu		Cr		As	
	$\log_{10}$ FLUX(t)	**FLUX(t)** [kg m^{-2} d^{-1}]	**$\log_{10}$ FLUX(t)**	**FLUX(t)** [kg m^{-2} d^{-1}]	**$\log_{10}$ FLUX(t)**	**FLUX(t)** [kg m^{-2} d^{-1}]
1	1,506	3,21 10^{-5}	1,447	2,8 10^{-5}	0,153	1,42 10^{-6}
2	1,288	1,94 10^{-5}	1,227	1,69 10^{-5}	0,054	1,13 10^{-6}
3	1,152	1,42 10^{-5}	1,07	1,18 10^{-5}	0,003	1,0 10^{-6}
4	1,05	1,12 10^{-5}	0,948	8,87 10^{-6}	-0,03	9,32 10^{-7}
5	0,968	9,30 10^{-6}	0,845	7,0 10^{-6}	-0,054	8,81 10^{-7}
6	0,9	7,95 10^{-6}	0,756	5,71 10^{-6}	-0,073	8,44 10^{-7}
7	0,842	6,95 10^{-6}	0,679	4,77 10^{-6}	-0,088	8,14 10^{-7}
8	0,79	6,18 10^{-6}	0,609	4,06 10^{-6}	-1,01	7,92 10^{-7}
….	…	…	…	…	…	…
30	0,241	1,74 10^{-6}	-0,202	6,28 10^{-7}	-0,199	6,32 10^{-7}
…	…	…	…	….	…	…
365 (1 year)	-1,0	9,90 10^{-8}	-2,326	4,72 10^{-9}	-0,247	5,66 10^{-7}
…	…	…	…	…	…	…
3653 (10 years)	-2,38	4,15 10^{-9}	-4,967	1,08 10^{-11}	-0,133	7,36 10^{-7}

STEP 3 :CALCULATION OF $Q^*_{LEACH,TIME}$; $Q_{LEACH,TIME}$; $CLOCAL_{SOIL}$ AND; $ELOCAL_{SURFACEWATER}$ FOR A CERTAIN ASSESSMENT PERIOD

Emissions from stored (industrially treated) wood prior to shipment

Scenario : wood stored after treatment by spraying

Parameter/variable	Nomenclature	Value	Unit	Origin
Storage: spraying scenario				
Inputs				
Effective surface area of treated wood, considered to be exposed to rain, per 1 m^2 storage area (i.e. soil)	$AREA_{wood-expo}$	11	$[m^2.m^{-2}]$	D
Surface area of the storage place	$AREA_{storage}$	• 79 for plants with $AREA_{wood-treated}$ = 2.000 m^2 • 790 for plants with $AREA_{wood-treated}$ = 20.000 m^2	$[m^2]$	D
Duration of the initial assessment period	*TIME1*	30	[d]	D
Duration of a longer assessment period	*TIME2*		[d]	D
Duration of storage of treated wood prior to shipment	$TIME_{storage}$	3	[d]	D
Volume of treated wood stacked per m^2 of storage area (i.e. soil)	$VOLUME_{wood-stacked}$	2	$[m^3.m^{-2}]$	D
Bulk density of (wet) soil	RHO_{soil}	1700	$[kg.m^{-3}]$	D from TGD
Soil depth	$DEPTH_{soil}$	0,1	[m]	D
Volume of (wet) soil	V_{soil}	• 7,9 for plants with $AREA_{wood-treated}$ = 2.000 m^2 • 79 for plants with $AREA_{wood-treated}$ = 20.000 m2	$[m^3]$	D
Fraction of rainwater running off the storage site	F_{runoff}	0,5	[-]	D

Calculations

Notes:

1. $Q^{exp}_{leach,0-1}$ is the quantity of the substance leached within the first day of a leaching experiment [kg]
2. As explained in Appendix 2, Section 2.2, fitting with a polynomial regression of second order does not take in account the ‘saturation term’, $FLUX_{time\rightarrow 0}$, that occurs when time approaches zero. To avoid the artefact of “zero region”, the summation of *FLUX(t)* can start, for example, from day 1 of the experiment. However, it is possible to calculate the total quantity leached starting from time zero of the leaching experiment ($Q^*_{leach,0-3}$) by adding to the calculated $Q^*_{leach,1-3} = \sum_{t=1day}^{3day} FLUX(t)$ directly the quantity experimentally determined during the first day of the experiment (i.e. $Q^{exp}_{leach,0-1}$).
3. $(FLUX)_{1day}$, $(FLUX)_{2day}$ etc is taken from the relevant shaded columns of Table A5_2.

Table A5_3: Calculation of $Q^*_{leach,time}$; $Q_{leach,storage,time}$; $Clocal_{soil}$ and; $Elocal_{surfacewater}$ for 30 days of assessment period

Parameter	Equation	Unit	Cu		Cr		As	
			Small plants	Big plants	Small plants	Big plants	Small plants	Big plants
	$\sum_{t=1day}^{3day} FLUX(t) = (FLUX)_{1day} + (FLUX)_{2day} + (FLUX)_{3day}$	kg.m^{-2}	6,57 10^{-5}		5,67 10^{-5}		3,65 10^{-6}	
	$\frac{Q^{exp}_{leach,0-1}}{AREA^{exp}_{wood}} = \frac{Q^{exp}_{leach,0-1}}{0,0620}$	kg.m^{-2}	5,70 10^{-5}		3,9 10^{-5}		2,29 10^{-6}	
$Q^*_{leach,0-3}$	$Q^*_{leach,0-3} = \sum_{t=1day}^{3day} FLUX(t) + \frac{Q^{exp}_{leach,0-1}}{AREA^{exp}_{wood}}$	kg.m^{-2}	1,23 10^{-4}		9,57 10^{-5}		5,94 10^{-6}	
$FLUX_{storage,spray}$	$FLUX_{storage,spray} = \frac{Q^*_{leach,0-3}}{TIME_{storage}}$	kg.m^{-2}.d^{-1}	4,09 10^{-5}		3,19 10^{-5}		1,98 10^{-6}	
$Q_{leach,storage,time1}$	$Q_{leach,storage,time1} = FLUX_{storage,spray} \cdot AREA_{wood-expo} \cdot AREA_{storage} \cdot TIME1$	[kg]	1,07	10,7	8,31 10^{-1}	8,31	5,16 10^{-2}	5,16 10^{-1}
$Q_{leach,storage,,time2}$	$Q_{leach,storage,time2} = FLUX_{storage,spray} \cdot AREA_{wood-expo} \cdot AREA_{storage} \cdot TIME2$	[kg]						
$Clocal_{soil,time1}$ $TIME1=30\ days; F_{runoff}=0,5$	$Clocal_{soil,time1} = \frac{Q_{leach,storage,time1}}{V_{soil} \cdot RHO_{soil}}(1 - F_{runoff})$	[kg.kg$_{wwt}^{-1}$]	3,97 10^{-5}	3,97 10^{-5}	3,1 10^{-5}	3,1 10^{-5}	1,92 10^{-6}	1,92 10^{-6}
$Clocal_{soil,time2}$	$Clocal_{soil,time2} = \frac{Q_{leach,storage,time2}}{V_{soil} \cdot RHO_{soil}}(1 - F_{runoff})$	[kg.kg$_{wwt}^{-1}$]						
$Elocal_{surfacewater,time1}$ $TIME1=30\ days; F_{runoff}=0,5$	$Elocal_{surfacewater,time1} = \frac{Q_{leach,storage,time1}}{TIME1} \cdot F_{runoff}$	[kg.d^{-1}]	1,78 10^{-2}	1,78 10^{-1}	1,39 10^{-2}	1,39 10^{-1}	8,60 10^{-4}	8,60 10^{-3}
$Elocal_{surfacewater,time2}$	$Elocal_{surfacewater,time2} = \frac{Q_{leach,storage,time2}}{TIME2} \cdot F_{runoff}$	[kg.d^{-1}]						

Emissions from treated wood in service:

<u>Part I:</u> Calculation of $Q^{*}_{leach,0-30}$ for *TIME1* = 30 days and $Q^{*}_{leach,0-365}$ for *TIME2* = 365 days :

Table A5_4: Calculation of $Q^{*}_{leach,0-30}$ and $Q^{*}_{leach,0-365}$

Parameter	***Equation***	**Unit**	**Cu**	**Cr**	**As**
For an initial assessment period of TIME1 =30 days					
	$\sum_{t=1day}^{30day} FLUX(t)$	$kg.m^{-2}$	$1{,}73\ 10^{-4}$	$1{,}2\ 10^{-4}$	$2{,}28\ 10^{-5}$
	$\frac{Q^{exp}_{leach,0-1}}{AREA^{exp}_{wood}} = \frac{Q^{exp}_{leach,0-1}}{0{,}0620}$	$kg.m^{-2}$	$5{,}70\ 10^{-5}$	$3{,}9\ 10^{-5}$	$2{,}29\ 10^{-6}$
$Q^{*}_{leach,0-30}$	$Q^{*}_{leach,0-30} = \sum_{t=1day}^{30day} FLUX(t) + \frac{Q^{exp}_{leach,0-1}}{AREA^{exp}_{wood}}$	$kg.m^{-2}$	$2{,}30\ 10^{-4}$	$1{,}6\ 10^{-4}$	$2{,}51\ 10^{-5}$
For a longer assessment period of TIME2 = 365 days					
	$\sum_{t=1day}^{365day} FLUX(t)$	$kg.m^{-2}$	$2{,}87\ 10^{-4}$	$1{,}402\ 10^{-4}$	$2{,}13\ 10^{-4}$
	$\frac{Q^{exp}_{leach,0-1}}{AREA^{exp}_{wood}} = \frac{Q^{exp}_{leach,0-1}}{0{,}0620}$	$kg.m^{-2}$	$5{,}70\ 10^{-5}$	$3{,}89\ 10^{-5}$	$2{,}29\ 10^{-6}$
$Q^{*}_{leach,0-365}$	$Q^{*}_{leach,0-365} = \sum_{t=1day}^{365day} FLUX(t) + \frac{Q^{exp}_{leach,0-1}}{AREA^{exp}_{wood}}$	$kg.m^{-2}$	$3{,}44\ 10^{-4}$	$1{,}79\ 10^{-4}$	$2{,}15\ 10^{-4}$

The above calculations are applicable for all scenarios of treated wood-in-service for which a leaching test with wood in direct water contact is required (see Table A1_I of Appendix 1).

PART II: Calculation of $Q_{leach,0-30}$ and $Q_{leach,0-365}$; $Clocal_{soil,0-30}$ and $Clocal_{soil,0-365}$

Class 3: Wood not covered, not in contact with ground, exposed to the weather or subject to frequent wetting

- **Scenarios**

	Nomenclature	Value	Unit	Origin
Scenario: Fence (Use Class 3)				
leachable wood area per m length	$AREA_{fence}$	2	[m^2]	D
(wet) soil volume per m length	V_{soil}	0,01	[m^3]	D
Scenario: House (Use Class 3)				
leachable wood area	$AREA_{house}$	125	[m^2]	D
(wet) soil volume	V_{soil}	0,50	[m^3]	D

D=default value proposed by the Expert Group

- **Calculations**

Table A5_5: Calculation of $Q_{leach,0-30}$ and $Q_{leach,0-365}$; $Clocal_{soil,0-30}$ and $Clocal_{soil,0-365}$

Parameter	Equation	Unit	Cu	Cr	As
For an initial assessment period of TIME1 =30 days					
$Q_{leach,0-30}$	*Fence :* $Q^*_{leach,0-30} = AREA_{fence} \cdot Q^*_{leach,0-30} = 2 \cdot Q^*_{leach,0-30}$	kg	4,60 10^{-4}	3,2 10^{-4}	5,0 10^{-5}
	House : $Q^*_{leach,0-30} = AREA_{house} \cdot Q^*_{leach,0-30} = 125 \cdot Q^*_{leach,0-30}$	kg	2,90 10^{-2}	2,0 10^{-2}	3,1 10^{-3}
$Clocal_{soil,0-30}$	*Fence :* $Clocal_{soil,leach,0-30} = \frac{Q_{leach,0-30}}{V_{soil} \cdot RHO_{soil}} = \frac{Q_{leach,0-30}}{0{,}01 \cdot 1700*}$	$kg.kg_{wwt}^{-1}$	2,70 10^{-5}	1,9 10^{-5}	2,9 10^{-6}

	House : $Clocal_{soil,leach,0-30} = \frac{Q_{leach,0-30}}{V_{soil} \cdot RHO_{soil}} = \frac{Q_{leach,0-30}}{0{,}50 \cdot 1700\,*}$	$kg.kg_{wwt}^{-1}$	3,40 10^{-5}	2,4 10^{-5}	3,65 10^{-6}

Table A5_5: Calculation of $Q_{leach,0-30}$ and $Q_{leach,0-365}$; $Clocal_{soil,0-30}$ and $Clocal_{soil,0-365}$ (cont.)

Parameter	Equation	Unit	Cu	Cr	As
For a longer assessment period of TIME2 = 365 days					
$Q_{leach,0-365}$	*Fence :* $Q_{leach,0-365} = AREA_{fence} \cdot Q^{*}_{leach,0-365} = 2 \cdot Q^{*}_{leach,0-365}$	kg	6,90 10^{-4}	3,6 10^{-4}	4,3 10^{-4}
	House : $Q_{leach,0-365} = AREA_{house} \cdot Q^{*}_{leach,0-365} = 125 \cdot Q^{*}_{leach,0-365}$	kg	4,3 10^{-2}	2,2 10-^{2}	2,7 10^{-2}
$Clocal_{soil,0-365}$	*Fence :* $Clocal_{soil,leach,0-365} = \frac{Q_{leach,0-365}}{V_{soil} \cdot RHO_{soil}} = \frac{Q_{leach,0-365}}{0{,}01 \cdot 1700\,*}$	$kg.kg_{wwt}^{-1}$	4,0 10^{-5}	2,1 10^{-5}	2,5 10^{-5}
	House : $Clocal_{soil,leach,0-365} = \frac{Q_{leach,0-365}}{V_{soil} \cdot RHO_{soil}} = \frac{Q_{leach,0-365}}{0{,}5 \cdot 1700\,*}$	$kg.kg_{wwt}^{-1}$	5,1 10^{-5}	2,6 10^{-5}	3,2 10^{-5}

* RHO= 1700 [$kg_{wwt}.m^{-3}$] : default value for the bulk density of wet soil proposed by the Expert Group.

APPENDIX 6

GLOSSARY AND DEFINITION OF TERMS

TERMS USED IN ENVIRONMENTAL RISK ASSESSMENT OF WOOD PRESERVATIVES

It is important that there is common understanding of terms that are used in estimating environmental exposure for use in risk assessment of biocides. The following list sets out the meaning of terms that are used in this document.

Term		**Definition**
Active ingredient (a.i.)	—	the chemical agent in a product having a toxic effect against wood inhabiting organisms
Active substance (a.s.)	—	term synonymous with "active ingredient" (a.i.).
Amateurs or consumers	—	private users who apply wood preservatives to their own property (Do-it-yourself) or to somebody's else property in peripatetic and occasional jobs (and without having a professional certification for exercising this job)
Anti-sapstain applications	—	industrial or professional processes, for surface treatment of wood shortly after it has been harvested or cut as lumber. (There may also be some non-professional users).
Application rate	—	the quantity of active ingredient applied to wood; normally expressed in kg.m^{-3} for deep penetration (e.g. in heavy duty processes) or in L.m^{-2}] for surface treatments.
Carpentry applications	—	processes mainly on the industrial scale treating wooden construction materials for long term protection against insects and fungi.
Concentration of the preservative product in the treating solution	—	the percentage (expressed as w/w, or w/v) of the preservative product in the carrier (water, or solvent) in the solution used for the actual treatment of wood
Curative treatments	—	are applied to remedy infestations *in-situ* once they have occurred, either in previously no treated wood or in wood that has never been treated. *Curative treatments (remedial)* are applied to wood *in-situ* by professionals or amateurs including the do-it-yourself fans.
Default value	—	parameter needed in an emission scenario that is estimated to the best of an expert's knowledge or at a higher certainty derived by a representative or statistical survey.
Do-it-yourself	—	private users who apply wood preservatives to their own property
Effects assessment	—	performed to estimate the toxic effects to flora and fauna that the estimated (or measured) exposure might have. After the environmental concentration has been determined, a dose-response assessment is performed on the basis of laboratory test results for several end-points (e.g. aquatic organisms, terrestrial organisms, microorganisms in the sewage treatment plant and top predictors such as fish-eating and worm-eating birds or mammals). The dose-response assessment generally derives concentrations at which no adverse effects are expected, known as the Predicted No Effect Concentration or PNEC.
Emission factor	—	the fraction of the amount used per application of the active ingredient that is released to air, water or soil during each life cycle stage. Emission factors represent the 90 percentile value.
Emission pathways	—	the pathways that the emissions enter to the relevant environmental compartment during the different stages of a product's life.
Emission rate (E)	—	quantity of an active ingredient or any substance of concern in a wood preservative product (formulation) that is released to an environmental compartment on a daily basis [mass.day^{-1}, here in kg. day^{-1}].
Emission scenario	—	the emission sources and pathways, application technology, uses of wood preservatives and treated wood, and provides an algorithm to estimate the emission quantities into air, water and soil [OECD 2000b].

Environmental exposure assessment	—	the determination of the emissions, pathways, and rates of movement of a substance in the environment, and its transformation or degradation, in order to estimate the concentrations/doses to which ecological systems and populations are or may be exposed. [OECD 1995].
FLUX	—	quantity of an active ingredient or any substance of concern in a wood preservative formulation that is leached out of one square meter of treated wood per day [$kg.m^{-2}.d^{-1}$]
Foreseeable misuse	—	includes over-application or inadequate dilution of preservative, spillages, etc.
Fumigation	—	the wood treatment with gases in contained rooms, e.g. fumigation chambers, shipment containers, plastic sheaths, sealed rooms.
Hazard Classes	—	a classification system introduced by the European Committee for Standardisation [EN 330] to classify the uses of wood based on the hazard associated with attack by insects and/or fungi to wooden commodities. This hazard is a major criterion for the choice of suitable wood species, wood preservatives and treating methods in order to obtain the optimal protection for a certain commodity.
Hazard identification	—	the identification of the adverse effects which a substance has an inherent capacity to cause [EU 1993]
HAP	—	Hazardous Air Pollutants
Heavy duty applications	—	industrial processes with deep-penetrating preservatives, such as vacuum-pressure processes.
Indirect exposure of humans via the environment	—	the dose humans are exposed to by exposure through food, drinking water and breathing air.
Industrial processes	—	are sometimes automated - the term is self-explanatory and professionals are always involved.
In-situ treatment	—	treatment of a wooden commodity at it's location of use, mostly curative.
In-use preservative	—	the product as it is being used, whether or not diluted by the user, as a paint, a spray, a vapour, or a solid. If not diluted, the in-use preservative is the same as *the preparation*.
Joinery applications	—	processes mainly on the industrial scale treating wood articles that have been made to shape, for example fence panels, composites, windows, doors and door frames, floors, architrave and decorative features. These applications can be surface (e.g. dipping) or deep penetrating applications (e.g. double vacuum).
Life cycle	—	embraces the stages of a chemical in production, formulation, processing (professional and amateur/non-professional), use of treated materials (wood in service), and disposal including waste treatment.
Life stage	—	stage of the life cycle of a chemical (e.g. the production stage, the processing stage etc.)
Loading of preservative		for industrial processes: term synonymous to *'retention of preservative'* and *'Uptake of preservative'*.
Local concentrations (Clocal)	—	concentration of an active ingredient or any substance of concern in a wood preservative product (formulation) in an environmental compartment at the local scale [$mass.mass^{-1}$ or $mass.volume^{-1}$]. For releases during the application phase the local concentrations are always considered on a daily basis.
Local emission rate (Elocal)	—	emission rates [$mass.day^{-1}$] are considered at the local scale;
Lumber	—	wood that has been cut into a finished product.
Metabolite or degradation product	—	a substance that appears in metabolism or degradation studies in environmentally relevant percentage, normally >10 %.
Non-professionals	—	includes "amateurs" or "consumers", and the "do-it-yourself enthusiasts"; it also includes people at work whose main job is unrelated to wood preservation.
PAHs	—	Polycyclic-aromatic hydrocarbons

Pattern of use	—	entails descriptions of a product's life cycle and use, following manufacture and up to disposal. "Patterns of use" also include the use of articles treated with that product, information on how primary and secondary human exposure may occur, and on emission sources to the environment.
PEC	—	*Predicted Environmental Concentration* • initial (PEC_{ini}): concentration immediately after the last application • actual (PEC_{act}): concentration to which an organism was exposed at a certain time point • time weighted average (PEC_{twa}): average concentration to which an organism was exposed during a certain period of time after the last application
Percentiles	—	are statistical values taken from data distributions.
Post-treatment conditioning	—	for industrial processes, it is the period of time following the withdrawal of the freshly treated timber from the treatment installation (all methods of industrial application) to allow the preservative to be firmly bound to the wood. Depending on the process, post- treatment conditioning can take place in the containment area of the treatment installation or outside it. Post-treatment conditioning is considered as a part of the industrial treatment process.
PNEC	—	Predicted No Effect Concentration
PPE	—	Personal Protection Equipment
Preparation or formulation	—	is the wood preservative product as placed on the market; the active substance with its co-formulants, diluents, carrier materials, stabilisers, etc.
Preventive treatments	—	are applied to prevent or retard the occurrence of biological degradation by fungi, bacteria and wood-boring insects (including termites and marine borers) on wood. *Preventive treatments* are usually applied at industrial scale operations to wood before the wood is put into service (although professionals and amateurs also treat preventively wood structures in-situ).
Primary receiving environmental compartments	—	are the environmental compartments that receive the emissions first
Professionals	—	are those who use wood preservatives as part of their work. Although workers in industrial processes are professionals, the term 'professionals' in this document cover only the professionals applying wood preservatives (preventively or curatively) ***in-situ*** i.e. to someone else's property. Workplace risk assessments can lead to control measures that reduce residual risks.
Quantity leach (Q_{leach})	—	cumulative quantity of an active ingredient or any substance of concern in a wood preservative product (formulation) that is released to an environmental compartment through leaching from the treated wood within a certain time period [mass over a time period].
Realistic worst case scenario	—	describes an exposure scenario, in which generic (representative) scenarios with realistic or statistically derived default data (values representative of the 'high end' of actual exposures) are incorporated in order to calculate a PEC value for a particular environmental medium.
Removal and disposal phase	—	of preservatives includes cleaning the workplace and work equipment and disposing of used preservative fluids, empty containers or treated wood.
Removal processes	—	the processes of removal of a substance's emissions from the receiving environmental compartment due to degradation, volatilisation, adsorption to soil, or sedimentation (in surface water)

Retention of preservative	—	retention of preservative / loading of preservative / uptake of preservative are to all intents and purposes the same. "Retention of preservative" is the amount of the wood preservative product retained in the wood before the wood is put into service. Retention is a term usually applied to industrial application processes such as vacuum pressure and double vacuum pressure/low pressure.
Risk assessment	—	the critical comparison of predicted environmental exposure concentrations (PEC) with appropriate toxicological indicators, e.g. the PNEC - the predictive no effect level.
Risk characterisation	—	the estimation of the incidence and severity of the adverse effects likely to occur in a human population or environmental compartment due to actual or predicted exposure to a substance, and may include risk estimation, i.e. the quantification of that likelihood [EU 1993].
Risk management techniques	—	reduce risk through market controls, emission reductions techniques, and label recommendations, controlling the product quantity or concentration or form, restricting the sectors for use, specifying control measures and PPE, etc.
Storage prior to shipment	—	the period that the treated wood is stored after the post-treatment conditioning phase while waiting for shipment.
STP	—	(Public) Sewage Treatment Plant
Timber	—	rough-sawn wood that has not been formed into a finished product i.e. logs.
Treated wood	—	wood that containssynthetic preservative products.
Treated wood-in-service	—	generic term to describe any wooden commodity (e.g. transmission pole), treated with a wood preservative, at it's location of use.
Treating concentration	—	the concentration to which the wood preservative from the market is diluted with water or organic solvents to prepare the *'in-use preservative'*
Treating solution		Term synonymous with the '*in-use preservative'*
Treatment	—	includes all the steps of preparing and applying the in-use wood preservative. For industrial processes, the treatment phase also includes the post-treatment conditioning. The term is used interchangeably with the terms *application* or *process.*
Uptake of preservative	—	for industrial processes: term synonymous to '*retention of preservative'* and *'loading of preservative'*
Use Classes	—	They are the same classes of wood uses, classified by CEN as 'Hazard Classes'. The term 'Use Classes' is considered more appropriate than the term 'Hazard Classes' to avoid any potential confusion by relating the word 'hazard' with the environmental hazard that a wooden commodity may have.
User sectors	—	for wood preservatives describe the processes and applications where these are used. The sectors are: industrial, professional, and non-professional.
Utility poles	—	poles used for telephone and power transmission
Ventilation	—	has several meanings, depending on the context. It includes control measures in the workplace (local exhaust ventilation - LEV; dilution ventilation); to air changes within a building (passive ventilation); and to the human breathing rate. It does not refer to air circulation within a given space. The context should make the specific meaning clear.
VOC	—	Volatile Organic Compounds
Wood destroying fungi	—	fungi that attack wood for its nutritional content, destroying the structure of the wood fibres, eventually causing its collapse.
Wood disfiguring fungi	—	fungi that attack freshly cut timber (sap stain) or wooden structures (blue stain) and can stain the wood surface thereby reducing its value

Wood preservatives	—	‘are active ingredient(s) or preparations containing active ingredient(s) which are applied to wood* or wood-based products themselves, or which are applied to non-wood substrates (e.g. masonry and building foundations) solely for the purpose of protecting adjacent wood or wood-based products from attack by wood-destroying organisms (e.g. dry rot and termites)’. * wood means logs received at the sawmill for commercial use and for all subsequent uses of the wood and wood-based products. [Definition of the European Committee for Standardisation (CEN, 35th Meeting of CEN/TC 38)]
Wood-in-service	—	see treated wood in service
Workplace environmental controls	—	mitigate environmental exposure and include structural containment, catchment systems and containment areas.
Worst case scenario	—	describes an exposure scenario, in which worst case assumptions are applied, e.g. use of highest known default values, no degradation.

Examples of wood preservative products:

ACC	—	Acid Copper Chromate
ACQ	—	Ammoniacal Copper Quaternary ammonium compound
ACZA	—	Ammoniacal Copper Zinc Arsenate
CC	—	Copper Chromium
CCA	—	Chromated Copper Arsenate
CCB	—	Copper Chromium Boron
CCF	—	Copper Chromium Fluorine
(CFK)		*CFK in German speaking countries*
CCFZ	—	Chromium-Copper-Fluorine-Zinc
CFB	—	Chromium-Fluoride-Boron
CQ	—	Copper Quaternary ammonium compound
Cu-HDO	—	Copper, bis(N-hydroxy-N-nitrosocyclohexanaminato-O,O')-
DCOIT	—	4,5-dichloro-2-octyl-2H-isothiazol-3-one
IPBC	—	3-Iodo-2-Propynyl-N-Butyl Carbamate
LOSPs	—	Wood preservative products formulated using white spirit type solvents
OBPA	—	Oxybisphenoxyarsin
OIT	—	2-n-Octyl-4-isothiazolin-3-one
PCP	—	Pentachlorophenol
TBT	—	Tributyltin
TBTF	—	Tributyltin Fluoride
TBTN	—	Tributyltin Naphthenate
TBTO	—	Tributyltin Oxide

List of Acronyms/Abbreviations

Acronym / Abbreviation	Description	Website
ASTM	American Society for Testing and Materials	http://www.astm.org/
BHF	Federal Research Centre for Forestry and Forest Products, Germany	http://www.dainet.de/bfh
BOD	Biologicalchemical Oxygen Chemical Demand	
BSG	OECD Biocides Steering Group	
CEN	European Committee for Standardisation	http://www.cenorm.be/
COD	Chemical Oxygen Demand	
CUWVO	'**C**oordinatiecommissie **U**itvoering **W**et **V**erontreiniging **O**ppervlaktewateren', The Netherlands *[Committee for Enforcement of the Pollution of Surface Waters Law]*	
DGfH	Deutsche Gesellschaft für Holzforschung e.V. (*German Association for Wood Research)*	http://www.dgfh.de
DK EPA	Danish Environmental Protection Agency	http://www.mst.dk/activi/
EC	European Commission	http://europa.eu.int/comm/index_en.htm
ECETOC	European Centre for Ecotoxicology and Toxicology of Chemicals	http://www.ecetoc.org/entry.htm
EMPA	Swiss Federal Laboratories for Materials Testing and Research	http://www.empa.ch/
ESD	Emission Scenario Document	http://www.oecd.org/ehs/ESD.htm
EU	European Union	http://europa.eu.int/
EUSES	The European Union System for the Evaluation of Substances. Commission of the European Communities	http://ecb.ei.jrc.it/Euses
EWC	European Waste Catalogue	http://www.ei.jrc.it/newsletter/16/Waste.html
EWPM	Association of European Wood Preservative Manufacturers	
FOCUS	EU Working Group: **FO**rum for the **C**o-ordination of pesticide fate models and their **US**e;	http://arno.ei.jrc.it:8181/focus/doc.html
HAP	Hazardous Air Pollutants	
INERIS	Inst. National de l' Environnement industriel et des Risques, France	http://www.ineris.fr
IRG	International Research Group of Wood Preservation	http://www.irg-wp.com
ISO	International Organisation for Standardisation	http://www.iso.ch/iso/en/ISOOnline.openerpage
MACRO/ Sweden	MACRO is an one-dimensional non-steady state model of water flow and solute transport in field soils. A complete water balance is considered in the model, including treatments of precipitation (rain, snow pack and irrigation), vertical unsaturated and saturated water flow, losses to primary and secondary field drainage systems, evapotranspiration and root water uptake.	http://www.mv.slu.se/bgf/Macrohtm/info.thm The MACRO Model (version 4.1) Nicholas Jarvis and Martin Larsson SLU, Department of Soil Sciences, Box 7014, S-750 07 Uppsala

OECD	Organisation for Economic Co-operation and Development	http://www.oecd.org
PAHs	Polycyclic Aromatic Hydrocarbons	
PEARL	PEARL is a one-dimensional, dynamic, multi-layer model, which describes the fate of a pesticide and relevant transformation products in the soil-plant system. This model is used by the pesticide regulatory authorities in the Netherlands and can be downloaded from the site indicated.	http//www.alterra.nl/models/pearl/home.htm
PELMO	**Pe**sticide **L**eaching **Mo**del. This model (software) is applied by the German UBA for ground water exposure assessment to pesticides for regulatory purposes.	http://www.iuct.fhg.de/F29723663/Software *You can use this INTERNET address to download PELMO*
PRIZM/ US EPA	Pesticide Root Zone Model: It is a one-dimensional, dynamic, compartmental model that can be used to simulate chemical movement in unsaturated soil systems within and immediately below the plant root zone.	
PMRA	Pest Management Regulatory Agency, Health Canada	http://www.hc-sc.gc.ca/pmra-arla/
PRTRs	Pollutant Release and Transfer Registers	http://www.oecd.org/ehs/prtr/index.htm
PWSS	Poorly Water Soluble Substance(s)	
RIVM	National Institute for Public Health and the Environment, Netherlands	http://www.rivm.nl/
STP	(Public) Sewage Treatment Plant	
TGD	**T**echnical **G**uidance **D**ocument in Support of Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances and Commission Regulation (EC) No. 1488/94 on Risk Assessment for Existing Substances. Office for Official Publication of the European Union. Four Parts. Luxemburg 1997. ISBN 92-827-8011-2.	http://ecb.ei.jrc.it search existing chemicals
TNO	TNO Institute of Environmental Science, Energy Research and Process Innovation, Apeldoorn/Netherlands	http://www.tno.nl/homepage.html
TRD	Canadian **T**echnical **R**ecommendations **D**ocument for the Design and Operation of Wood Preservation Facilities	http://www2.ec.gc.ca/nopp/wood/index_e.html
UBA	Umweltbundesamt (Federal Environmental Agency, Germany)	http://www.umweltbundesamt.org
UNEP	United Nations Environment Programme	http://www.unep.org/
US EPA	United States Environmental Protection Agency	http://www.epa.gov/opptsfrs/home/opptsim.htm
USES	Uniform System for Evaluation of Substances	
VOC	Volatile Organic Compounds	
WEI	Western European Institute for Wood Preservation	

APPENDIX 7

NOMENCLATURE FOR EXPOSURE ASSESSMENT OF WOOD PRESERVATIVES

Nomenclature	Description	Units
$AREA_{storage}$	= surface area of the storage place	[m^2]
$AREA_{wood}$	= leachable treated wood area [m^2], proposed in the relevant wood-in-service scenarios	[m^2]
$AREA_{wood\text{-}expo}$	= effective surface area of treated wood, considered to be exposed to rain, per 1 m^2 storage area (i.e. soil)	[$m^2.m^{-2}$]
$AREA_{wood\text{-}treated}$	= area of wood treated per day	[$m^{2}\cdot d^{-1}$]
C_{ai}	= concentration of a.i. in product	[%]
$Clocal_{applic}$	= local concentration of an active ingredient ingredient (or any substance of concern in a wood preservative product) in soil or surface water at the end of the day of application (*in-situ* treatments – Chapter 6)	[$kg.kg^{-1}$] resp. [$kg.m^{-3}$]
$Clocal_{diss,time1}$	= time weighted dissolved concentration an active ingredient ingredient (or any substance of concern in a wood preservative product) in local water over the initial assessment period	[$kg.m^{-3}$]
$Clocal_{diss,time2}$	= time weighted dissolved concentration an active ingredient ingredient (or any substance of concern in a wood preservative product) in local water over a longer assessment period	[$kg.m^{-3}$]
$Clocal_{pore,time1}$	= average concentration in soil pore water over the initial assessment period	[$kg.m^{-3}$]
$Clocal_{pore,time2}$	= average concentration in soil pore water over a longer duration	[$kg.m^{-3}$]
$Clocal_{soil,brush}$	= local concentration of active ingredient (or any substance of concern in a wood preservative product) in soil at the end of the day of application (by brushing)	[$kg.kg_{wwt}^{-1}$]
$Clocal_{soil,leach,time}$	= local concentration of an active ingredient ingredient (or any substance of concern in a wood preservative product) in soil resulting from leaching from treated wood, due to rainfall or due to direct contact with the soil, after a certain time period **of service life**, considered for assessment	[$kg.kg^{-1}$]
$Clocal_{soil,leach,time1}$	= local concentration in soil at the end of the initial assessment period	[$kg.kg_{wwt}^{-1}$]
$Clocal_{soil,leach,time2}$	= local concentration in soil at the end of a longer assessment period	[$kg.kg_{wwt}^{-1}$]
$Clocal_{total,time}$	= local concentration of active ingredient (or any substance of concern in a wood preservative product) in soil or surface water resulting from application and subsequent leaching from treated wood at the end of the assessment period	[$kg.kg^{-1}$] resp. [$kg.m^{-3}$]
$Clocal_{water,brush}$	= local concentration of an active ingredient ingredient (or any substance of concern in a wood preservative product) in water at the end of the day of application (by brushing)	[$kg.m^{-3}$
$Clocal_{water,leach,time}$	= local concentration of an active ingredient (or any substance of concern in a wood preservative product) in a receiving water body resulting from leaching from treated wood, due to rainfall or due to direct contact with the water body, after a certain time period of service life, considered for assessment [$kg.m^{-3}$]	[$kg.m^{-3}$]
$Clocal_{water,leach,time1}$	= local concentration in water at the end of the initial assessment period	[$kg.m^{-3}$]
$Clocal_{water,leach,time2}$	= local concentration in water at the end of a longer assessment period	[$kg.m^{-3}$]
E_{applic}	= quantity of the active ingredient emitted to soil or surface water per day of application (*in-situ* treatments – Chapter 6)	[$kg.d^{-1}$] or [$l.\ d^{-1}$]

$E_{atm,fumi}$	=	emission rate of active substance to atmosphere after fumigation	[kg.d^{-1}]
$Elocal$	=	emission rate, i.e. the quantity of the active ingredient (or any other substance of concern in a wood preservative formulation) emitted per day to local primary receiving environmental compartments	[kg.d^{-1}]
$Elocal_{air}$	=	local emission rate to air (industrial processes – Chapter 4)	[kg.d^{-1}]
$Elocal_{facilitydrain}$	=	local emission rate to facility drain (industrial processes – Chapter 4)	[kg.d^{-1}]
$Elocal_{surfacewater}$	=	local emission rate in surface water, resulting from leaching from stored treated wood, due to rain run-off	[kg.d^{-1}]
$E_{soil,brush}$	=	quantity of an active ingredient (or any substance of concern in a wood preservative product) emitted to soil during the day of application (by brushing)	[kg.d^{-1}]
$E_{soil,leach,time}$	=	average emission rate, i.e. the average quantity of an active ingredient (or of any substance of concern in a wood preservative formulation) leached per day from the leachable treated wood area, considered in the relevant scenarios, over a certain assessment period	[kg.d^{-1}]
$E_{soil,leach,time1}$	=	average emission rate of an active ingredient (or any other substance of concern in a wood preservative formulation) to soil due to leaching from treated wood over the initial assessment period	[kg.d^{-1}]
$E_{soil,leach,time2}$	=	average emission rate of an active ingredient (or any other substance of concern in a wood preservative formulation) to soil due to leaching from treated wood over a longer assessment period	[kg.d^{-1}]
$E_{STP,time1}$	=	average emission rate of an active ingredient (or any other substance of concern in a wood preservative formulation) to STP over the initial assessment period	
$E_{STP,time2}$	=	average emission rate of an active ingredient (or any other substance of concern in a wood preservative formulation) to STP over a longer assessment period	
$E_{water,brush}$	=	quantity of active ingredient (or any substance of concern in a wood preservative product) emitted to water during the day of application (by brushing)	[kg.d^{-1}]
$E_{water,leach,time1}$	=	average emission rate of an active ingredient (or any other substance of concern in a wood preservative formulation) to water due to leaching from treated wood over the initial assessment period	[kg.d^{-1}]
$E_{water,leach,time2}$	=	average emission rate of an active ingredient (or any other substance of concern in a wood preservative formulation) to water due to leaching from treated wood over a longer assessment period	[kg.d^{-1}]
F	=	Emission Factor	[--]
$f_{a.i.}$	=	fraction of active ingredient in product	[--]
$F_{applic.}$	=	Emission Factor: fraction of product lost to soil or surface water during product application	[--]
F_{disin}		fraction of disintegration	[--]
F_{drift}	=	Emission Factor: fraction of spray drift deposition	
$F_{facilitydrain}$		Emission Factor: fraction of the applied product that released to facility drain (industrial processes –Chapter 4))	[--]
$FLUX_{storage}$	=	average daily flux i.e. the average quantity of an active ingredient that is daily leached out of 1 m^2 of treated wood during a certain storage period	[kg.m^{-2}.d^{-1}]
F_{ret}	=	fraction of retention in goods	[--]
F_{runoff}	=	Emission Factor: fraction of rainwater running off the storage site (i.e. not infiltrating in soil)	[--]
$F_{soil,brush}$	=	Emission Factor: fraction of product lost to soil during application	[-]
$Fsolid_{soil}$	=	Volume fraction of solids in soil	[m^3.m^{-3}]
F_{STP}	=	Emission Factor: fraction of the emission from treated wood released to the STP	[--]
k	=	first order rate constant for removal from water or soil	[d^{-1}]
Kp_{susp}	=	solids-water partitioning coefficient for suspended matter	[m^3.kg^{-1}]
$K_{sed\text{-}water}$	=	total sediment – water partitioning coefficient	[m^3.m^{-3}]

$K_{soil\text{-}water}$		soil-water partitioning coefficient	[$m^3.m^{-3}$]
M_{soil}	=	(wet) soil mass	[kg]
$Q^*_{leach,time}$	=	cumulative quantity of an active ingredient (or any other substance of concern in a wood preservative formulation) leached out of 1 m^2 of treated wood over a certain time period of service or storage prior to shipment, considered for assessment. $Q^*_{leach,time}$ is calculated based on the results of a leaching test.	[$kg.m^{-2}$]
$Q^*_{leach,time1}$	=	cumulative quantity of an active ingredient leached out of 1 m^2 of treated wood over the initial assessment period	[$kg.m^{-2}$]
$Q^*_{leach,time2}$	=	cumulative quantity of an active ingredient leached out of 1 m^2 of treated wood over the a longer assessment period	[$kg.m^{-2}$]
Q_{ai}	=	application rate: i.e. the quantity of an active ingredient (or any other substance of concern in a wood preservative formulation) applied per m^2 or m^3 of wood	[$kg.m^{-2}$ or $kg.m^{-3}$]
$Q_{applic,product}$	=	application rate of the product, i.e. quantity of the product applied per m^2 resp. m^3 of wood	[$kg.m^{-2}$ or $l.m^{-2}$] [$kg.m^{-3}$ or $l.m^{-3}$]
$Q_{product\text{-}fluid}$	=	application rate of a fluid product: quantity of a.i. applied per m^2 of wood area resp per m^3 of wood volume	[$l.m^{-2}$] resp. [$l.m^{-3}$]:
$Q_{product\text{-}solid}$	=	application rate of a solid product: quantity of a.i. applied per m^2 of wood area resp per m^3 of wood volume	[$kg.m^{-2}$] resp. [$kg.m^{-3}$]
$Q_{leach,storage,time}$	=	cumulative quantity of an active ingredient or any substance of concern in a wood preservative product, leached due to rainfall from treated wood stored, within a certain assessment period	[kg]
$Q_{leach,time}$	=	cumulative quantity of an active ingredient, emitted to the relevant environmental compartment due to leaching from treated wood, over a certain time period of service, considered for assessment	[kg]
$Q_{leach,time1}$	=	cumulative quantity of an active ingredient, leached over the initial assessment period	[kg]
$Q_{leach,time2}$	=	cumulative quantity of an active ingredient, leached over a longer assessment period	[kg]
$RHO_{product}$	=	density of liquid product	[$kg.m^{-3}$]
RHO_{soil}	=	(wet) soil bulk density	[$kg.m^{-3}$]
RHO_{solid}	=	density of solid phase	[$kg.m^{-3}$]
$SUSP_{water}$	=	concentration of suspended matter in the surface water	[$kg.m^{-3}$]
$TAU_{seawater}$	=	residence time of the seawater (Wharf scenario – Chapter 5)	[d]
TAU_{wway}	=	residence time of water in waterway (Speet piling Scenario - – Chapter 5)	[d]
$TIME$	=	time period considered for assessment	[d]
$TIME_{storage}$	=	duration of storage of treated wood prior to shipment	[d]
$T_{release}$	=	period during release to outdoor air after treatment	[d]
$V_{fumigated}$	=	total room fumigation volume	[m^3]
$VOLUME_{wood\text{-}stacked}$	=	volume of treated wood stacked per 1 m^2 of storage area (i.e. soil)	[$m^3.m^{-2}$]
$VOLUME_{wood\text{-}treated}$	=	volume of wood treated per day	[$m^3.d^{-1}$]
V_{sed}		volume of sediment compartment	[m^3]
V_{soil}	=	(wet) soil volume	[m^3]
V_{water}	=	volume of the receiving water body	[m^3]

APPENDIX 8

BIBLIOGRAPHY

(1) **Adriaanse PI, 1996**
Fate of pesticides in field ditches: the TOXSWA simulation model.
Wageningen, The Netherlands: DLO Winand Staring Centre .
Report no. 90. 241 pp.

(2) **Australia 1999**
Emission Estimation Technique Manual for Timber and Wood Product Manufacturing, Australian National Pollutant Inventory, first published July 1999.

(3) **Baines EF; Davis SJ, 1998**
Environmental risk assessment of preservative treated wood. International Research Group on Wood Preservation (IRG): Wood Preservation - 4th International Symposium - Cannes/France, 2-3 February 1998. Section 5. Stockholm 1998, p. 221-245.

(4) **Beentjes C *et al.*, 1994**
Beentjes C; Visée HA 1994
Houtverduurzaming met behulp van zouten en andere middelen dan creosootolie. Instituut voor Milieu- en Systeemanalyse (IMSA), quoted by van Dokkum *et al.* 1998. VHZ039, 1994**.**

(5) **Berbee RPM, 1989**
Onderzoek naar de uitloging in oppervlaktewater van PAK en koper, chroom, arseen uit geimpregneerd hout Institute for Inland Water Management and Waste Water Treatment (RIZA), notanr. 89.049. Lelystad 1989.

(6) **Boonstra MJ *et al.*, 1991**
Boonstra MJ; Havermans JBGA; Homan WJ; Esser PM; Oldeman GJW **1991**
Evaluatie van onderzoek naar de uitloogkarakteristieken van verduurzaamd hout. TNO Report B-91-0082, 1991.

(7) **Brückner G *et al.*, 1992**
Brückner G; Willeitner H
Einsatz von Holzschutzmitteln und damit behandelten Produkten in der Bundesrepublik Deutschland. Umweltbundesamt: Umweltbundesamt Texte 48/92. UBA-FB-92-045. Berlin 1992, p. 152.

(8) **Brudermann GE, 1999**
Recommendations for the design and operation of wood preservation facilities (available also in French). Environment Canada: http://www.ec.gc.ca/nopp/wood/index_e.html. Cat.No. En40-578/1999E. Ottawa 1999. ISBN 0-662-27778-3, p. 226.

(9) **CEN 1992**
Durability of wood and wood-based products: Definition of hazard classes of biological attack; Part 1: General. European Committee for Standardisation (CEN): EN 335-1. Brussels 1992.

(10) **CEN 1996**
CEN Standard EN 599: Durability of wood and of wood-based products. Performance of preventive wood preservatives as determined by biological tests - Part 1: Specification according to hazard classes; Part 2: Classification and labelling, 1996.

(11) **Chadwick J *et al.*, 1992**
Chadwick J; Reston S
The regulatory problems in estimating the toxicity of wood preservatives to bats. Proceedings of the Second Conference on Ecotoxicology, Amsterdam, 11-15 May 1992. Sci. Total Environ., Supplement: 1507-1512.

(12) **CUWVO 1986**
Aanbevelingen met betrekkinig tot de interne sanering van lozingen afkomstig van houtimpregneerbedrijven -- Coördinatiecommissie uitvoering wet verontreiniging oppervlaktewateren - Werkgroep VI, quoted by van Dokkum et al. 1998

(13) **CUWVO 1992**
Hemelwaterproblematiek bij houtimpregneerbedrijven. Aanvullende nota - Coördinatiecommissie uitvoering wet verontreiniging oppervlaktewateren - Werkgroep VI. quoted by van Dokkum et al. 1998.

(14) **Deutsche Gesellschaft für Holzforschung 1991**
Verfahren zur Behandlung von Holz mit Holzschutzmitteln, Teil 1: Druckverfahren; Teil 2: Nichtdruckverfahren
(*Processes for wood treatment with preservatives - Part 1: Pressure processes; Part 2: non-pressure processes).* Merkblatt. München 1991.

(15) **Deutscher Holzschutz Verband e.V. 1999**
Entsorgung von Gebrauchthölzern (Disposal of treated wood).
http://www.holzschutz.com/entsorgung.html. Leonberg 1999.

(16) **Diem M, 1956**
Messung der Größe der Regentropfen in natürlichem Regen und bei künstlicher Beregnung. Beitr. zur naturkundl. Forschung 15:75-90.

(17) **DK EPA 1997**
Guidelines for assessment of the environmental risks associated with industrial wood preservatives. Danish Environmental Protection Agency, Pesticides Division. 12 February 1997

(18) **DK EPA 2001**
Danish Mapping Study on Biocides (Draft), Copenhagen 2001, p. 124.

(19) **ECETOC 1994 (European Centre for Ecotoxicology and Toxicology of Chemicals)**
Environmental Exposure Assessment. Technical Report. Vol. 61. Brussels 1994, p. 106

(20) **ECETOC 2001**
ECETOC Difficult Substances Environmental Risk Assessment of Poorly Water Soluble Substances
This paper presents ECETOC proposals for the revision of the EU TGD regarding risk assessment of Poorly Water Soluble Substances (tgd/ebg/ind 5)

(21) **EFG 2000**
EFG Document on Environmental Exposure Scenarios from Treated Wood (Version 4), February 2000. Background Document 4 prepared by the Environmental Focus Group (EFG) for the OECD Workshop on Exposure Assessment to Wood Preservatives, Belgirate, Italy, 10^{th}-12^{th} April 2000 [OECD 2000c]

(22) **Envirochem 1992**
Evaluation of leachate quality from CCA preserved wood products, Envirochem Special Projects Inc., on behalf of Environment Canada, March 1992.

(23) **EU 1993**
Commission Directive 93/67/EEC of 20 July 1993 laying down the principles for assessment of risks to man and the environment of substances notified with Council Directive 67/548/EEC. In: Official Journal of the European Communities No L227, p. 9-17

(24) **EU 1998**
Directive 98/8/EG of the European Parliament and the Council of 16 February 1998 on placing of biocidal products on the market. In: OJ L123 (24 April 1998), p. 1-63

(25) **EU TGD 1997**
Technical Guidance Document in Support of Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances and Commission Regulation (EC) No. 1488/94 on Risk Assessment for Existing Substances Office for Official Publication of the European Union. four parts. Luxemburg 1997. ISBN 92-827-8011-2.

(26) **EUSES 1996**
EUSES - The European Union System for the Evaluation of Substances Commission of the European Communities - European Chemicals Bureau (ECB) Ispra/Italy 1996.

(27) **EWPM 2000**
A protocol for the environmental risk assessment of wood preservatives. European Wood Preservative Manufacturers Group (EWPM). Version 2.3, 28 February 2000

(28) **FEI 1999**
Emission scenarios used in the Finnish Environment Institute (FEI) for wood preservatives in treated wood in service. Finnish Environment Institute. 11 November 1999

(29) **FOCUS 2000**
FOCUS groundwater scenarios in the EU review of active substances
Report of the FOCUS Groundwater Scenario Workgroup,
EC Document Reference SANCO/321/2000 rev. 2, 202 pp.

This report as well as other FOCUS reports can be downloaded from the following web site http://arno.ei.jrc.it:8181/focus/doc.html

(30) **Homan *et al.*, 1999**
Waldermar J.Homan; Arno L. Oosten 'Statistically stable models for determination of PEC', 30st Annual IRG meeting, Rosenheim, June 1999.

(31) **Jury WA *et al.*, 1990**
Jury WA; Russo D; Streile G; Abd HE
Evaluation of volatilization by organic chemicals residing below the soil surface. Water Resour. Res. (26):13-20, 1990.

(32) **Kloskowski R *et al.*, 1999**
Kloskowski R; Fischer R;, Binner R
Draft guidance on the calculation of predicted environmental concentration values (PEC) of plant protection products for soil, groundwater, surface water and sediment. del Re AAM; Brown C; Capri E; Errera G; Evans SP und Trevisan M (eds.): Human and Environmental Exposure of Xenobiotics - XI Symposium Pesticide Chemistry, Sept. 11-15, 1999. Cremona/Italy 1999, p. 835-849.

(33) **Kohler M *et al.*, 2000**
Kohler M; Künniger T; Schmid P; Guier E; Crockett R; Wolfensberger M
Inventory and emission factors of creosote, polycyclic aromatic hydrocarbons (PAHs), and phenols from

railroad ties treated with creosote. In: Environ. Sci. Technol. 34 (22), p. 4766-4772 (2000).

(34) **Linders *et al.*, 1998**
Linders JBHJ and Jager DT
Uniform System for the Evaluation of Substances (USES), National Institute of Public Health and the Environment (RIVM), report 679 102 044, Bilthoven 1998.

(35) **Luttik R *et al.*, 1993 November**
Luttik R; Emans HJB; Van der Poel P; Linders JBHJ
Evaluation System for Pesticides (ESPE): 2. Non-agricultural pesticides; to be incorporated into the Uniform System for the Evaluation of Substances (USES) National Institute of Public Health and Environmental Protection (RIVM), report 679102021. Bilthoven 1993 November, p. 60.

(36) **Luttik R *et al.*, 1995 February**
Luttik R; Van der Poel P; Van den Hoop MAGT
Supplement to the methodology for risk assessment of non-agricultural pesticides (ESPE): 2. incorporated in the Uniform System for the Evaluation of Substances (USES) National Institute for Public Health and Environmental Protection (RIVM), report 679102028. Bilthoven 1995 February, p. 20.

(37) **Millington RJ; Quirk JP, 1960**
Transport in porous media. In: Van Beren FA *et al*. Trans. Int. Congress Soil Sci Soc. 7th Volume 1. Madison, WI. Elsevier, Amsterdam. p. 97-106.

(38) **Mitchell-Jones AJ *et al*., 1989**
Mitchell-Jones AJ; Cooke AS; Boyd IL; Stebbings RE
Bats and remedial timber treatment chemicals – A review. Mammal Rev. 19: 93-110, 1989.

(39) **OECD 1989**
Report on the OECD Workshop on ecological effects assessment Organisation for Economic Co-operation and Development (OECD), Paris 1989.

(40) **OECD 1992**
Screening Assessment Model System (SAMS). A Program of Simple Models for Exposure Assessment to Chemicals. OECD Environment Directorate. July 1992.

(41) **OECD 1995**
Report of the Workshop on Environmental Hazard/Risk Assessment. Organisation for Economic Co-operation and Development (OECD): OECD Environment Monograph. Vol. 105. Paris 1995

(42) **OECD 1999**
Environmental exposure assessment strategies for existing industrial chemicals in OECD Member countries. Organisation for Economic Co-operation and Development (OECD): Series on Testing and Assessment / http://www.oecd.org/ehs/. Vol. 17. Paris 1999, p. 31.

(43) **OECD 2000a**
Report of the OECD Workshop on improving the use of monitoring data in the exposure assessment of industrial chemicals. Organisation for Economic Co-operation and Development (OECD): Series on Testing and Assessment. Vol. 18. Paris 2000.

(44) **OECD 2000b**
Guidance Document on Emission Scenario Documents. Organisation for Economic Co-operation and Development (OECD): Series on Emission Scenario Documents. Vol. 1. Paris 2000, p. 22

(45) **OECD 2000c**
Report of the OECD Workshop on Environmental Exposure Assessment to Wood Preservatives - Belgirate/Italy 10 - 12 April 2000. Organisation for Economic Co-operation and Development (OECD): Paris 2000, p. 77.

(46) **OECD 2000d**
Wood Preservation and Human Exposure (Version 4) - Workshop Document 1 prepared for the OECD Workshop on Exposure Assessment to Wood Preservatives, Belgirate, Italy, 10th-12th April 2000, p. 124.

(47) **OECD 2000e**
Wood Preservatives and Environmental Exposure: Overview of Emission Scenarios for Treated Wood in Service. Workshop Document 3 prepared for the OECD Workshop on Exposure Assessment to Wood Preservatives, Belgirate, Italy, 10th-12th April 2000.

(48) **OECD 2000f**
Guidance Document on aquatic toxicity testing of difficult substances and mixtures
No. 23, ENV/JM/MONO(2000)6

(49) **OECD 2001a**
Meeting Document EXGP(2001)2 *'Compilation of industry responses to the OECD survey on industrial wood preservation applications'* of the Expert Group for the development of the OECD ESD for Wood Preservatives – February 2001.

(50) **OECD 2001b**
Meeting Document EXGP(2001)4 *'Scenarios for the Environmental Exposure from Treated Wood in Service'* of the Expert Group for the development of the OECD ESD for Wood Preservatives – February 2001.

(51) **Paneli M, 2001a**
Paneli M, *'Suggestions for calculation of the long term emissions of preservative component(s) from treated wood, based on experimental leaching data'*
Working document EXGP(2001)11 of the Expert Group for the development of the OECD ESD for Wood preservatives, August 2001.

(52) **Paneli M, 2001b**
Paneli M, **'***Comparison of the performance of Model I and Model II for calculation of the emissions of preservative component(s) from treated wood, based on experimental leaching data'*
Working document EXGP(2001)15 of the Expert Group for the development of the OECD ESD for Wood Preservatives, October 2001.

(53) **Peek R, 2001a**
Peek R, *'Requirements for leaching tests to fulfil the needs for exposure assessment: duration of simulated rain events and pH of the rain'*
Working Document EXGP(2001)8of the Expert Group for the development of the OECD ESD for Wood preservatives, May 2001.

(54) **Peek R, 2001b**
Peek R, Working Document EXGP(2001)13 '*Literature Review of Available Leaching Studies*' of the OECD Expert Group for the development of the ESD for Wood preservatives, August 2001.

(55) **Raven KG *et al.*, 1987**
Raven KG; BelangerDW; Carter M, 1987: Inventory of coal gasification plant waste sites in Ontario. Proc.Ont.Ind.Waste Conf. 34:47-73

(56) **RIVM, VROM and VWS 2000**
Uniform System for the Evaluation of Substances 3.0 (USES 3.0). National Institute of Public Health and the Environment (RIVM), Ministry of Housing, Spatial Planning and the Environment (VROM), Ministry of Health, Welfare and Sport (VWS), The Netherlands.

(57) **Sloof W *et al.*, 1989**
Slooff, W., Janus, J.A., Matthijsen, A.J.C.M., Montizaan, G.K., Ros, P.J.M. (eds.). 1989. Integrated criteria document PAHs. Bilthoven, The Netherlands: National Institute of Public Health and Environmental Protection (RIVM), report nr. 758474011

(58) **Schoknecht U *et al*., 2001**
Schoknecht U; Wegner R; Jann O, Horn W
'Investigation on the emission of biocides from treated materials'
(UBA project 299 67 410)

(59) **UBA 1992**
Konzept für die Prüfung und Bewertung der Umweltverträglichkeit von Holzschutzmitteln. Umweltbundesamt Berlin. Bringezu, S. February 1992

(60) **UBA 2001**
"Gutachten zur Erhebung struktureller Daten ueber industrielle und gewebliche Anwender von Holzschutzmitteln in Deutschland' (FKZ 360 04 008), Study performed by Fresenius Umwelt Consult on behalf of the German UBA, February 2001.

(61) **Ullmann 1996**
Wood preservation. Elvers B und Hawkins S (eds.): Ullmann's Encyclopaedia of Industrial Chemistry. Vol. A28. Weinheim: VCH Verlagsgesellschaft 1996. ISBN 3-527-20128-9, p. 357-380.

(62) **UNEP 1994**
Environmental aspects of Industrial Wood Preservation -- A Technical Guide (translated also into French). United Nations Environment Programme (UNEP) and Industry and Environment: Technical Report Series. Vol. 20. Paris 1994. ISBN 92-807-1403-1, p. 105.

(63) **US EPA 1995**
Profile of the lumber and wood products. EPA Office of Compliance: Sector Notebook Project: http://es.epa.gov/oeca/sector/index.html. EPA/310-r-95-006. Washington D.C. 1995

(64) **US EPA 1999**
Emission Factor Documentation for AP-42 'Compilation of Air Pollutant Emission Factors' , Section 10.8, Wood Preserving. US EPA, Office of Air Quality Planning and Standards. Emission Factor and Invetory Group.

(65) **Van der Poel P 1999 July**
Supplement to the Uniform system for evaluation of substances (USES) - Emission scenarios for waste treatment (elaborated for biocides) National Institute of Public Health and the Environment (RIVM). RIVM report 601 450 003. Bilthoven 1999 July, p. 80.

(66) **Van Dokkum HP *et al.*, 1998**
Van Dokkum HP; Bakker DJ; Scholten MCT
Development of a concept for the environmental risk assessment of biocidal products for authorization purposes (BIOEXPO) - Part 2:Release estimation for 23 biocidal product types . Umweltbundesamt: UFOPLAN 106 01 065. TNO-MEP-R-97-443. Berlin 1998, p. 152.

(67) **Van Leeuwen CJ *et al*., 1996;**
Van Leeuwen CJ; Bro-Rasmussen F; Feijtel TC; Arndt R; Bussian BM; Calamari D; Glynn; Grandy NJ; Hansen B; van Hemmer JJ; Hurst P; King N; Koch R; Müller M; Solbé JF; Speijers GAB; Vermeire T
Risk assessment and management of new and existing chemicals. In: Environ. Toxicology Pharmacology 2, p. 243-299.

(68) **Quarles van Ufford QCHA 1994**
SPIN rapport: Industriele houtverduurzaming. National Institute of Public Health and Environmental Protection (RIVM) & Institute for Inland Water Management and Waste Water Treatment (RIZA): quoted by van Dokkum et al. 1998. RIVM report No. 736301162 & RIZA notanr. 92.003/62. Biltoven 1994.

(69) **Vermeire TG *et al.*, 1997**
Vermeire TG; Jager DT; Bussian B; Devillers J; den Haan K; Hansen B; Lundberg I; Niessen H; Robertson S; van der Zandt PTJ
European Union System for the Evaluation of Substances (EUSES). Principles and Structure. In: Chemosphere 34 (8), p. 1823-1836.

(70) **CONCAWE Ecology Group**
Environmental risk assessment of petroleum products – Hydrocarbon Block Approach. Brussels

(71) **ISO draft standard** *'An international framework for classifying wood products durability based on use classes'*

*(72) **'The Biocides Business, Regulation, Safety and Applications',** Edited by Derek J. Knight & Mel Cooke, WILEY-VCH, 2002*

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