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Thematic Strategy on Sustainable Use of Plant Protection Products – Prospects and Requirements for Transferring Proposals for Plant Protection Products to Biocides

Annex II:

Case study on PT 8: Wood Preservatives

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On behalf of the Federal Environmental Agency

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Contents

List of Abbreviations

CAR	Competent authority report
CCA	Copper chrome arsenate
ESD	Emission Scenario Document
DGfH	German Association for Wood Research (Deutsche Gesellschaft für Holzforschung e.V.)
DiBt	Deutsches Institut für Bautechnik
ESD	Emission Scenario Document
K-HDO	Cyclohexylhydroxydiazene 1-oxide, potassium salt
PT	Product type
RAL	Institut für Gütesicherung und Kennzeichnung eV
SDS	Safety data sheet
TRGS	Technical Rule for Hazardous Substances

1 Introduction

1.1 Target organisms

The Biocide Directive defines wood preservatives as “products used for the preservation of wood, from and including the saw-mill stage, or wood products by the control of wood-destroying or wood-disfiguring organisms.”

Wood preservatives are used for both preventive and curative treatments of wood in order to either prevent/retard the occurrence of biological degradation by wood-destroying or wood-disfiguring **fungi** and **insects** or to remedy already existing infestations of insects. Thus, depending on the target organisms, wood preservatives either act as fungicides or insecticides.

Table 1 gives on overview of the target organisms of preventive and curative treatments with wood preservatives.

Table 1 Target organisms of wood preservatives

<table>
<tr><td rowspan="2">Preventive treatments</td><td colspan="2">Fungi</td><td rowspan="2">Insects (wood boring & wood destroying)</td></tr>
<tr><td>Wood destroying fungi</td><td>Wood discolouring fungi</td></tr>
<tr><td></td><td>▪ Basidiomycetes;
▪ Rot (Serpula lacrimans, Coniophora puteana, Antrodia vailantii / Antrodia sinuosa)
▪ other</td><td>▪ Blue stain,
▪ Sap stain;
▪ Mould
▪ other</td><td>▪ larvae of the house longhorn beetle (Hylotrupes bajulus),
▪ Common house borer (Anobium punctatum),
▪ Powder-post beetles (Lyctidae);
▪ Termites (Reticulitermes santonensis)
▪ other</td></tr>
<tr><td>Curative treatments</td><td colspan="3">Insects (wood boring & wood destroying)</td></tr>
<tr><td></td><td colspan="3">▪ larvae of the house longhorn beetle (Hylotrupes bajulus);
▪ Termites (Reticulitermes santonensis)</td></tr>
</table>

1.2 Use and user groups

Preventive treatments are usually applied to wood at industrial treatment plants before the wood is put into service whereas curative treatments are mostly applied to

wood in-situ by professionals or amateurs. According to OECD (2003), in Germany about 95% of wood preservatives are applied in preventive treatment and about 5% in curative treatment.

Table 2 gives an overview of the typical wood preservative user groups.

Table 2 Wood preservatives user groups

User sector	Typical user
Industry	Sawmill, joinery, carpentry workers
Specifically trained professionals	Specifically trained and/or certified professionals (e.g. pest control technicians)
General public/amateurs	Non-trained applicators (using household wood preservatives)

1.3 Active substances

Regulation 2032/2003[1] listed about 80 active substances for PT 8, of which 41 active substances were included in the EU review programme to be evaluated with a view to their possible inclusion in Annex I, IA or IB to Directive 98/8/EC. Up to December 2010, 18 active substances of PT 8 have been included into Annex I or IA to Directive 98/8/EC (see Table 3). Depending on the target organisms, wood preservatives either act as insecticides or fungicides, with some of them being efficient against both insects and fungi.

Table 3 Active substances of PT 8 already included in Annex I, IA or IB to Directive 98/8/EC[2]

Substance	Insecticide	Fungicide
Boric acid	X	X
Boric oxide	X	X
Clothianidin	X	
Dazomet		X
Dichlofluanid		X
Disodium octaborate tetrahydrate	X	X
Disodium tetraborate	X	X

1 http://eur-lex.europa.eu/pri/en/oj/dat/2003/l_307/l_30720031124en00010096.pdf

2 http://ec.europa.eu/environment/biocides/annexi_and_ia.htm

Substance	Insecticide	Fungicide
Etofenprox	X	
Fenpropimorph		X
IPBC		X
K-HDO		X
Propiconazole		X
Sulfuryl fluoride	X	
Tebuconazole		X
Thiobendazole		X
Thiacloprid	X	
Thiamethoxam	X	
Tolylfluanid		X

In Germany, wood preservatives that are used for the preservation of construction timber need a special registration: the national technical approval or “Bauaufsichtliche Zulassung”. This technical approval is issued by the German Institute for Construction Techniques (Deutsches Institut für Bautechnik – DiBt). Approved wood preservatives are published in the “Directory of wood preservatives” (“Holzschutzmittelverzeichnis“; DiBt 2009).

The quality label RAL-GZ 830 (Version 04/2007) is assigned by the “Gütegemeinschaft Holzschutzmittel” to those wood preservatives used for the preservation of non-construction timber that fulfil defined quality standards on biological efficacy, safety for human health and environmental compatibility (http://www.holzschuetzen.de/).

1.4 Formulation types and mode of application

1.4.1 Formulation types

Wood preservative products are categorised by the type of formulation carrier. The OECD ESD (2003) distinguishes between four groups of formulation carriers, namely water, light organic solvent (white spirit type solvents), coal tar derivates and gases.

With reference to the first group – water based preservatives – a further distinction is made between non-fixating and fixating wood preservatives.[3]

Fixating wood preservatives are suitable for outdoor uses with direct contact to soil and/or water. In contrast, wood treated with non-fixating wood preservatives needs to be protected against weathering and is therefore only to be used indoors. Fixating wood preservatives contain components that support the fixation of the active ingredient to the wood. In order to ensure the proper fixation of the active ingredient of the wood preservatives, fixation times need to be maintained after the impregnation and before the actual use of the treated timber. After this fixation time, the treated timber can be exposed to weathering or be used in applications in contact with the ground or water.

Chromium has been extensively used as a fixative agent, especially in combination with copper and arsenic wood preservatives (copper chrome arsenate (CCA)). During this process the carcinogenic chromium (VI) is turned into chromium (III).There have been discussions in the EU regarding the use of chromium and its efficacy as wood preservative active agent. If chromium were to be considered as an active substance it could not be used in formulated biocidal products, because it would most likely fail the review for Annex I inclusion. Therefore, industry refers to its use as a fixative below its effective concentration as wood preservative.[4] This is an example of where the substance of concern is not the active substance but the fixative agent.

1.4.2 Mode of application

With regard to the mode of application, two main treatment techniques may be distinguished, namely deep penetrating and surface treatments. Each of these two treatment techniques covers several different possible preservation/application processes:

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[3] The ESD refers to fixation of the active substance by chemical or other means with the wood substrate. Fixation is a term originally used for chromium containing preservatives (OECD 2003).

[4] The guidance document agreed between the Commission services and the competent authorities of Member States on the role of chromium in wood preservation ENV.B.4/KB D(2005), Brussels, 4.07.2005 http://ec.europa.eu/environment/biocides/pdf/nfg_cr_040705.pdf

Penetrating application processes:

- Vacuum pressure
- Double vacuum, low pressure
- Injection

Surface treatments:

- Fumigation (indoor)
- Spraying, dipping, brushing, injection (indoor)
- Brushing, injection, wrapping, termite prevention = foundation treatment (outdoor)

Deep penetrating treatments like vacuum-pressure or double vacuum are exclusively applied to wood in industrial treatment plants for preventive purposes. Surface treatments like spraying, dipping or brushing are applied both for preventive and curative purposes in all use sectors, i.e. by industrial, professional and amateur users (see Table 4).

Table 4 Overview of application processes of wood preservatives (OECD 2003)

Type	User sector	Preservation process
Preventive	Industrial	Vacuum pressure & double vacuum process Vacuum (Automated) spraying / dipping Thermal impregnation
	Professional *in-situ* treatments	Spraying Injection Wrapping Brushing
	Amateurs	Brushing Spraying[5]
Curative	Professionals	Fumigation, injection, wrapping, spraying/ Brushing
	Amateurs	Spraying/

[5] In several countries (e.g. in Germany) spraying by amateurs is forbidden.

2 Possible emission routes and available ESD

The Thematic Strategy on the sustainable use of pesticides focuses on the reduction of risks during the use phase of the applied products.

With regard to the use phase of wood preservatives, it is necessary to differentiate between the application/treatment phase, the storage of treated timber and the service life phase.

Emissions of wood preservatives and resulting exposure to the environment may occur during the application phase, storage and the service life. The route and degree of emission depend very much on the specific application.

2.1 Emissions during the application/treatment phase

As described in section 1.4.2, wood can be treated using a deep penetration treatment process (for example vacuum pressure impregnation) or a superficial treatment process, which may be via dipping, spraying or brushing. The extent of emission during the application depends very much on the treatment technique.

Deep penetrating treatment techniques are usually carried out in industrial treatment plants. The wood is treated in a closed system and thus emissions to the environment are expected to be quite low: Emissions to soil and air may only occur in the case of accidental leakage or if safety standards are not followed. Discharges to waste water may take place by accidental spillage and during the cleaning of equipment and work clothes. According to COWI (2009), the total loss to waste and the environment during vacuum and pressure processes is estimated at < 5% of the biocides used.

The main surface treatments of timber include spraying, dipping/immersion or brushing. Surface treatments are often performed *in-situ* (i.e. outdoors) by both professional and amateur users. Wood preservatives may be released to soil or water if the treated wood is dripping, either during or shortly after application. In addition, spray applications may form aerosols causing emissions to the surroundings. Furthermore, cleaning machinery (immersion vessels), tools (brush, sprayer) and empty packages may lead to releases of wood preservative into the sewage system or even directly to the environmental compartments of soil and water.

2.2 Emissions during the storage of treated wood before use

In industrial treatment plants, freshly-treated wood is usually stored on-site before further processing takes place. Depending on the storage conditions, wood preservatives may be washed out of treated wood by precipitation, resulting in contamination of soil, groundwater and/or surface water.

In the first period following the preservation procedure, the biocidal active ingredients have to react with the wood constituents to be fixed in the wood. During that period, the risk of leaching by precipitation is highest and thus has to be minimised to ensure the efficacy of preservation as well as to prevent emissions into the environment.

Leaching can be efficiently prevented by storing the treated wood in roof-covered and paved (= impermeable) storage areas. Relevant risk mitigation measures are therefore specified in the Inclusion Directives of several active substances that have already been included in Annex I, IA or IB to Directive 98/8/EC (see section 3.1).

2.3 Emissions during the service life phase

The service life phase of treated timber can be very long; up to 50 years, depending on the specific application.

ISO (2007) defines five use classes that represent different service situations to which wood and wood-based products can be exposed. A description of the use classes with respective typical examples of end-uses and primary receiving environmental compartments is presented in Table 5. According to a presentation given by the European Wood Preservatives Manufacturers Group (EWPM) at a leaching workshop in Arona (2005), 70-80 % of the wood in use is in use/hazard class 3 (Plassche & Rasmussen, 2005).

For most preserved wood, the most significant losses to the environment take place during the service life phase, where the preserved wood is directly exposed to soil, water and/or weathering depending on the use class. According to COWI (2009), experiments have shown that about 25% of chromium, copper and arsenic will be washed out and released to the environment within 20-40 years of service life. The leaching rate decrease over time (Plassche & Rasmussen, 2005).

Table 5 Use classes of wood preservatives with typical examples

Use Class	Description	Typical examples of timber end-use	Primary receiving environmental compartment
1	Wood or wood-based product is under cover, fully protected from the weather and not exposed to wetting	All timbers in normal pitched roofs except valley gutters and tiling battens; floorboards, architraves and internal joinery timbers not built into solid external walls	Indoor/outdoor air *(emissions to outdoor air are considered negligible)*
2	Wood or wood-based product is under cover, fully protected from the weather but high environmental humidity can lead to occasional but not persistent wetting	Frame timbers in timber frame houses; timers in flat roofs	-
3	Wood or wood-based product is not covered and not in contact with the ground. It is either continually exposed to the weather or is protected from the weather but subject to frequent wetting	External joinery, bargeboards, fascias, valley gutter timbers. Fence rails, gates, deck boards, cladding. Noise barriers.	soil
4	Wood or wood-based product is in permanent contact with the ground or fresh water and thus is permanently exposed to wetting, divided into:		
4a	Wood in contact with the ground	Fence posts, gravel boards, transmission poles, playground equipment, motorway and highway fencing.	soil
4b	Wood in contact with fresh water	Lock gates and revetments. Cooling tower packing	freshwater
5	Situation in which wood or wood-based product is permanently exposed to salt water	Marine piling, jetties, dock gates	seawater

Figure 1 gives an overview of the main treatment types and processes for wood preservatives and includes potential emission routes to different environmental compartments.

In summary, with the exception of the industrial treatment in closed systems (e.g. vacuum and pressure treatments), many of these wood preservative applications are “open applications” with a potential risk of contaminating the environment.

2.4 Emission scenario documents (ESD)

The OECD Emission Scenario Document No. 2 Wood Preservatives Part 1-4 (OECD 2003) contains different emission scenarios for:

- Industrial preventive treatments to estimate emissions occurring during the industrial application phase;
- Service life of industrially pre-treated wood to estimate the emissions occurring during the service life phase, and
- Preventive and curative *in-situ* treatments by professionals and amateurs to estimate the emissions occurring during the application and the service life stage of the treated wood.

The existing emission scenarios provide guidance on how the emissions of active substances from wood preservatives to the environmental compartments of soil, water and air can be estimated.

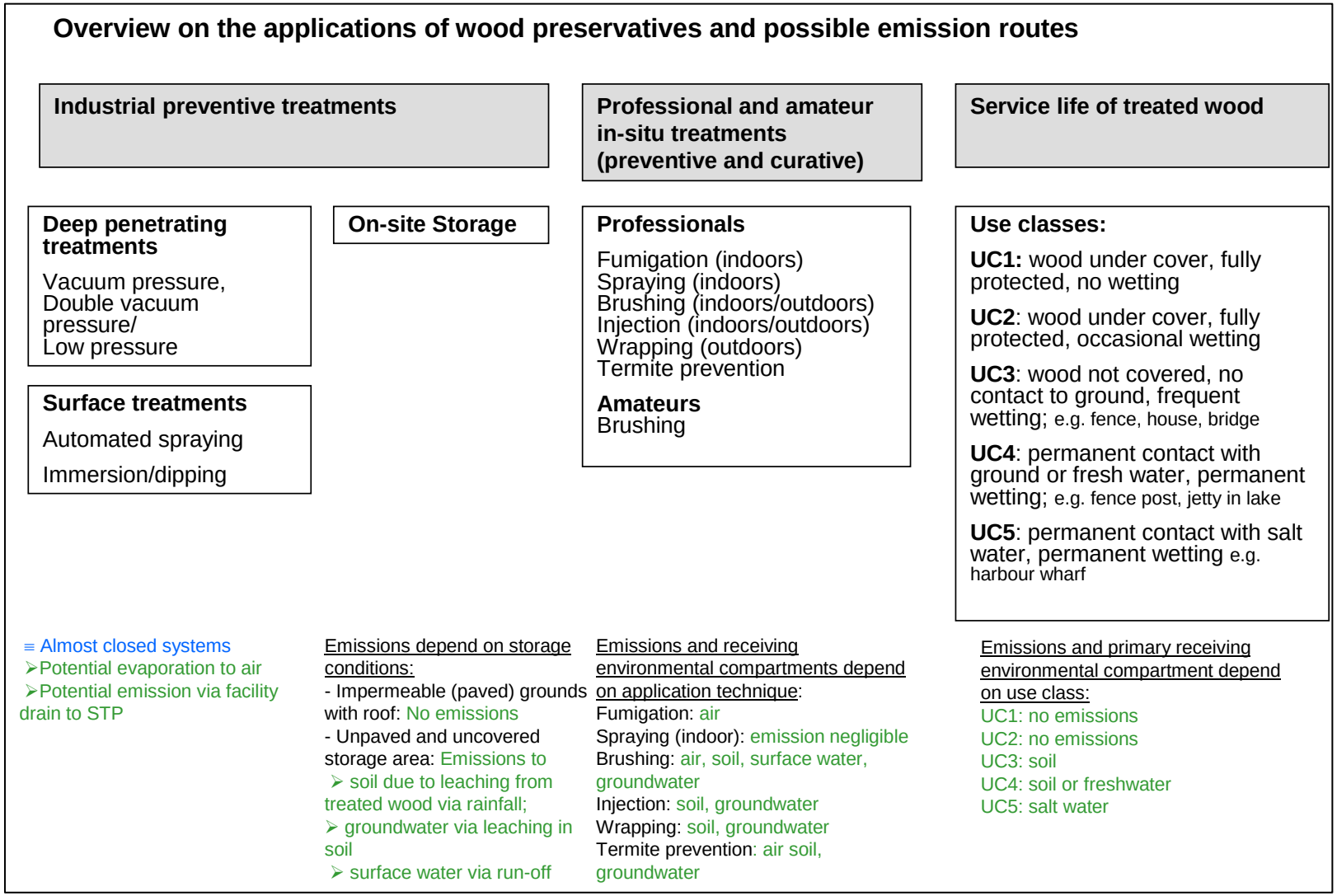

Figure 1: Overview of the main treatment types and processes of wood preservatives with respective potential emission routes to environmental compartments

3 Elements of sustainable use

3.1 Risk Mitigation Measures

Status

The Inclusion Directives for those active substances that have already been included in Annex I, IA or IB to Directive 98/8/EC, describe different risk mitigation measures which shall be considered during the authorisation of biocidal products containing theses active substances. Specific provisions for product authorisations, available so far, are summarised in Table 6.

Table 6 Provisions for product authorisations from the Inclusion Directives

Area	Risk mitigation measures	Active Substance
User restriction	Restriction of the use of the fumigant sulfuryl fluoride to **trained professionals**	Sulfuryl fluoride
	Restriction to industrial operators	K-HDO
Area of application	**Restriction of use** of K-HDO for the treatment of wood that may enter in direct contact with infants.	K-HDO
	Restriction of the use class for certain wood preservatives: No **in-situ treatment of wood** outdoors. *)	Boric acid Disodium tetrahydrate Propiconazole Tebuconazole Thiabendazole Thiamethoxam Tolylfluanid
	Restriction of the use class for certain wood preservatives for wood that will be in continuous contact with water or weathering allowed.*)	Boric acid Disodium tetrahydrate Propiconazole Clothianidin Tebuconazole Thiabendazole Thiamethoxam Tolylfluanid
	Restriction of in situ treatment of wooden structures near water, where direct losses to the aquatic compartment cannot be prevented, or for wood that will be in contact with surface water	Thiacloprid
Equipment	Restriction K-HDO as wood preservative to industrial use in **fully automated and closed equipment.** *)	K-HDO
Post application	**Storage** of timber freshly treated with wood preservatives under shelter or on impermeable hard standing to prevent direct losses to soil or water	IPBC Boric oxide Clothianidin Dichlofluanid Fenpropimorph Propinconazole Tebuconazole Thiabendazole Thiamethoxam Tolylfluanid
Disposal	**Collection** of any losses of wood preservative for reuse or disposal	Most wood preservatives

Area	Risk mitigation measures	Active Substance
Risk management measures	Use of appropriate **personal protective equipment** for reducing human exposure through industrial and/or professional use of certain wood preservatives	Most wood preservatives
	Appropriate risk mitigation measures for operators and bystanders exposed to the fumigants	Sulfuryl fluoride

*) Condition may be modified according to the outcome of a risk assessment

The use of a topcoat to reduce emissions of wood preservatives during their service life has been challenged in some draft CARs. However, the effectiveness of this RMM has been questioned because a top coat on construction timber will only be appropriate for a longer time span (3 to 5 years) if the wooden structure does not significantly change its dimensions. However, some deformation is inevitable if the wooden structure is permanently exposed to weathering and if no scheduled maintenance of the coating takes place (Fischer 2008).

In Germany, the technical standard DIN 68800 (Protection of timber, Part 1-5) regulates the appropriate and safe use of wood preservatives:

- DIN 68800-1: General specifications
- DIN 68800-2: Preventive constructional measures in buildings
- DIN 68800-3: Preventive chemical protection
- DIN 68800-4: Measures for the eradication of fungi and insects
- DIN 68800-5: Preventive chemical protection for wood based materials.

In addition, several technical rules (TRGS) exist, both for preventive treatments (TRGS 551 and 618) and curative treatments of wood (TRGS 512 and 523). For example, TRGS 523 contains special protective measures to be taken in connection with pest control activities (including curative treatments with wood preservatives) using substances or preparations that are highly toxic, toxic or otherwise hazardous to health.

On overview of existing standards, BAT and other relevant documents is given in Appendix 5.1.

Options

Further potential RMM to be applied for wood preservatives are; the limitation of package size (especially with regard to amateur users), use or user restrictions for certain modes of application, restriction to certain use classes and the collection of remnant packages by suppliers.

Harmonised standards and technical rules on the safe use of wood preservatives should be introduced at a European level.

The suitability and efficiency of RMM for biocidal products of PT 8 (and PT 18) have been evaluated in more detail within research project FKZ 3709 65 402.

3.2 Training

Status

According to the Inclusion Directive for the fumigant sulfuryl fluoride, Member States shall ensure that products containing this active substance may only be sold to and used by professionals trained to use them.[6]

In Germany, preventive and curative treatments via spraying and/or fumigation have to be undertaken by trained professionals, such as pest control technicians.[7]

The German Association for Wood Research (Deutsche Gesellschaft für Holzforschung e.V.) publishes numerous guidance documents which set out best practice for wood protection and biocide application.[8]

Furthermore, with regard to wood preservation in Germany, several training structures exist as part of the building protection industry:

The German Holz- und Bautenschutzverband e.V. offers a seminar / training course leading to the qualification of professional users. Successful participants in this course are awarded an expert knowledge certificate for wood preservation (“Sachkundenachweis Holzschutz”). The certificate confirms the qualification meets

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6 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:414:0078:0080:EN:PDF

7 During the 26th CA-Meeting it was agreed that the spraying method can be accepted for amateur users as long as no PPE is required.

8 http://www.dgfh.de/

the requirements of DIN 68800, part 4 and indicates that the owner has adequate scientific and technical knowledge in the preparation, guidance, execution and testing of wood preservation measures.[9]

In Germany, since 2007 the training requirements of a woodwork and building protector include a 3-year traineeship[10]. The occupational skills required include, inter alia:

- to detect and assess damage to woodwork and wooden construction elements;
- to complete preventive wood protection measures against animal (insects) and plant (fungal) pests which cause damage to wood;
- to detect and combat insects and fungi which cause damage to wood;
- to rectify damage to wood caused by animal and plant pests.

The German Technical Rule for Hazardous Substances (TRGS) 523 applies to pest control activities using substances and preparations that are highly toxic, toxic and/or hazardous to health inter alia in the area “preservation and protection of wood and buildings”. Professionals who want to apply to the relevant authority for recognition in accordance with Section 4.3.2 of the TRGS 523 have to submit evidence of their knowledge (e.g. in form of certificates evidencing an examination or training course) and evidence on their on-the-job experience.[11]

In Sweden, there are requirements for professional users concerning the use of rodenticides (PT 14), wood preservatives (PT 8) and insecticides (part of PT 18), and training is part of a specific provision in the authorization (see Annex II to COWI).

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[9] Ausbildungsbeirat Holzschutz am Bau (Hrg.). Handbuch zur Sachkundeausbildung Holzschutz am Bau Fragen und Antworten3. Auflage Stand Februar 2009

[10] http://www.bibb.de/en/ausbildungsprofil_31944.htm

[11] http://www.baua.de/en/Topics-from-A-to-Z/Hazardous-Substances/TRGS/pdf/TRGS-523.pdf?__blob=publicationFile&v=2

In France, there are voluntary standards for the training and certification of professional users:

- NFU 43500 standard (certificate) of good practice in the use of plant protection products or biocidal products, by professional users[12]
- CTB A+ certification of professional users of wood preservatives (PT08). This standard is awarded by companies on a voluntary basis and certified by the FCBA.[13]

In the USA, the state of Michigan offers an extensive manual/guide for commercial applicators of Category 7B pesticides for the control of “wood destroying pests” (Randall et al. 2000).

Options

Each improvement in the level of understanding of the users of wood preservatives, via for example training courses, other forms of education and the availability of best practice guidance documents, could be considered to support the sustainable use of wood preservatives.

The obligatory certification of workers at industrial treatment facilities and professional users of wood preservatives would be one option to increase the level of understanding of users. The development of harmonised guidance on best practice and suitable use instructions for applicants via the label or guidance documents, are further measures for improving sustainable use.

3.3 Requirements for sales of pesticides

Status

In Annex II of the COWI study, an overview is given of national qualification schemes for retailers/distributors of biocides, e.g.:

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[12] Norme NF U 43-500 sur les bonnes pratiques d'applications des produits phytosanitaires et biocides (Septembre 2006).

[13] http://www.ctbaplus.fr/ and http://www.fcba.fr/

- In Sweden, retailers need a certificate to sell products with certain hazardous properties and it is the retailer's responsibility to ensure that the buyer has the required qualifications such as a relevant certificate.
- In Finland, retailers/distributors and producers provide the national competent authorities once a year with data on the production, import/export and sales of biocidal products.
- In Germany, distributors or retailers selling biocidal products classified as toxic, very toxic or harmful (R40, R62, 63, 68) or oxidising or extremely flammable need a certificate of competence as required under the Chemikalien-Verbotsverordnung (ChemVerbotsV).

Biocidal products classified as very toxic or toxic should not be marketed via self-service systems, including from outlets with open shelves where products may be handled by the customer before purchase and internet commerce (Chemikalien-Verbotsverordnung, ChemVerbotsV). In Germany these methods are prohibited for the sale of plant protection products, irrespective of their classification, according to the plant protection law (Pflanzenschutzgesetz. PflSchG).

Nevertheless, many consumer biocides like wood preservatives are often displayed for sale on open shelves (self–service), or sold via the Internet where adequate use information, safety instructions and information on health and environmental risks are often not provided to customers.

Options

Requirements covering the sale of all biocidal products should be introduced which apply the requirements of the Directive on sustainable use of pesticides, including the prohibition of self-service sales of wood preservatives and provision for general information regarding the risks associated with the use of wood preservatives to be provided to customers by distributors, including information on hazards, exposure, proper storage, handling and application, and disposal.

3.4 Awareness programmes and information

Status

In Germany, a web-based information system for biocides (web portal combined with print media) has been established for the general public. The information system is available from the website, http://www.biozid.info/. This portal, developed and run by the Federal Environment Agency, aims to inform the general public about physical, chemical and other measures as alternatives to the use of biocidal products or which may minimize their use. On this website, particular emphasis is placed on describing preventive measures that may be applied to avoid the need to use biocides.

Furthermore, the Federal Ministry for Food, Agriculture and Consumer Protection (BMELV) published a “Practical Guide for Consumers on wood preservatives” in order to provide amateur (private) users with information on the safe use of wood preservatives (BMELV 2008).

Options

- Development of awareness programmes and practical guides for the general public on the risks of wood preservatives (and of biocides in general), as well as increasing awareness of the existence of these among their intended audience.
- Promotion of preventive (biocide-free) measures as alternatives to the use of chemical wood preservatives.
- Promotion of voluntary labelling (e.g. Blue Angel, EU Ecolabel).[14]

[14] e.g. RAL-UZ 12a Schadstoffarme Lacke does exclude the use of preservatives for other purposes than in-can preservation http://www.blauer-engel.de/_downloads/vergabegrundlagen_de/UZ-012A.pdf

3.5 Certification and inspection of equipment in use

Status

Equipment used for wood preservation in industrial treatment plants has to fulfil certain requirements laid down in different EC Directives and technical standards.

For example, vessels for the pressure treatment of wood using water-soluble impregnating agents or coaltar oil (creosote) fall under the Pressure Equipment Directive (97/23/EC) and the Machinery Directive 2006/42/EC.

In many European countries (and elsewhere), wood treatment plants need to be authorised for operation by national authorities according to environmental laws or regulations which describe in detail the required design of a treatment plants.. In addition, industry associations have issued “Best Practice Guides for Treatment Plants” (see below DGfH Guides). According to OECD (2003) the status of these guides is voluntary in most countries but the guides are usually recognised and used by the authorities responsible for the authorisation of plants.

In Germany, the Deutsche Gesellschaft für Holzforschung e.V. (DGfH) published several Guides, called “DGfH-Merkblätter” which represent state-of-the-art guidance for wood treatment with preservatives and which form the basis for the approval of a new treatment plant, e.g. for pressure treatments, for (non-pressure) treatments in dipping/immersion plants and treatments with gas.[15] The DGfH Guides, as well as other existing technical standards, are listed in Appendix 5.1.

OECD (2003) states that the stringency and enforcement of the available regulations vary between different member countries. Even where regulations are in place, it is questionable whether or not older plants are in compliance with new and stricter regulations for their operation.

For details of the certification and inspection of spraying equipment please refer to the case study on PT 18 (insecticides).

[15] The DGfH halted its activity for economic reasons and the future status of the guidance documents is unclear.

Options

Harmonised EU standards for all treatment processes (pressure and non-pressure treatment) could be further developed.

The scope of the Directive on Machinery 2006/42/EC for considering equipment used for the application of pesticides could be extended to cover equipment for the application of biocides.

3.6 Form of the biocide and mode of application

Status

The different modes of wood preservative application are divided into penetrating application processes (usually pressure applications) and superficial treatments in open tanks and impregnation facilities along with manual procedures such as, e.g. brushing or spraying (see chapter 1.4.2). These procedures must be assessed differently as far as their load on the environment is concerned (see chapter 2.1).

Deep penetrating treatments

With respect to environmental protection, pressure methods such as vacuum pressure treatments in closed facilities are considered to be the safest application methods. Furthermore, deep penetrating treatments of wood under pressure result in a better (i.e. deeper) penetration of the wood preservative into the wood thus reducing the leachability and emission from the wood during its service life.

The application of some wood preservatives such as K-HDO is restricted to industrial use in fully automated and closed equipments.

Surface treatments

Surface treatments are usually performed *in-situ* (i.e. outdoor) by both professional and amateur users. Wood preservatives may be released to soil or water if the treated wood drips preservative either during or shortly after application. In addition, spray applications may form aerosols causing emissions to the surroundings.

In several EU member states only trained professional users are permitted to spray wood preservatives and this must be undertaken in closed stationary treatment

plants. Therefore, the question of whether and under which conditions the use of wood preservatives by spraying should be allowed for amateur users was discussed at the 26th CA Meeting[16]. This meeting decided that, at an EU level, amateur users could be allowed to apply spray wood preservatives, provided that no PPE is required. However, the exclusion of certain application methods, such as external treatment by spraying or brushing, has been proposed as a risk mitigation measure (Fischer et al. 2009).

For details of spray applications in general and fumigation in particular, please refer to the case study on PT18 (insecticides).

Options

Depending on the intended use class of treated wood, different levels of protection are required: in particular, to reduce the leachability of wood preservatives and to ensure their long term protection throughout their service life, wood to be used for applications likely to require contact with soil and/or water (use classes 3, 4 & 5) should only be treated by deep penetration processes (e.g. vacuum or pressure treatments).

Post-treatment conditions (storage of treated wood before use) should be regulated to ensure the sustainable use of biocides: In particular, intermediately after impregnation, wood must be stored on a paved and impermeable surface that is sufficiently protected from rain to prevent contamination of soil and ground water from any run off that may contain preservative.

In addition, harmonised minimum fixation times[17] after the treatment of wood (both by vacuum/pressure impregnation or dipping) should be specified at EU level (Schoknecht et al. 2003).

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[16] CA-Sept07-Doc.5.3 - Final Spraying method of wood preservatives for amateur users.

[17] In a certain period following the impregnation procedure the active ingredients of the wood preservatives have to react with the wood constituents to be fixed in the wood. During that period the risk of leaching by precipitation has to be minimised to ensure the efficacy of the preservation as well as to prevent emissions into the environment.

Although the restriction of spraying applications of wood preservatives to professional users has been rejected at the 26th competent authority meeting (see above), an EU wide regulation to restrict spray applications to (trained) professional users would be a preferable measure for the sustainable use of biocides. Furthermore, the application of wood preservatives by spraying should only be allowed in closed stationary systems.

3.7 Emissions during service life

Instruments for the reduction of environmental emissions during the service life are not considered in Directive 2009/128/EC on sustainable use of pesticides. However, a considerable proportion of total emissions of wood preservatives occur during the service life, through leaching from the treated timber (see chapter 2.3). Therefore, in contrast to plant protection products, the service life of biocidal products should be considered in detail in addition to the use phase.

Status

Provisions for the consideration of emissions from wood preservatives during the service life of wood within risk assessment are already part of the ESD for (OECD 2003). As consequence of the outcome of such risk assessments, the Inclusion Directives of several wood preservatives included in Annex I, IA or IB to Directive 98/8/EC contain restrictions concerning the *in-situ* treatment of wood outdoors or for wood that will be in continuous contact with water. These use restrictions prevent emissions of wood preservatives into water during the application phase and throughout the service life of treated wood (see chapter 3.1).

3.8 Specific measures to protect the aquatic environment

Emissions of preservatives to the aquatic environment may occur during the application, storage and service life of preserved wood (see chapter 2).

Status

In order to protect the aquatic environment, the Inclusion Directives for certain wood preservatives restrict the *in-situ* outdoor treatment of wood or of wood that will be in continuous contact with water (point 3.1). The same applies to *in-situ* treatments of

wooden structures near water, where direct losses to the aquatic compartment cannot be prevented.

In addition, the Inclusion Directives for several wood preservatives that have been included in Annex I, IA or IB to Directive 98/8/EC require that freshly treated timber must be stored after treatment under shelter or on impermeable hard standing to prevent direct losses to soil or water, and that any losses must be collected for reuse or disposal.

Option

In line with Directive 2009/128/EC, preference should be given to biocides that are not classified as dangerous for the aquatic environment (pursuant to Directive 1999/45/EC) and do not contain priority hazardous substances, as set out in Article 16(3) of Directive 2000/60/EC. This applies in particular to the preservation of timber intended for use classes 4 & 5, where the treated wood will be in permanent contact with ground and/or fresh- and salt water (see chapter 2).

In-situ treatments of wooden structures in contact with or near water, where direct losses to the aquatic compartment cannot be prevented, should be restricted. Wooden structures that are intended to be in contact with water should preferably be treated using deep penetrating application techniques (e.g. vacuum or pressure treatments) to reduce the leaching potential of the wood preservatives concerned.

The requirement to store treated timber on sealed and covered surfaces should be a general prerequisite for all industrial wood preservatives to prevent leaching into soil, with subsequent contamination of groundwater, and run-off into surface water.

As a general rule for all biocides, unused products or surpluses should be disposed of properly and not washed down the drain.

3.9 Reduction of biocide use in sensitive areas

Status

For wood preservatives, several outdoor applications in sensitive areas can be identified, for example: fences, poles, railroad ties or other construction facilities (e.g. cabins, jetties) in areas used by the general public or by sensitive populations or in areas assigned to the conservation of wild birds, natural habitats and of wild fauna and flora.

As well as these outdoor applications indoor applications of wood preservatives may also be considered as uses within sensitive areas. For example, wooden roof timbers may be part of habitats used by wild animals such as bats and kestrels.

As a general rule, wood used within habitable rooms under normal conditions does not need to be protected against fungal attack. Furthermore, construction techniques, such as covering wood to protect it against insect infestation and open construction to allow visual inspection are described in DIN 68800-2.

The preventive protection for wood to be used for load-bearing and reinforcing timber construction elements is also regulated under German state building regulations. The protective measures to be taken (the wood preservative and the impregnation method to be used) are set out in detail in the German standard DIN 68 800, part 3 for preventive protection and in DIN 68 800, part 4 for curative measures. With regard to preventive protection measures, the construction supervisory authority should require that "a suitable procedure with the least environmental impact is to be given preference" when selecting impregnation procedures. In the case of control measures, part 4 of the standard explicitly stipulates that protected animals must be given special consideration: "In the case of timber construction elements, roof structures, etc. in which animals worthy of protection reside (e.g. bats, owls, kestrels, etc.), only those wood preservatives may be used that have been tested by a suitable testing office and their compatibility and suitability proved. These control measures may only take place at a time of year when these animals do not reside in these building elements."

Options

Measures that should be implemented to protect the aquatic (and the terrestrial) environment, which can be considered as sensitive areas per se, are described in section 3.8.

With regard to indoor applications, such as roof construction timbers, the controls described above concerning preventive protection and control measures must be followed.

3.10 Handling and storage of biocides and their packaging and remnants

Status

Handling

In Germany, under a voluntary agreement with industry, the packaging size for wood preservatives intended for non-professional use is limited to 750 mL.[18]

Disposal of remnants

Waste wood preservatives (remnants) fall under the Hazardous Waste Directive 2000/532/EC and have to be disposed of according to the following waste codes.

Waste Code	Type of waste
03 02	Wood preservation wastes
03 02 01*	Non-halogenated organic wood preservatives
03 02 02*	Organochlorinated wood preservatives
03 02 03*	Organometallic wood preservatives
03 02 04*	Inorganic wood preservatives

A significant amount of wood preservative enters the waste stream in the form of treated wood products and, in Germany the regulations covering the disposal of “used wood” (Altholzverordnung) include provisions for the recovery and disposal of wood treated with wood preservatives.

[18] http://www.holzfragen.de/seiten/pop_biozide.html

Incineration of wood treated with wood preservatives

The incineration of wood has been questioned in some CARs. However, the substances of concern here are not limited to biocidal active substance and so focus on this life-cycle stage has been deferred to Member States' assessment at the product authorisation stage. For example it is known that about 5-10% of Chromium (III) used as a fixative for some wood preservatives is converted into Chromium (VI) during incineration.[19]

It should be noted that incineration of (treated) wood does not always occur under controlled conditions in licensed thermal treatment plants (as example suggested in the German regulations concerning "used wood"). For example, wood may be burned to heat private homes or in outdoor fires. The control of such incineration would require the preparation of guidance intended for non-professionals (the general public).

Options

- Limitation of packaging sizes and restriction of amateur use to ready-to-use products only.

- Instructions for non-professional concerning cleaning of treatment equipment (brush and container) following the application of wood preservatives.

- Instructions for non-professionals covering the disposal of treated wood, including guidance that such wood should only be burned in licensed incineration plants.

3.11 Integrated Pest Management

Status

Good practice in the application of biocides includes the identification of a need (problem analysis, identification of pests), the examination of potential measures to control pests, and the consideration of preventive and/or non-biocidal measures. All

[19] IPPC BREF Tanning of Hides and Skin draft 27. February 2009 , ftp://ftp.jrc.es/pub/eippcb/doc/tan_review_1D_pub.pdf

these elements are part of integrated pest management (IPM) approach, similar to that applied to the use of plant protection products. IPM integrates knowledge of pest biology, the environment and available technology, including the use of biocides.

Several studies and good practice (GP) guides are available describing integrated approaches to the reduction of the use and release of wood preservatives, e.g.:

- Description of the appropriate use and good practice during the use and disposal of biocidal products (Gartiser et al. 2005)
- Feasibility Study on the Support of the Information Requirement in Compliance with §22 ChemG on Alternative Measures for the Minimization of the Use of Biocides (Gartiser et al. 2006)
- Wood preservation: tips and information for correct handling of wood preservatives (Umweltbundesamt 2001)
- Practical Guide for Consumers on wood preservatives (BMELV 2008)

Gartiser et al. (2005 and 2006) describe inter alia elements of appropriate use and good practice during the use and disposal of wood preservatives. In this context they propose a uniform structure of GP reference documents (see Table 7). The proposed GP-structure reflects several elements of IPM principles such as the problem analysis and decision making process, the consideration of preventive and non-biocidal measures, as well as the controlling of success and documentation. The authors conclude that GP reference documents are not complete without references to legislation or other regulating documents, such as DIN-standards or information sheets from professional associations, which contain the basic information needed to implement GP. With regard to wood preservatives, the German technical standard DIN 68800 (Protection of timber, Part 1-5) includes provisions for the appropriate and safe use of wood preservatives (see chapter 3.1) and technical rules (TRGS) are available for both preventive treatments (TRGS 551 and 618) and curative treatments of wood (TRGS 512 and 523).

Table 7 shows the elements of good practice proposed by Gartiser et al. 2005 and names exemplarily elements of good practise or IPM principles for wood preservatives.

Table 7 Elements of good practice proposed by Gartiser et al. 2005

Step	Proposed general structure of Good Practice Documents	Good practice elements for wood preservatives
1	General principles and goals of the GP	
2	Description of the area of application	Preventive treatments; Curative treatments
3	Determination of the need for a biocide (problem analysis, definition of the goal)	Preventive treatments: Determination of the hazard and use class DIN 68800-3 and EN 335-1 and consequently determination of the preservation requirements (see Table 5). Curative treatments: Determination of the grade of infestation
4	Examination of the measures and decision making	Determination of measures to achieve the above goals
5	Prevention and non-biocidal measures	Preventive options: Preventive constructional measures in buildings according to DIN 68800-2; Selection of more resistant wood types; Depending on the intended use class, consideration of durability and treatability of different wood species according to EN 350-2; acetylation of wood etc. Curative treatments: Non-biocidal treatments like heat treatment
6 6.1 6.2 6.3 6.4 6.5 6.6	Proper use of biocidal products: Selection of low-risk products Minimising the amount of biocide used Licensing of equipment Applying risk management measures Controlling of success Waste disposal	Appropriate and safe use of wood preservatives according to technical standard DIN 68800ff. (Protection of timber, Part 1-5); Guidance documents for best practices of wood protection and biocide application (DGfH Merkblätter; see Appendix 5.1); Risk mitigation measures (see Table 6); Preference of deep penetrating treatments to reduce leaching; Application of special protective measures in connection with pest control activities for the use of highly toxic, toxic and health hazardous substances and preparations (TRGS 523); Collection of leachate/ run-off and recycling to prevent release, e.g. to the drains.
7	Documentation	Application of biocidal products for curative treatments has to be documented according to TRGS 523.
8	Storage and transport	Storage of treated timber on hard standing (impermeable ground) and under a roof.

Options

Further development of harmonised good practice documents and promotion of IPM guidance are considered to be the most promising measures for improving the sustainable use of wood preservatives.

Although promotion of efficient alternatives is already part of existing good practice guides (see above) it seems that more information (dissemination) is needed, especially for non-professional users.

Further measures for the application of IPM principles could include:

- Promotion of the use of ecolabelled products
- Substitution of, or at least a very strict use restriction on, very dangerous active substances

3.12 Indicators

Status

Reliable and up-to-date data on the production and consumption of wood preservatives (both on national and European level), are limited.

For Germany, the total consumption of wood preservatives is given in Lange (2001; cited in OECD 2003): According to these figures the total consumption in Germany was 29.000-31.000 tonnes (year not indicated). About 53 % of the preservatives were used in professional applications, about 41 % in industrial applications and about 6 % in do-it-yourself applications. About 95 % of the preservatives were applied in preventive treatment and about 5 % in curative treatment (OECD 2003).

A brief survey of the quantitative information on production volume contained in notification reports for biocides received by the European Chemicals Bureau was undertaken in July 2008 as part of the COWI report. Production tonnage data (1998-2001) were obtained for 65 % of the substances in PT8 and the total production volume of these substances was 11.233 tonnes. The tonnage of the five most important substances made up 93 % of the total. The PT 8 tonnage was 2.8 % of the total biocide tonnage (PT1-23).

In addition, COWI gives consumption data for Denmark: In 1998/1999 pressure and vacuum preservatives accounted for 9.1 % (377-453 tonnes) of the total consumption of biocidal active substances while preservatives for surface treatment accounted for 0.4 % (16-21 tonnes) (Lassen et al. 2001; cited in COWI 2009).

Options

Data on the manufacture and consumption of wood preservatives are needed for an evaluation of amounts used in the context of the sustainable use of biocides. Furthermore, data on the number of infestations with wood destroying insects and fungi, as well as the number of curative treatments, would be helpful for describing the problem.[20] Therefore, the inclusion of biocides into Regulation 1185/2009 concerning statistics on pesticides would be one option for gathering the required data on sales and consumption.

4 Example Outdoor brush coating of wooden structures

Use pattern	**Outdoor brush coating of wooden structures (e.g. fence or timber house)**
Target organisms	Wood destroying and discolouring fungi; wood destroying insects
User/applicator	Professionals and amateur users
Location	Outdoor; Use class 3 (outdoor application without contact to soil)
Active substances	Biocidal Product: Impranol-Holzschutzgrund; package 0,75-; 2,5-; 5- and 30-L Active substances: Tebuconazole: (0,60%) Dichlofluanid (0,55% Permethrin (0,15%)
Mode of application and dosage	Mixing: product is used undiluted Application: brushing, dipping at least 2 coats Dosage: 200-250 mL/m² in 2 coats Drying period: ca. 8 hours

[20] For example, in Germany infestations with the wood-boring beetle *Hylotrupes bajulus* must be indicated to authorities in most federal states. ➔ http://www.holzfragen.de/seiten/recht.html

Use pattern	Outdoor brush coating of wooden structures (e.g. fence or timber house)
Main emission route	Brushing: (air)[21], soil, surface water, groundwater Waste from remnants, cleaning, used tools (e.g. brush) and gloves
Environmental behaviour	Tebuconazole is not readily biodegradable and has a low mobility potential. Dichlofluanid is inherently biodegradable. In biologically active soils it is rapidly degraded to DMSA (N,N-dimethyl-N'-phenylsulfamide). Dichlofluanid is extremely toxic to aquatic organisms but has a low toxicity to earthworms. DMSA shows a low aquatic toxicity.
Elements of sustainable use of biocides of PT 8	
Risk mitigation measures	Risk mitigation measures requested in the Inclusion Directives of the active substances Tebuconazole and Dichlofluanid: Use restrictions: - The inclusion document for Tebuconazole states that products with Tebuconazole as active substance cannot be authorised for the in situ treatment of wood outdoors or for wood that will be in continuous contact with water unless data are submitted to demonstrate that the product will meet the requirements of Article 5 and Annex VI, if necessary by the application of appropriate risk mitigation measures. - No in situ application by brush (professional or amateur) to wooden structures should be permitted where direct losses to the environmental compartment cannot be prevented. - Impregnated wood must not come in contact with food or feedstuffs. Risk management measures: - for painting (brush application) – suitable cotton coverall, protective -gloves and footwear are recommended.
Training	Status: Training of non-professional users (amateur users) is not foreseen. Product data sheets contain application recommendations and safety instructions. Reference to the Data Sheet "Merkblatt für den Umgang mit Holzschutzmitteln" is given in the product data sheet. Options Product data sheets should contain detailed application recommendations and safety instructions, especially for non-professional users (amateur users).
Requirements for sales	Status: Product must be classified and labelled properly. Product can be ordered from internet sale. A product data sheet containing application recommendations and basic safety instructions can be downloaded from the internet. Options: Information used by professional users as TRGS, UVV, SDS is not available to (and normally not understandable by) the non-professional user. Product

[21] The active substances have a low vapour pressure. Therefore, emissions to air are not relevant.

Use pattern	**Outdoor brush coating of wooden structures (e.g. fence or timber house)**
	information (like product data sheets) could be used for giving more (understandable) information to non-profession users including which important issues, risk and respective risk management measures the user should be aware of e.g. more detailed information of handling (e.g. instruction to cover the soil with tarpaulin during application). A harmonized format for this kind of product could be developed
Awareness programmes	Status: - Options - Publication of practical guides for amateur users
Certification and inspection of equipment in use	Status: Application with flat brush recommended. Options No certification/inspection of equipment required.
Form of the biocide and mode of application ➔ Emission during life cycle	Status: Outdoor application by brushing. As brushing is a surface treatment without deep penetration of the product / active substance into the wood, leaching out of the wood during the service life might be significant. Options: User instructions that outdoor applications in form of brushing should only be done during dry weather conditions to ensure minimum penetration and drying (= fixation) in order to minimise leaching
Specific measures to protect the aquatic environment	See also Risk Mitigation Measures. Status: - No in situ application by brush (professional or amateur) to wooden structures should be permitted where direct losses to the aquatic environment cannot be prevented. - Use restriction to use class 3: “wood not covered, no contact to ground (or fresh/salt water) - Product data sheet contains safety instructions with regard to the environment: “Do not let the product or its remnants get into surface waters, soil or waste water systems”. Options: - Use restrictions where direct losses to the aquatic environment cannot be prevented; a minimum distance from location of use to surface water could be introduced.
Reduction of pesticide use in sensitive areas	See specific measures to protect the aquatic environment.
Handling and storage of pesticides and their packaging and remnants	The waste packaging might be collected and returned to the supplier.
Integrated Pest Management	Proper use of the biocidal products: Selection of low-risk products or ecolabelled products; Minimising the amount of wood preservative used; Applying risk management measures; Appropriate cleaning of treatment equipment (brush and container) and waste disposal;
Indicators	Number of curative treatments.

5 Appendices

5.1 Overview on standards, BAT and other relevant documents

Standards	
DIN EN 84 (May 1997)	Wood preservatives- Accelerated ageing of treated wood prior to biological testing - Leaching procedure
DIN EN 335-1 (Oct. 2006) DIN EN 335-2, (Oct. 2006) DIN EN 335-3, (Sept. 1995)	Dauerhaftigkeit von Holz und Holzprodukten; Definition der Gefährdungsklassen für einen biologischen Befall; neue Bezeichnung: Dauerhaftigkeit von Holz und Holzprodukten -Definition der Gebrauchsklassen Teil 1: Allgemeines, Teil 2: Anwendung bei Vollholz, Teil 3: Anwendung bei Holzwerkstoffen
DIN 68800-1 (Nov. 2009) DIN 68800-2 (Nov. 2009) DIN 68800-3 (Nov. 2009) DIN 68800-4 (Nov. 2009)	Holzschutz - Teil 1: Allgemeines Holzschutz - Teil 2: Vorbeugende bauliche Maßnahmen im Hochbau Holzschutz – Teil 3: Vorbeugender Schutz von Holz mit Holzschutzmitteln Holzschutz - Teil 4: Bekämpfungs- und Sanierungsmaßnahmen gegen Holz zerstörende Pilze und Insekten
DIN 68800-5 (Mai 1978)	Holzschutz im Hochbau -Vorbeugender chemischer Schutz von Holzwerkstoffen
DIN EN 599-1 (Oct. 2009)	Dauerhaftigkeit von Holz und Holzprodukten - Wirksamkeit von Holzschutzmitteln wie sie durch biologische Prüfungen ermittelt wird - Teil 1: Spezifikation entsprechend der Gebrauchsklasse
DIN EN 599-2 (Aug. 1995)	Dauerhaftigkeit von Holz und Holzprodukten - Anforderungen an Holzschutzmittel wie sie durch biologische Prüfungen ermittelt werden - Teil 2: Klassifikation und Kennzeichnung
DIN EN 350-1 (Okt. 1994) DIN EN 350-2 (Okt. 1994)	Dauerhaftigkeit von Holz und Holzprodukten -Natürliche Dauerhaftigkeit von Vollholz - Teil 1: Grundsätze für die Prüfung und Klassifikation der natürlichen Dauerhaftigkeit von Holz. Teil 2: Leitfaden für die natürliche Dauerhaftigkeit und Tränkbarkeit von ausgewählten Holzarten von besonderer Bedeutung in Europa.
DIN EN 460 (Okt. 1994)	Dauerhaftigkeit von Holz und Holzprodukten -Natürliche Dauerhaftigkeit von Vollholz -Leitfaden für die Anforderungen an die Dauerhaftigkeit von Holz für die Anwendung in den Gefährdungsklassen
DIN EN 13991 (Nov. 2003)	Derivate der Kohlenpyrolyse -Öle aus Steinkohlenteer: Kreosot - Anforderungen und Prüfverfahren
Vornorm DIN CEN/TS 15003 (Juni 2005)	Dauerhaftigkeit von Holz und Holzprodukten -Kriterien für Heißluftverfahren zur Bekämpfung von holzzerstörenden Organismen
BS 5268-5 (Sept. 1989)	Verwendung von Holz im Bauwesen -Leitfaden für die Schutzbehandlung von Bauholz
ISO 21887 (2007)	Durability of wood and wood-based products -- Use classes
BAT	
BREF „Surface Treatment using Organic Solvents“ (Aug. 2007)	Chapter 18: Wood Preservation
Technical rules	
TRGS 512	Begasungen (Juni 2004)
TRGS 523	Schädlingsbekämpfung mit sehr giftigen, giftigen und gesundheitsschädlichen Stoffen und Zubereitungen (Nov. 2003) - “Pest control using highly toxic, toxic and health hazardous substances and preparations”
TRGS 618	Ersatzstoffe und Verwendungsbeschränkungen für Chrom(VI)-haltige Holzschutzmittel (Dezember 1997)

TRGS 551	Teer und andere Pyrolyseprodukte aus organischem Material (Juni 2003)
BGVV	Vom Umgang mit Holzschutzmitteln – Eine Informationsschrift (1997)
BMVEL (Referat 532)	Verbraucherleitfaden Holzschutzmittel (2003)
HBG (BGI 736)	Holzschutzmittel – Handhabung und sicheres Arbeiten (1999)
Bayer. Staatsministerium für Gesundheit, Ernährung und Verbraucherschutz	Gesundheitsgefahren und Schutzmaßnahmen beim betrieblichen Einsatz von wasserlöslichen Holzschutzmittel (2001)
Bayerisches Landesamt für Wasserwirtschaft	Wasserwirtschaftliche Anforderungen Holzimprägnieranlagen (Merkblatt Nr. 3.3./3, 1995)
BBA-Merkblatt Nr. 22	Vorsichtsmaßnahmen bei der Anwendung von Methylbromid (Brommethan) zur Schädlingsbekämpfung in Räumen, Fahrzeugen, Begasungsanlagen oder unter gasdichten Planen (1989)
BBA-Merkblatt Nr. 71	Drucktest zur Bestimmung der Begasungsfähigkeit von Gebäuden, Kammern oder abgeplanten Gütern bei der Schädlingsbekämpfung (1993)
BIA-Empfehlung Nr. 1023	Einsatz von Bis-(N-Cycohexyldiazeniumdioxy)-Kupfer-(Cu-HDO)-haltigen Holzschutzmitteln
UK Process Guidance Note NIPG 6/3 (Version 2, Oct. 2004)	Chemical Treatment of Timber and Wood Based Products
Codes of Practice (Merkblätter)	
DGfH.Merkblatt	Verfahren zur Behandlung von Holz mit Holzschutzmitteln Teil 1: Druckverfahren (1991)
DGfH.Merkblatt	Verfahren zur Behandlung von Holz mit Holzschutzmitteln Teil 2: Nichtdruckverfahren (1991)
DGfH.Merkblatt	Sicherer Betrieb von Kesseldruckanlagen mit aromatischen Imprägnierölen (1990)
DGfH.Merkblatt	Sicherer Betrieb von Kesseldruckanlagen mit wasserlöslichen Imprägnierölen (1990)
DGfH.Merkblatt	Sicherer Betrieb von Nichtdruckanlagen mit wasserlöslichen Imprägnierölen (1990)
DGfH.Merkblatt	Sonderverfahren zur Behandlung von Gefahrenstellen (3/2003)
DGfH.Merkblatt	Schutz von Holzwerkstoffen (ohne Jahresangabe)
DGfH.Merkblatt	Leitlinie für die holzschutzmittelverarbeitenden Betriebe bei Umweltfragen (1991)
DGfH.Merkblatt	Kompaktinformationen „Baulicher Holzschutz“ (1997)
DGfH.Merkblatt	Kompaktinformationen „Chemischer Holzschutz“ (1997)
DGfH.Merkblatt	Die Bekämfung von holzzerstörenden Insekten – Merkblatt über Notwendigkeit, Durchführung und Einschränkung einer Behandlung mit Gas (2002)
Deutsche Bauchemie e.V.	Merkblatt für den Umgang mit Holzschutzmitteln (1997)
VdL-Richtlinie 05 (Dez. 1998)	Richtlinie zur Registrierung von Bläueschutzmittel “VdL-Richtlinie Bläueschutzmittel“
WTA-Merkblatt 1-1. 1987	Das Heissluftverfahren zur Bekämpfung tierischer Holzzerstörer

WTA-Merkblatt E1-2-03/D	Der echte Hausschwamm (2003)
WTA-Merkblatt 1-4-00/D	Baulicher Holzschutz Teil 2: Dachwerke
WTA-Merkblatt	Holz (1-2-91und 1-4-00)
Code of Practice	UK Wood Protection Association (2003): Timber Treatment Installations – Code of Practice for Safe Design and Operation.
Leaching Test Guidelines	
OECD 107 (Jul 2009)	OECD Guidance on the Estimation of Emissions from Wood Preservative-Treated Wood to the Environment: for Wood held in Storage after Treatment and for Wooden Commodities that are not covered and are not in Contact with Ground http://www.oecd.org/dataoecd/42/31/43411595.pdf
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