TEXTE

Reduction of environmental risks from the use of biocides: Environmental sound use of disinfectants, masonry preservatives and rodenticides

Annex IV: Case study on PT 7/10: Masonry preservatives and facade paints and plaster



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Reduction of environmental risks from the use of biocides: Environmental sound use of disinfectants, masonry preservatives and rodenticides

Annex IV: Case study on PT 7/10: Masonry preservatives and facade paints and plaster

by

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1 Introduction

Algae, fungi, and mosses often disfigure the material surfaces of buildings and facilities. They grow on walls, façades, roofs and terraces. Typically, this is the case for certain algae such as the *Chlorella sp. Scenedesmus vacoulatus* or the *Trentepholia oderata* and for the fungi *Aspergillus niger*, *Alternaria sp.* or the *Cladosporium sp.* These primary organisms (Baumann 2000, Gaylarde et al. 2011) release products such as organic acids that can lead to unwanted biodeterioration of façade materials.

Moisture existing in the construction materials as a natural consequence of wind, rain and dew, is the main factor for microorganism growth. Mineral coatings such as mortars and various cementitious materials are known for their rapid water uptake and drying characteristics. These products are characterized by short periods in a moist state. Coatings containing substantial amounts of polymeric (hydrophobic) binders demonstrate only limited water movement. In these materials, periods with high moisture tend to be longer in comparison with mineral materials. Architectural paints and renders with polymeric binders for exterior façades have significant market share with a consumption quantity of 134'000 t of paint and 114'000 t of render in 2010 in Germany (VdL 2011).

Different types of layered systems exist. For example, paint renovation means that paint is applied to the previous existing render. A paint layer forms a solid, cohesive, adherent film and is usually applied twice to the treated surface (100 - 300 μ m thickness). Renders and paints in combination are important components of so-called exterior thermal insulation composite systems (ETICS). ETICS are layered systems that typically consist of an insulation panel, upon which a ca. 5 mm mineral render- or mortar layer is applied. An embedded glass fiber mesh provides additional mechanical strenth and a finishing layer of textured render (e.g., 2 mm thickness due to 2 mm grain size of certain fillers) or two paint layers are added for smoothing the granular render surface. According to the EN 971-1 renders are defined as coatings that protect the masonry physically against direct influence of weather and moisture. The thickness of the finishing render is typically 2 - 5 mm. The excellent thermal decoupling effect of ETICS on the surface of buildings is leading to a significant drop in temperature between day and night which favours the algae growth by extended periods of moisture. In practice more than 90% of ETICS consist of polymeric layered coatings (Venzmer 2008).

To avoid uncontrolled microbial deterioration of both polymeric films and renders, different microbial active substances are used as preservatives (van Dokkum 1998, Paulus 2004). Biocides are typically added to the render and paint whilst they are liquid and ready to use. After application, biocides slowly migrate to the surface of the dry coating during wetting events. Such applications aim at providing inhibitory concentration at the coating surface over a period of time. These biocides preserve the surface properties of paints and renders and are referred to film preservatives (PT 7) as defined by the Biocidal Product Regulation (BPR).

By definition of the Emission Scenario Document (ESD) (Migné 2002), masonry preservatives (PT 10) are products used for preservation and remedial treatment of masonry and similar construction materials (except PT 8), by controlling microbiological and algal attack. In fact, masonry biocides of PT 10, that use substances other than PT 7, are mainly liquids that are used for surface disinfection of the underlying substrate. Such agents are needed to dispose of existing microbes before painting renovation. Products applied for the maintenance of underlying masonry materials are biocidal products. Mineral coatings like mortar, concrete, and plaster mentioned under PT 10 (masonry products, see ESD) are dry materials (bagged products) and do not contain organic biocides.

In-can preservatives (PT 6) used in organic paints and renders will not be part of the following evaluation.

2 Active Substances and target organisms

Regulation 1451/2007/EC listed 89 active substances for PT 7 and 94 active substances for PT 10. For PT 7 and PT 10 28 and 29 dossiers are submitted, respectively. Consequently, of all notified substances, in total 63 biocides of PT 7 and 67 biocides of PT 10 are not being evaluated under the BPR. That means several active ingredients phased out. Eighteen biocides are listed both under PT 7 and PT 10 at the same time. This is due to missing clarity about the grouping of products to both product types. According to market reality, only very few products exist with overlapping substances (Table 1), which contradicts the submitted dossiers for the two PT. According to the BPR, under PT 7 and PT 10, two biocides each (PT 7: silver, silver nitrate; PT 10: *Pythium oligandrum*, BIT) are in the evaluation as new substances.

Currently, the drafted assessment reports of several active substances for PT 7 and PT 10 are under evaluation by the member states.

| Film | Group-Name | Target Organisms | Active ingredients |
|-------------------------------------|-------------------------------------|---|---------------------|
| Preservatives (PT 7) | Isothiazolinones | Bacteria, fungi | OIT, DCOIT |
| Triazines Algae (C Trentep | | Algae (Chlorella sp. Scenedesmus vacoulatus or Trentepholia oderata) | Terbutryn, Irgarol¹ |
| | Phenylureas | Algae (Chlorella sp. Scenedesmus vacoulatus or Trentepholia oderata) | Diuron, Isoproturon |
| | Carbamates | Fungi (Aspergillus niger, Alternaria sp. or Cladosporium sp.) | IPBC, Carbendazim |
| | Metal organic | Bacteria, fungi | Zinc pyrthione |
| | | | |
| Masonry Preservatives (PT 10) | Quaternary ammonium compounds | Algae | QAC |
| | Isothiazolinones | Bacteria, fungi | OIT |

 Table 1:
 Overview of target organisms (Baumann 2000, Wangler 2012)

¹ No dossier submitted for PT 7 and no market products contain Irgarol anymore.

3 User groups and mode of application

<u>User groups:</u> 90% of the total utilization of exterior paints, renders, mortars, and ETICS occurs via professional painters and plasterers (Kramberger, VdL, pers. comm.). This large market share is by nature very different from the market of indoor applications or wood preservatives, since exterior coatings are more complex and volume and resource intensive. However, these products are also offered in construction stores to non-professional users (Do-It-Yourself, DIY). Cleaning agents (PT 10 products) to liberate façades, terraces and footways from microorganisms or agents for preventive treatments are used, both by professionals and private actors.

<u>Mode of application</u>: Brushing, rolling, and spraying are used for paints and liquids for microbial cleaning (Migné 2002), whereby spraying is only used by professionals (Hafner 2006). Brushing and rolling are also used for organic renders (Bakker 2001).

4 Possible emission routes and available ESD

The BPR requires a risk assessment concerning effects of active substance in environmental compartments. Sources and pathway of biocides used in construction products, i.e. in material for façades, must be known and their environmental impact assessed. Products of interest regarding the evaluation of reduction measures might be registered under PT 7 or PT 10.

4.1 Emission scenario documents

Different emission scenarios and routes of exposure are described by the Emission Scenario Document (ESD) for PT 7 and PT 10, respectively (Migné 2002). The ESD provides information on sources and release pathways of biocides used in products to the environment. Key element of the document is a model house proposed for wood preservatives (PT 8) (OECD, 2002; revised 2013). The following factors are also included in the scenario:

- Site of the treated building, i.e. countryside or city
- Application methods on roofs and façades, e.g. spraying and rolling
- Influence of different nozzles using spraying equipment

For example, in one scenario spraying emissions up to 6.9 meters distance from the building, 0.5 m depth and 50 m length (143 m^3 soil volume; model house including roof with 4.1 m height, 17.5 m length, and 7.5 m width) at an average wind speed of 4 m/s measured at 10 m, and a settling velocity for the droplets of 2.46 m/s are expected.

The application of a second scenario, following ESD PT 10, occurs via rolling, whereby dripping of paint or plaster can reach a width of 50 cm distance from the house and might be distributed to 50 cm depth (MOTA 2013). Due to the fact that the model house of PT 7 is similar to PT 10, also the soil compartments for PT 7 products are of similar width. The expected pollution of soil adjacent to the model house is in this case 13 m³ large (perimeter of 50 m). It is suggested that releases of biocides during service life, enter the same volume of soil. The ESD suggests that leaching of biocides from products, should be obtained from standard leaching tests, similar to PT 8 products (Migné 2002, EN 16105, 2011).

4.2 Parameter controlling the release of biocides

The release of biocides from façade materials containing antimicrobial preservatives is controlled by environmental conditions, the product (composition) and the properties of the active ingredients.

Under field exposure, their release is trigged by regional and site specific weather conditions, e.g. rainfall, wind direction and speed, temperature, dew etc. Blocken et al. (2012) reviewed factors such as wind driven rain, rain drop size, building height and roof overhang. Further factors to be considered are the contact time of water, surface temperature and the extent to which UV-irradiation is influenced by the directional orientation of the respective building façade (Burkhardt et al. 2012).

In addition, the initial concentration of the respective active ingredient and product specific factors are adjusting the release. Up to 20 ingredients in polymeric paints and renders (matrix) control the diffusion rate of the biocides (Schoknecht et al. 2009). Wangler et al. (2012) has demonstrated that emission can vary up to a factor of 3 for the same initial concentration and substance due to product formulation. Encapsulated biocides, which are quite common on the market (more than 30% market shares in Germany, more than 80% in Switzerland), reduce leaching of different biocides by a factor of 2 to 20 (Edge et al. 2001, Breuer et al. 2012, Jämsä et al. 2013). Polymeric paints and renders contain nearly the same ingredients.

The above mentioned parameters do not affect PT 10 products because of the differences in their formulation (liquid versus dry) and their intended use (release to surface versus penetration into substrate).

4.2.1 Physicochemical properties of active ingredient

Currently used biocides in paints and renders as film preservatives are listed in Table 2 (Burkhardt et al. 2013). According to Schoknecht et al. (2012), the emission of biocides is determined mainly by two substance properties: Water solubility and partition coefficient Pow (partitioning in n-octanol/water). Increased leaching corresponds with higher water solubility and lower Pow. Biocides with similar water solubilities show similar emission profiles. These insights are confirmed by Wangler et al. (2012) and further support the theory that physicochemical properties of active ingredients strongly influence the diffusion rate.

Algaecides used in PT 7 façade coatings are known for their limited degradation in aquatic systems and soil (DT 50 up 150 days) and their reversible effects of photosynthesis inhibition (Paulus 2004). On the other hand, isothiazolinones degrade rapidly (DT 50 < 2 days) and biological effects are irreversible.

| Active ingredient | Water solubility [mg/L] | Pow [-] |
|-------------------|-------------------------|---------|
| Diuron | 42 | 2.7 |
| Isoproturon | 65 | 2.8 |
| Terbutryn | 22 | 3.7 |
| Carbendazim | 8 | 1.5 |
| IPBC | 168 | 2.4 |
| DCOIT | 14 | 3.6 |
| OIT | 500 | 2.5 |
| Zinc pyrithione | 8 | - |

 Table 2:
 Most common film preservatives in paints and renders (PT 7). Water solubility: Paulus 2004; Pow: ChemSpider 2012.

4.2.2 Concentration of active ingredients in coatings

Biocides in endproducts require a certain concentration range in order to obtain optimal effects on target organisms¹. The concentration varies between 100 to 1500 ppm of active ingredients in paints and renders (Table 3). Isoproturon is used in concentrations in the range of 100 to 500 ppm, Carbendazim, Zinc-pyrithione, Isothiazolinones between 100 to 1000 ppm, and Diuron and Terbutryn between 100 to 1500 ppm. OIT and Zinc pyrithione are used in higher concentration ranges due to their lower stability and Diuron and Terbutryn due to high leachability. The concentration for encapsulated biocides seems to be in the same range. Differences in biocide concentrations do not exist between DIY and professional products.

The concentrations of biocides in paint products tend to be higher by a factor of two compared with their render products. The biocide amount applied per square meter occurs vice versa. Renders are applied by ten times higher amounts than paints. Consequently, the initial concentration per kilogram is lower in renders but the mass applied per area is much larger.

to the ingredient quantities, OIT, Diuron, Terbutryn, and Zinc pyrithione are the most used preservatives, followed by Carbendazim, IPBC, and DCOIT. Isoproturon is known for rapid leaching and therefore not of

¹ Personal communication with several producers of biocides and paints / renders and own market review.

much interest in the market. For PT 7 products the biocide suppliers always offer two to four biocides in combination, in order to control several organisms at the same time.

In PT 10 product concentrations are usually >1% active ingredient and are not applied in mixtures and are not encapsulated.

| | | Concentration | |
|--------|--------------------|---|-------------------------|
| | 100 - 500 ppm | 100 - 1000 ppm | 100 - 1500 ppm |
| Paint | Isoproturon | Carbendazim, DCOIT OIT, Zinc pyrithione | Diuron, Terbutryn, IPBC |
| Render | Isoproturon, DCOIT | Carbendazim, OIT, Zinc-pyrithione, Terbutryn | Diuron, IPBC |

| Table 5. Concentration range for active ingredients in paints and rende | Table 3: | Concentration range | e for active | ingredients | in paints and ren | der |
|---|----------|---------------------|--------------|-------------|-------------------|-----|
|---|----------|---------------------|--------------|-------------|-------------------|-----|

4.2.3 Environmental parameters

<u>Availability of Water</u>

Leaching of biocides from materials into the environment requires water for transport - first within the matrix and secondly that the biocide can actually enter the environment (Schoknecht et al. 2009, Burkhardt et al. 2012). Coating material become moist by rain or condensation water. Wind driven rain acts as the main factor behind runoff water from the façades and is characterized by the horizontal rainfall intensity, wind speed, and angle of the wind direction relative to the façade. Calculating the amount of runoff water per square meter façade is difficult, because of the various interactions between coating and rainfall that also entails indirect effects such as splashing, bouncing, adsorption, adhesion, and evaporation (Blocken et al. 2012). However, a driving rain coefficient can account for the roughness, topography, obstruction and wall pattern of the area (Burkhardt et al. 2012). Burkhardt et al. (2012) observed a linear relationship between wind driven rain (calculated by ISO²) and runoff water with approximately 6 to 7% runoff of the total horizontal rainfall at a model house (height about 2 m). However, this runoff, measured from the model house, overestimate the amount for real buildings caused by the blocking effect; in which larger façades impede wind flow. Runoff water was measured by Burkhardt et al (2012) to be less than 1% of annual precipitation of a 11 m high building.

<u>Temperature</u>

A higher environmental temperature favours emission of biocides. A study by Wangler et al. (2012) showed that emissions of biocides increase with higher temperatures. This can be recognised by increased diffusion of active ingredients to surface. Similar results were demonstrated by Bagda et al. (2011) and Burkhardt et al. (2012).

Irradiation

UV irradiation can limit the concentration of active ingredients at the surface of coating materials caused by photolysis. Schoknecht et al. (2009) observed that the concentration of active ingredients from leachates exposed to UV irradiation was lower than that of leachate stored in the dark. Furthermore, the colour of render and paints changed from white to yellow indicating chemical transformation (Schoknecht et al. 2009). Burkhardt et al. reported a lack of mass recovery by calculating the leaching amount and the remaining

² ISO 15927-3 (2009): Hygrothermal performance of buildings - Calculation and presentation of climatic data - Part 3: Calculation of a driving rain index for vertical surfaces from hourly wind and rain data.

active substance in the coating material. In these studies, the degradation product M1 of Irgarol and Terbutryn was determined in significant concentrations. Lacking mass balances are reported also for the biocides with low persistence (OIT, DCOIT, IPBC) (Burkhardt et al. 2012, Wangler et al. 2012)

Exposure and architecture

Emission of biocides depends on the exposure characteristic such as latitude and altitude, architecture, orientation of the façade, and exposure of coated material to weather conditions (Burkhardt et al. 2012). Obviously not all locations are subject to the same level of infestation, although all buildings are similarly equipped with preservatives. Leaching of biocides from exterior façades could be reduced by a preventive architecture considering roof overhang, eaves, and tint or soffit on windows.

4.2.4 Characteristics of coatings

Several textured coating and paint products that use a mixture of active ingredients are available on the market. Products like organic paints and renders consist of about 20 components (Schoknecht et al. 2009). The main factors that influence the degree of leaching from different products are the porosity of the matrix, the connectivity of pores, the surface roughness and the affinity of biocides to the binder. The pH-values vary between 6 and 10 depending on carbonate- and silicate amounts. Water uptake of the coating material strongly depends on the specific characteristics of the matrix and porous structure (Schoknecht et al. 2012). Schoknecht et al. (2009) showed that an increase in water uptake correlates with the biocide emission.

4.2.5 Leaching pattern of active ingredients

Active ingredients used in PT 7 products have to migrate from treated materials to target organisms. Leaching from coating materials requires dissolution of the active ingredients into water followed by diffusion and vapour transport to the coating surface (Schoknecht et al 2009, Wangler et al. 2012). Biocides are enriched on coating surfaces. Finally, the biocides enter the environment during wash-off events. Longer water contact time leads to higher concentration of active ingredients in runoff water.

The highest emission of active ingredients is observed in the early stage of exposure and in the early stage of each leaching event (50 to 60% of the total release in first 15 minutes) (Burkhardt et al. 2009). In a later state of the coating-lifetime biocide concentration tend to reach a fairly consistent range of a few hundred micrograms per litre (Burkhardt et al. 2012). Longer travel distances of the preservatives decrease the emission (Wangler et al. 2012).

Systems consisting of render and paint compared with render without further coating, causes higher emission per square meter, since both layers contain biocides (Schoknecht et al. 2009, Wangler et al. 2012). Wangler et al. (2012) covered a render containing biocides with a top coat without biocides. This showed a slow release at the start of exposure (zero order for acrylate binder and smooth leaching curve for styrene binder) and is explained by the physical effect of the membrane acting (paint layer) as a diffusion barrier. Burkhardt et al. (2011, 2013) and Breuer et al. (2012) investigated encapsulated biocides in hydrophobic renders and paints. Encapsulation reduced the leaching of terbutryn, OIT, and DCOIT 4-, 17-, and 25-fold compared to free biocides used in the same amounts in the render determined with EN16105 laboratory immersion test (Burkhardt et al. 2013). Results from a field study and pilot-scale irrigation test showed a decrease in emission for encapsulated biocides by a factor of 2 to 20 in comparison with free biocides, especially in the initial phase.

4.3 Emission during application / treatment phase

Table 4 illustrates a summary of receiving compartments for biocides that are released during application phase. These release scenarios for façade and roof treatment are described in the "Emission Scenario Document" (Migné 2002). Beside the ESD, only safety data sheets describe the application and handling of coating products, coating biocides and similar PT 10 products.

PT 7 film preservatives are used on exterior walls. Emission of biocides to soil and water bodies can occur during application mode and the likelihood of this happening is increased by wrong handling (Migné 2002). As described in section 1.2, paints are processed by brushing, rolling, and spraying whereby render is applied by coat spreader and trowel. The degree of emission thus strongly depends on the application techniques and the level of professional know-how of applicators (e.g. adequate groundcover, proper disposal etc.). Spraying paint on façades can lead to a drift of aerosols from spraying nozzle to the surrounding environment (Migné 2002). Based on information from interviews conducted with various stakeholders, the diffuse emission during application is typically less than 1 m distance from the application area.

PT 10 preservatives are used in renovation treatment of façades. Emissions occur due to brushing, rolling, or spraying as a result of spilling, dripping, runoff and spray drift. The ranges of losses for brushing and rolling are estimated to be 3% for professional and up to 5% for non-professional users (Hafner 2006).

During application using spraying techniques, drift losses can be reduced by 10% if the spray pressure is less than 3 bars (Migné 2002). Other important parameters for drifting are wind speed, height of release and settling velocity (depending on nozzle size).

Abrasive cleaning is mainly done mechanically with brushes and with high-pressure cleaners. In this case emission depends on the age of treated material, which determines the amount of remaining biocides in the product, and in the availability of catching equipment for discharged water.

Furthermore, emission to sewage systems or directly into environment occurs by cleaning tools and machinery at construction site. Information on its impact to the environment is unclear.

| Substrate | Place | Spraying | | Rolling/ | Rinse | |
|-----------|-------------|----------|--------|----------|-------|--------|
| | | Drift | Runoff | Brushing | Drift | Runoff |
| Roof | Countryside | Soil | Soil | Soil | Soil | Soil |
| | | Air | | | Air | |
| | City | Water | Water | Water | Water | Water |
| | | Air | | | Air | |
| Façade | Countryside | Soil | Soil | Soil | Soil | Soil |
| | | Air | | | Air | |
| | City | Water | Water | Water | Water | Water |
| | | Air | | | Air | |

Table 4: Receiving compartments of biocides released during application mode (Migné 2002)

4.4 Emission during service life

As soon as biocides enter the surface, wash-off by wind driven rain transports the substances into the environment (Burkhardt et al. 2011, Wittmer et al. 2011, Coutu et al. 2012). Runoff water infiltrates into the soil and groundwater, enters surface water by separated sewers or is discharged via waste water treatment plants into receiving waters. The pulse of exposure can affect aquatic or terrestrial organisms (Menge 2005, Jungnickel et al. 2008, Burkhardt et al. 2011).

The service life of façade coatings ranges from 10 to 20 years, depending on various factors such as exposition, latitude, altitude, orientation, weather conditions and architectural specificities. During service life biocides are washed out by precipitation. Although emissions of biocides are diffuse and show a high temporal variation, the most significant concentration does occur within the first year (Burkhardt et al. 2012). Cumulated losses at façades with west orientation (main weather direction) vary between 2% for DCOIT and about 20% for Diuron of the initial amount over a period of about one year. After this initial phase concentration levels are in the microgram per litre range (Burkhardt et al. 2009).

In catchment studies of urban areas Carbendazim, Diuron, Isoproturon, and Terbutryn entered receiving waters by passing wastewater treatment plants under wet-weather conditions or by separated sewers (Singer et al. 2010, Burkhardt et al. 2011, Wittmer et al. 2011). Biocides quickly degradable such as OIT and IPBC are not found. Often, both parent substance and degradation of biocides (e.g. M1, PBC) used in coatings are not regularly monitored in aquatic systems.

4.5 Emission during restore end-of life stage

Manufactures and formulators store preservative products indoors. The products are usually stored in cans or buckets. Safely stored, it is highly unlikely that preservatives are washed out and enter the environment.

To date, there are no studies available that investigated how much biocides remain in preservatives treated coatings once these coatings have reached the end of their service life. It can be assumed that with increasing life time the remaining concentration of biocides becomes negligible.

However when disposing of preservative products, it is important to distinguish between the empty bulk and the waste containing biocides. Empty bulk can be disposed of directly under the disposal code 08-02, (HZVA) whereas waste containing biocides should be disposed under the disposal code 17-09 (debris from treated façades) (Hafner 2006).

5 Elements of sustainable use

5.1 Stakeholder survey

A questionnaire on the application and use phase of renders and paints, containing film preservatives (PT 7) and masonry preservatives, registered as biocidal products (PT 10), was drafted with the purpose to evaluate measures for sustainable use of biocides and reduction of their environmental impact. The questions were elaborated in accordance with stakeholders representing biocide and formulated end-product manufacturers, experts and regulators. The survey consists of one main and three group specific questionnaires. Measures to reduce emissions during application and use phase were categorised in training and education, conditions for marketing and sales, information and awareness raising, and surveillance of applications. An efficiency ranking was established consisting of: high, medium, low, not efficient. In addition, the general understanding of environmental impact of biocides was asked for. All participants received the questionnaire by e-mail.

The participation of stakeholders was highly sufficient with about 60% of the groups listed in Table 5. The answers represent a cross section of all relevant groups. In detail, all manufacturers of biocides answered the questionnaire (Thor, Troy, Lanxess, Dow, Lonza, and Ashland,). The list of asked and replied manufacturers of formulated end-products needs to be treated confidential, however, the companies are representing about two-third of the German market, including markets leaders as well as small companies. Participants of user / expert companies are represented, e.g. by CEPE (www.cepe.org), Verband der deutschen Lack- und Druckfarbenindustrie (www.lackindustrie.de, www.putz-dekor.org), and Fachverband der Stuckateure für

Ausbau und Fassade Baden-Württemberg SAF (www.stuck-verband.de). The Swedish Chemicals Agency KEMI (www.kemi.se) and the Swiss Federal Office for the Environment FOEN (www.bafu.admin.ch/en) as regulators, and the Pesticides Action Network Germany PAN-Germany (www.pan-germany.org) as NGO, answered the questionnaire as well.

| Table 5: | Addressed and returns | , from the stakeholder survey |
|----------|-----------------------|-------------------------------|
|----------|-----------------------|-------------------------------|

| | Addressed | Returns |
|---|-----------|---------|
| Manufacturers of biocides | 6 | 6 |
| Manufacturers of formulated end-products (paints, plasters, etc.) | 26 | 14 |
| Users / expert companies (painters, plasterers) | 7 | 2 |
| Authorities / Regulators | 2 | 2 |
| Associations (NGO's) | 1 | 1 |
| Summary | 42 | 25 |

5.2 Risk mitigation measures

The BPR governs the guard rail for placing biocidal products on the market. According to BPR, biocidal products are only authorised when they have no unacceptable effects on human and animal health or on the environment (Article 19). By discovering unacceptable risk during the risk assessment, it may be possible to reduce the risk to an acceptable level by means of implementing "risk mitigation measures" (RMM). RMM should be evaluated and worked out in cooperation with producers, users and authorities in terms of practicability and efficiency. To date, no RMM document exists for the questionnaire for products PT 7 and PT 10. According to the ICAO Doc 9859 - Safety Management Manual, possible RMM include general and specific strategies.

General risk mitigation:

- Revision of the system design (before system implementation)
- Modification of operational procedures
- Changes to staffing arrangements
- Training of personnel to deal with the hazard

Specific risk mitigation measures are introduced with the objective to:

- Eliminate the risk
- Mitigate the risk, if elimination is not feasible
- Cope with it, if neither elimination nor mitigation is feasible

In summary, stakeholders considered eight RMM to be the most efficient in limiting environmental impact during application and use phase (Figure 1). In this evaluation "most" is defined as to have at least 60% interviewees consider the measures highly or medium efficient. In Chapter 5.3 survey feedback and RMM will be further discussed. According to stakeholders, guidelines for a safe use of biocides should be provided for professionals as well as for private users. It is particularly important to ensure the proper use of the products, and their users should be aware of their compliance. The product packing often does provide some information regarding use and disposal. However, more specific guidelines, structured education and training for users (painter / plasterer) as well as appropriate equipment for employers should be provided.

During application phase suitable RMM are plastic sheets covering the ground. Freshly treated surfaces should be protected from rain and moisture during the drying period. In particular, paints and renders should be applied at dry weather conditions. New application techniques might limit uncontrolled spilling. Further, proper waste management on the construction site is necessary.



Guidance for sustainable use and disposal as part of professional training.



Guidance for sustainable use and disposal as part of training of nonprofessionals.



Authorisation of professional users after participation in training program.



Education in sustainable use of paints and renders containing film preservatives for architects.



Control of guidance on safe handling of end-products for professionals conducted by manufacturers (safety and technical data sheet).

Efficiency

Medium

High

Low

Non



Providing information on best practice and safe use of DIY-products.



practice in safe application and disposal for

professional users.

Organized collection and disposal of waste disposed of by mandated public authorities.

29%

13%

Figure 1: Most efficient and practical measures to reduce environment impact by application and use of biocides used as film and masonry preservatives. The percentages refer to the number of stakeholders considering a measure as high, medium, low or not efficient.

Promising RMM are related to improved architecture of buildings with sufficient roof overhang, systems limiting condensation and moisture absorption and any performance avoiding large differences in surface temperature on façades. A potential technology is the application of top coats without biocides on preserved renders to reduce leaching (Wangler et al. 2012). Further RMM are regular maintenance of façades (cleaning, etc.) and stormwater treatment systems (e.g. for removal of biocides).

The industry has pronounced, in the questionnaire, its strong interest in developing technologies that reduce the release of biocides from paint films. Innovative formulations such as controlled release technologies are already used or under development by nearly all biocide manufactures. Approximately 75% end-product manufacturers develop technical RMM to reduce emissions, and 80% are convinced by the success of encapsulated biocides. Further, following measures are expected with lower efficiency by most stakeholders and are ranked from 58% to 16% agreement:

| 1. | Promotion of web-based information platforms | 58% |
|-----|--|-----|
| 2. | Development of a classification system for sustainability of products including the emission of biocides (based on fridge classification with A, B, C, etc.) | 57% |
| 3. | Introduction or integration of environmental criteria into new or existing signs and / or labels | 56% |
| 4. | Remarks to the mode of action of biocides (Explanations of R-phrases) | 54% |
| 5. | Restrictions of sales to retailers stores for general public (e.g. regulation of packaging sizes for consumer) | 52% |
| 6. | Prohibition of certain products and applications for non-professional users (private users) | 50% |
| 7. | Sales of products through retailer stores only after employees joined a training program | 48% |
| 8. | Regular checks on construction sites to record the use and disposal residues of those products | 48% |
| 9. | Declaration of leaching rates on products (CE-label) | 48% |
| 10. | Establishment of collection systems for residues by the manufacturer / distributor | 48% |
| 11. | Development of technical standards and guidelines for the cleaning of equipment (brushes, syringes, etc.) | 46% |
| 12. | Requirements for the marketing of biocides products for retailer stores | 42% |
| 13. | Promotion and further education training for employee such as retailers | 40% |
| 14. | Requirements for the marketing of biocide products for formulator (manufacturer of the finished products) | 38% |
| 15. | Prohibition of application in sensitive locations (close to water bodies, water protection areas, etc.) | 35% |
| 16. | Monitoring of stormwater runoff quality into surface and groundwater near buildings | 30% |
| 17. | Prohibition of spray applications for non-professional users | 30% |
| 18. | Buffer zones of water bodies in which an application must be subject to approval | 26% |
| 19. | Treatment systems for stormwater runoff taking into account the applied area (e.g. m ² façade) | 22% |
| 20. | Restriction of paints and renders containing biocides on buildings without stormwater runoff treatment systems | 20% |
| 21. | Prohibition of spray applications for professional users | 18% |
| 22. | Regular reporting of product amounts used by professionals | 17% |
| 23. | Planning of stormwater management taking into account the use phase (leaching) | 17% |
| 24. | Information from independent sources (research institutions, recognized labels, etc.) | 16% |

5.3 Training/Education

In Europe the use of film and masonry preservatives is allowed without restriction. Both professional and non-professional users have access to these products and can apply them without encountering any legal action or regulatory boundaries. Until now standards and guidelines, educating the user in sustainable use and disposal, are entirely missing. There is nevertheless a common practise of separate waste containers on construction sites.

In the survey, stakeholders were asked to rate the practicability and efficiency of training and education. The highest practicability and efficiency is attributed to the measure, *placement of "standards" for sustainable use and disposal as part of professional training, e.g. for painters* (Figure 2), with an overall score of 92% (considering answers that were answered with high or at least with medium). Stakeholders are expecting a high or at least a medium efficiency in the reduction of environmental impacts by means of this measure. Beyond all stakeholder groups, more than 80% of each stakeholder group answered the question with high or at least with medium efficiency. Only 8% of participants supposed that this measure has low or no effect. Further popular measures are *promotion and further education training for a sustainable use of paints and plasters containing biocides, during the application and utilization phase for architects* with 76% agreement (Figure 2).

The Regulation 305/2011/EC controls the marketing of construction products and repealed the Directive 89/106/EEC. According to the regulation, construction work has to be designed and executed without affecting the environment in a negative manner. Construction must be designed and built so that potential pollution or poisoning of water or soil is avoided (Annex I). When assessing the performance of a construction product, health aspects should be taken into account, also with regard to the entire product life cycle. Consequently, regulation should be brought closer to architects and chief workers who are able to influence the construction and selection of products.





High agreement was also found for the measures *placement of "standards" for sustainable use and disposal* as part of training, e.g. for semi-skilled workers (72%) and certification of professional users after participation in training and education program (user training) (62%). The first measure was supported by at least 50% in each group. Predominantly manufacturers of biocides (50%) and to a lesser extent manufacturers of formulated end-products (30%) did not believe this to be an efficient means. Both associations and one authority even viewed the second measure as inefficient.

Lowest acceptance in the category training and education is attributed to the measure *promotion and further education training for employee in DIY-sector* (40%). A reason could be the complex implementation of this measure caused by a typically high fluctuation of employees in DIY stores.

Additionally, participants were asked if they are aware of training opportunities that focus on the handling of paints and renders containing biocides. Around 60% of the stakeholders answered with "No". Few participants remarked that different training opportunities are offered by manufacturers of biocides, associations, and technical schools. Indeed, some manufacturer of paints and plasters do offer courses for customers and support other paints and plaster manufacturers in handling biocidal products. It has been

remarked that in Germany painters and plasterers are instructed "indirectly" as a part of the technical teaching in waste and residual disposal. Additional sources that were mentioned are fact sheets, publications from associations and experts, and journals. The topic should be included in an education block with focus on environmental impact during professional education and promoted as information on best practice, holistic approach.



Figure 3: Guidance for sustainable use and disposal as part of training of non-professionals (left) and Authorisation of professional users after participation in training program (user training) (right).

5.4 Requirements for sales of biocides

Within the survey, stakeholders were asked to rate conditions for marketing and sales. Stakeholders suggested, with an overall agreement of 73% (Figure 4), that the measure, "proof of advice/consulting on the handling of paints and plasters containing biocides for professionals by the manufacturer (safety, technical data sheet)" would be the most practicable. Currently, a negligible proportion of paints and renders containing biocides are distributed through DIY or online shops. Main customers are professionals from craft business. Therefore, the measure "proof of advice" focuses on a precise customer group with a strong supplier-to-customer relationship. This group can be clearly addressed by manufacturers to ensure high acceptance compared with customers in DIY-shops.

The stakeholders attributed to the remaining measures only a "low" or even "not efficient". These measures with expected low or no efficiency include:

- *Regulation of sales for DIY-stores, e.g. regulation of packaging sizes for consumers* (52%). Over 80% of the manufacturers of biocides and also 46% of formulated end-products have doubts on the practicability and efficiency.
- Sales of products by DIY-stores, only after approval of employees in a training program (48%). Both authority and all manufacturers of biocides classify the measure as low.
- Requirements for the marketing of products containing biocides for DIY-stores (42%).
- Requirements for the marketing of products containing biocides for formulators (manufacturers of paints, renders) (38%).
- Recording of amounts of products applied by professional users (17%).



Figure 4: Proof of advice/consulting on handling paints and plasters containing biocides for professionals by the manufacturer (safety, technical data sheet).

Regulation 305/2011/EC provides harmonized technical specifications for CE labelling of construction products. This framework could be used for sales of products after testing by harmonized European standards (hEN) or European technical approvals, which are issued by the European Organisation for Technical Approvals (EOTA). In Germany the technical approval of a construction product is implemented by the Construction Productions Act (Bauproduktegesetz). This technical approval allows the manufacturer to mark construction products with a CE label. This labelling requires a declaration of the performance of the product (305/2011/EC, Article 6). According to article 6(6), the performance declaration requires that the information of the content of hazardous substances in the construction product is provided. Obligations for CE labelling should be implemented for paints and renders with antimicrobial additives. Currently, there are no sales and distribution restrictions for these products with exception of the chemical classification system (Directive of Dangerous Substances, http://ec.europa.eu/environment/archives/dansub/consolidated_en.htm).

5.5 Awareness programmes and information

Stakeholders were asked to refer to existing guidance documents on best practices as well as standard documents related to practical application and safe handling. About 70% of the stakeholders were not aware of such documents. Manufacturers of formulated end-products reported that they provide product briefings, trainings and in-house training in addition to sales consultancy and post-sales support for customer and professional users on a voluntary basis.

When questioning the stakeholders about the practicability and efficiency of different requirements for awareness and information raising, they attributed the highest rate to the measure, *providing information on best practice for use and safe disposal of products containing biocides for customers in DIY-sector with an overall agreement of 84% (Figure 5) and providing multilingual information on best practice for the safe application and disposal for professional users with an acceptance of 80% (Figure 5).*



Figure 5: Providing information on best practice for use and safe disposal of products containing biocides, for customers in DIYsector (left), and providing multilingual information on best practice for the safe application and disposal for professional users (right).

The following measures are proposed and ranked by "low" or "no efficiency":

- Promotion of web-based information platforms with an overall agreement of 58%.
- Introduction or integration of environmental criteria into new or existing signs and / or labels (56%). Especially many manufacturers of biocides and of formulated end-products attributed the measure with low or no efficiency. This measure would mostly affect this group, because they would be responsible to equip their products with notes and new labels.
- Declaration of the mode of action of biocides used in products (explanations of hazard labels) with an overall agreement of 54%.
- Notes for further information by independent sources (research institutes, recognized labels, etc.) with an overall agreement of 16%.

The first three measures still have potential in regard to their practicability and efficiency. A web-based information system for the general public which is also helpful for professional users should provide information, e.g. on biocides used in formulated paint and renders, guidelines and documentation for correct handling and disposal. Such a web-portal has to be set up and continuously extended. However, further information from independent sources is attributed to low efficiency.

According to Regulation 305/2011/EC Paragraph 25, information on the content of hazardous substances should be accompanied in the construction product. The purpose of the safety data sheets is to ensure that users are able to take the necessary health, safety and environment measures into account. As a matter of fact, safety data sheets often are not available in market stores (DIY). In the best cases, salespersons have access to such sheets but do not automatically hand over them to customers.

All products in the construction sector will be harmonized under the Construction Product Directive (305/2011/EC). The measures for PT7 and PT10 could be implemented in the technical standards driven by the European Committee for Standardization (CEN). The following mandate could be extended to include the implementation of measures. Regulation for masonry and coating products for application on objects could be implemented by extending the technique standards such as CEN/TC 125 (M/116) "Masonry and related products", CEN/TC 298 (M/128) "Products related to concrete, mortar and grout", CEN/TC 128 (M/122) "Roof coverings, roof lights, roof windows and ancillary" and CEN/TC 154 (M/125) "Aggregates".

5.6 Equipment for biocide application

Paints are applied by brushing, rolling, and spraying whereas renders and mortars are processed by coat spreader and trowel. Brushing, rolling, and spraying are also used for engaging cleaning agents (PT 10 products) to liberate façades, terraces and footways from microorganism. Any requirements for equipment are attributed as low or not efficient (Figure 6). Those not much favoured measures include:

- *Prohibition of certain products and applications for non-professional users (i.e. private users)* with an overall agreement of (50%). Mainly manufacturers of formulated end-products did not prefer the measure.
- Development of technical standards and guidelines for the cleaning of equipment (brushes, syringes, etc.) (46%). Mainly manufacturers of biocides and formulated end-products attributed low or even no efficiency at all to the measure.
- Prohibition of spray applications for private users (30%).
- Prohibition of spray applications for professional users (19%).

Prohibition and restriction of the use of certain equipment are generally not favoured measures by stakeholders. The implementation and control of such restrictions would also be difficult because of a large number of construction sites and the time pressure in construction works.

The degree of emission depends on the product properties (e.g. concentration, substance properties) and the application procedure (e.g. groundcover, proper disposal, equipment etc.) which is based on the knowledge of applicators. Release to sewage systems or direct release into soil or surface waters usually occurs by cleaning tools and equipment at construction site. A Swiss guideline for painters "Vollzugshilfe Malerarbeiten" (BUWAL 1995) and DWA-Merkblatt M-370 "Abfälle und Abwässer aus der Reinigung und Entschichtung von Fassaden" (DWA 2011) gives guidance to manage wastewater from façade cleaning or to proper cleaning of equipment. However, the main pathway into the environment is expected through waste disposal.



Figure 6: Prohibition of certain products and applications for non-professional users (i.e. private users) (left), development of technical standards and guidelines for the cleaning of equipment (brushes, syringes, etc.) (middle), and prohibition of spray applications for professional users (right).

5.7 Further measures to reduce emission during application

For the requested measure, regular checks on construction sites to record the use and disposal of residues of products containing biocides used as film preservatives received only 48% agreement. Associations and

authorities classified this measure between low to medium whereas answers of manufacturer of biocides and manufacturer of end-products range between "high" to "not efficient". The implementation of this measure would entail personal expenses for authorities.

5.8 Measures to reduce emission during service life

Stakeholders were asked to rate the practicability and efficiency of the measures, *development of a classification system for paints and renders including the biocides (based on Refrigerator: A, B, C, etc.)* and *declaration of leaching rates on products (CE-label)*. Participants classified the two measures with an overall agreement of 56% and 48% as almost practicable (Figure 7). The first measure was not favoured neither by manufacturers of biocides (67% disagreement) nor by manufacturers of end-products (58%) (Table 6). The second measure (left, Figure 7) was not favoured by any manufacturer of biocides (100% disagreement) and by manufacturers of formulated end-products only to a small extent (38%).

The development of a classification system for paints and renders (similar to the Swiss system: www.stiftungfarbe.org) would mainly affect manufacturers of formulated end-products. Nevertheless, the "Blauer Engel" label of UBA for ETICS has been successfully introduced to the market (RAL UZ140, www.blauer-engel.de). The determination of leaching rates is on the one hand time consuming and cost intensive and on the other hand the benefit to reduced negative impacts is quite limited.

A promising source-control measure to reduce emissions during service life is related to improved product quality. Leachability of biocides mainly depends on the water solubility and Pow (partitioning between octanol and water), the formulation recipe (encapsulated or free biocides) and the persistence of the active ingredients used. Manufactures of biocides and formulators of end-products are able to influence those properties. For example, isothiazolinones are readily degradable in water systems and available as encapsulated biocides. Those technologies lead to a reduction of biocides in leachate with lower toxicity to organisms in receiving waters. All manufacturers answered that such technologies aiming at encapsulation are already introduced to the market or under development. However, even more important is a preventive architecture, e.g. roof overhang, eave and tint or soffit on windows. Weather protected coatings with limited water contact time are less attacked by microorganisms.



Figure 7: Development of a classification system for paints and renders (classes A, B, C, etc.) (left) and declaration of leaching rates on products (CE-label) (right).

Regulation 1107/2009 governs the placing of plant protection products on the market. In Article 31 a general description defines the maximum dose, the application periods and maximum number of applications. This regulation gives guide rails which can be developed also for preservatives used in exterior films and renders.

The Regulation 305/2011/EC that regulates the marketing of construction products could also be revised. General description for handling products containing substances of concern such as maximum biocide concentration per square meter, application time (e.g. rain), equipment tools, and preventive measures (ground covering) could be documented and shown on demand.

 Table 6:
 Development of a classification system for paints and renders including the biocide (based on Refrigerator: A, B, C, etc.) – stakeholder specific answers.

| Stalkahaldar | High / Medium | Low / Non |
|---|---------------|------------|
| Slakenoluei | % of total | % of total |
| Manufacturers of biocides | 33 | 67 |
| Manufacturers of formulated end-products (paints, plasters, etc.) | 58 | 42 |
| Users / expert companies (painters, plasterers) | 100 | 0 |
| Authorities / Regulators | 50 | 50 |
| Associations (NGO's) | 100 | 0 |

5.9 Measures to reduce emission during restore and end-of life stage

Stakeholders were questioned regarding collection and disposal systems. Highest practicability and efficiency is attributed to the measure *organized collection and disposal of residual amounts mandated by public authorities* (Figure 8) with an agreement of 62%. Most stakeholders score this measure as a potential option for emission reduction (Table 7). Since the implementation for this measure would primarily affect painters and plasterers, it is not surprising that their feedback to this measure was negative (not efficient). The measure *establishment of collection systems for residues by the manufacturer / distributor* (Figure 8) are accepted by 48%. Practicability and efficiency is attributed to be lower compared with collection systems that are mandated by public authorities. Manufacturers of biocides (40%) and especially manufacturers of formulated end-products (69%) disapproved the suggestion. The question raised is: Do authorities, manufacturers or another party take ownership of the implementation?



Figure 8: Organized collection and disposal of residual amounts mandated by public authorities (left) and establishment of collection systems for residues by the manufacturer / distributor found an acceptance (right).

Limited information is available on the amounts of biocides remaining in coatings treated with preservatives after service life. It can be assumed that with greater life time, the remaining concentration of biocides becomes smaller. Directive 91/689/EC on hazardous waste, establishes a list in Annex II that mentions biocides as a constituent of waste. Biocides with carcinogenic or toxic properties (Annex III) belong to this

group. Diuron is already listed in Annex VI (Regulation 1272/2008) as a potentially carcinogenic substance. In case of exceeded threshold values, waste must be disposed separately. Re-use of construction materials contaminated with biocides would not be allowed to exceed a certain threshold. The regulation for end-of life of pesticides (Regulation 396/2005/EC) governs the maximum residue levels in food and feed. Adaption to biocides has to be evaluated.

 Table 7:
 Organized collection and disposal of residual amounts mandated by public authorities – Answers of different stakeholders.

| Stakeholder | High / Medium % of total | Low / Non % of total |
|---|-----------------------------|-------------------------|
| Manufacturers of biocides | 80 | 20 |
| Manufacturers of formulated end-products (paints, plasters, etc.) | 64 | 36 |
| Users / expert companies (painters, plasterers) | 0 | 100 |
| Authorities / Regulators | 50 | 50 |
| Associations (NGO's) | 100 | 0 |

Important for a sustainable use of paints and plasters containing biocides, is the adequate and safe disposal of containerd on construction sites. Empty containers can be disposed directly under the disposal code 08-02, (HZVA) whereas waste containing biocides, should be disposed of under the disposal code 17-09 (debris from treated façades) (Hafner 2006). Based on the feedback from the survey, this procedure represents the current practice.

5.10 Specific measure to protect the aquatic/terrestrial environment

Different measures exist to limit the negative impact on aquatic and terrestrial environments, caused by biocides released from façades.

Before using biocides, antimicrobial substances have to be registered and their fate and behaviour assessed. Algaecides used in PT 7 facade coatings, for example, are known for their limited degradation in aquatic systems and soil (DT 50 up 150 days) (Paulus 2004) whereas isothiazolinones degrade rapidly (DT 50 < 2 days). Hence, in the registration process, reduction measures for substances of potential impacts on the environment can be defined.

After the registration and use phase, measures mainly focus on planning and monitoring. The stakeholders rate the practicability and efficiency of those measures to protect the aquatic/terrestrial environment:

- *Monitoring of the quality of rainwater runoff to surface and groundwater close to buildings* was supported only by 30%. Manufacturers of end-products denied the efficiency of the measure (92%).
- *Establishment of protection and buffer zones to waters in which an application must be subject to approval* with a support of 26%. In fact, it would lead to an extension of needed settling areas, and monitoring the implementation by authorities.
- *Treatment facilities for rainwater runoff taking into account the areas applied with products containing biocides (e.g. m² façade)* with an overall agreement of 22%. All manufacturers of end-products (100%), most manufacturers of biocides (80%) expressed their doubts about the efficiency whereas NGO, one authority, and two associations supported the RMM. The doubt of manufacture is reasonable because realisation will lead to added workload.

- Abandonment of paints and renders containing biocides at buildings if pre-treatment of surface runoff is not ensured with a support of 20%. Harsh restrictions are supported neither by producers nor by authorities.
- *Planning of rainwater management by taking into account the leaching of used paints and renders* with an overall agreement of 17% (Figure 9).

These five measures are not much favoured across all groups. Since stakeholders of different levels of information and competence have to be involved in the planning and implementation process, the success of these measures is rather unlikely.



Figure 9: Planning of rainwater management by taking into account the leaching of used paints and renders.

Water quality standards are set in a list of priority substances with a certain risk to the aquatic environment by EU Water Framework Directive 2000/60/EC. The goals of the directive are to prevent and reduce water pollution, to promote sustainable use of water and to protect the aquatic environment. Measures to mitigate substances of concern have to be developed. Diuron and Isoproturon are listed as priority substances which are used as pesticides and in film preservatives. Since August 2013 Terbutryn is listed by the 2013/39/EU amending directives 2000/60/EC and 2008/105/EC as priority substances in the field of water policy. A monitoring of these substances in water samples will force manufactures of biocides to develop new technologies in order to reduce leaching or substitute algaecides of concern.

5.11 Reduction of biocides used in sensitive areas

Only a few stakeholders supported the measure, *prohibition of application at sensitive sites (close to surface water, drinking water protection areas, etc.)* with an overall agreement of 34%. The meaning of "sensitive" area was probably not rendered clear enough in the survey. However, more important is the definition of the boarders of sensitive catchments in practice. Surface and subsurface flow as well as specifically protected sites and "common" sites are often hard to distinguish. For pesticides, restrictions of use in sensitive areas exist whereas no restrictions are defined for biocides of PT 7 or PT 10 up to now.



Figure 10: Prohibition of the application at sensitive sites (close to surface waters and drinking water protection areas, etc.).

5.12 Existing guidance documents on best practices and standards

Paints, plasters and PT 10 products used under conditions of "best practice" covers save application equipment, preventive measures (e.g. ground covering), and proper disposal of residuals. In this context, guidance documents such as leaflets and best practice documents are important tools to reduce wrong handling.

Stakeholders were asked to refer to documents on best practices and standard documents that describe practical application and safe handling of paints and plasters containing biocides. About 70% of the stakeholders were not aware of specific documents and referred to standards-, safety- and product sheets. Even the German "Gefahrstoff-Informationssystem der Berufsgenossenschaft der Bauwirtschaft" (GISBAU) has announced nothing so far (www.gisbau.de). One association highlighted the leaflet "Sanierung von Fassaden mit Algen- und Pilzbefall", published by EMPA 2003, as well as a technical journal³. Both are based on the handbook of Büchli and Raschle (2004). Further documents with different characteristics, also from abroad Germany, are listed in Table 8. For example, an implementation guideline for painters "Vollzugshilfe Malerarbeiten" (BUWAL, 1995) exists in Switzerland.

According to one NGO, the emission scenario documents (ESDs), should be improved together with spread sheets and models like EUSES⁴. However, the ESD is intended to support the registration process of biocides and not the users in practice.

³ http://fzarchiv.sachon.de/index.php?pdf=Fachzeitschriften/Maler-und_Lackierermeister/Mitteilungen/2004/02_04/ML-Mitteilungen_02-04_Thueringen.pdf

⁴ http://ihcp.jrc.ec.europa.eu/our_activities/public-health/risk_assessment_of_Biocides/new-version-of-euses-2.1.2

| Organization | Guideline / Best practice | Country | Link |
|----------------------|---|-------------|---|
| Organization | document / standard | - | |
| DWA | Merkblatt DWA-M 370 Abwässer und Abfälle | D | www.dwa.de/shoplink/M-370-11 |
| | aus der Reinigung und Entschichtung von | | |
| | Fassaden | | |
| Fachverband Putz und | Technische Information, Algen und Pilze auf | D | |
| Dekor e.V. (u.a.) | Fassaden | | |
| Peters et al. | Best Available Techniques (BAT) for the | D | http://ec.europa.eu/environment/air/pollut |
| | Paint- and Adhesive Application in Germany: | | ants |
| | Volume I: Paint Application | | |
| CITB | Health and Safety Advice for Painters & | UK | www.citbcsni.org.uk |
| | Decorators | | |
| English Heritage | lemporary protection of wall paintings | UK | http://www.english- |
| | during building works: Practical Information | | heritage.org.uk/publications/temporary- |
| | Leanet 2 | | protection-or-wall- |
| DUWAI | Empfohlungen und Grundlagen für | CU | paintings/wanpaintprotect.put. |
| DUWAL | Empreniungen und Grundidgen für Malararheiten | СП | - |
| oco-hau | Malei al Dellell Nachhaltigkoit im öffontlichon Rau: BKD 226 | СП | http://www.oco-bau.ch |
| eco bau | und 227 | UI | http://www.eco bad.ch |
| SMGV | Instandhaltungsanleitung Beschichtungen | СН | http://www.smay.ch/shop/index.php?route |
| | und Vernutze auf Fassaden und | U II | =product/product&product_id=85 |
| | Aussenwärmedämmungen | | product, productaproduct_id ob |
| Greenpainter | Painting Australia a Sustainable Future | AU | http://www.greenpainters.org.au |
| Wikipedia | Paint recycling | - | http://en.wikipedia.org/wiki/Paint recyclin |
| | | | g |

Table 8: Examples of best practice guidelines for PT 7 and PT 10 available in the EU, Switzerland, and abroad.

6 Indicators

The stakeholder marked of the following 6 indicators - out of 16 indicators - for evaluating the success of the above mentioned potential measures, obtained in sustainable use of paints (PT 7) and masonry preservatives (PT 10), as most promising (Figure 11):

- 1. Biocide specific monitoring of effluents from sewage treatment plants (18%).
- 2. Biocide specific monitoring of surface waters (18%).
- 3. Biocide specific monitoring of groundwater and drinking water (18%).
- 4. Monitoring of biocides in consumer products (13%).
- 5. Consumption survey, data for specific product groups (7%).
- 6. Survey of created m^2 surfaces (7%).

Figure 11 shows the result of the six most favoured indicators chosen by the participants. Indicators 1 to 4 with highest ranking are more or less in practice. Overall agreements are 18% for each indicator followed by the indicator, *monitoring of biocides in consumer products* with an acceptance of 13%. The last two indicators are less preferred, each with 7% agreement and are not judged as effective.





The three monitoring indicators are not specifically implemented with focus on biocides and existing release patterns. In Germany, the report "Vorbereitung eines Monitoring-Konzepts für Biozide in der Umwelt" (FKZ 360 04 036) announced a monitoring concept by the end of 2015 ("Umweltbelastung durch Biozide: Erarbeitung der Eckpfeiler eines Monitoring-Messprogramms für Biozide in der Umwelt" FKZ 3712 67 403). In Switzerland, biocides are already included in an adopted monitoring program (Munz 2012). Environmental monitoring can be improved by exchange of these data between different site specific programmes additionally. As a consequence, measurements have to be revised and harmonised in order to perform and acquire suitable monitoring data.

Remaining indicators such as consumption survey data for specific products and installed m^2 surfaces are not judged as effective. Stakeholder remarked that those indicators are not practicable to implement or these information need to be treated confidential due to the European antitrust law.

Remaining indicators are judged as low or not efficient with an acceptance below 5%. These 'ineffective' indicators are:

- Survey of proportion of private use
- Surveys of professional / private users
- Survey of the number (certified / trained) of professional users
- Survey of the number of training events and participants
- Survey of the collection amount of waste (waste products)
- Survey of funds for research and development spent on risk reduction (technical solution)

7 Recommendations and package of measures

Measures listed in Table 9 received the highest acceptance by at least 60% of all stakeholders (sum of high and medium efficient) and at least 50% of each stakeholder group (manufacturer of biocides, formulators, authorities, associations). Favoured measures are from the categories, "training and education" with three nominations, followed by, "information and awareness", with two, and "marketing and sales", and, "reduction during use phase" with one nomination each. Stakeholders attribute low or no efficiency to the category "surveillance of applications".

Stakeholders consider three measures as most efficient and practical regarding their potential to reduce the negative environmental impacts of paints and renders that contain biocides and masonry preservatives:

- 1. Placement of "standards" for sustainable use and disposal as part of professional training, e.g. for painters (overall agreement 94%)
- 2. Providing information on good practice for use and safe disposal of products containing biocides, for customers in the DIY-sector (overall agreement 84%)
- 3. Providing multilingual information on "best practice" for the safe application and disposal for professional users (overall agreement 80%).

Stakeholders underline that education courses could be implemented in the official apprenticeship. Measures could be managed the contact with association and education offices of painters and plasterers. Implementation of the measure, *providing information on good practice of products containing biocides for customers in the DIY-sector*, can be provided by associations and manufactures whereby authorities take the part of controlling. Manufactures should provide technical data sheets, sheets about safe disposal, multilingual technical information sheets and training support for DIY-customers and professionals.

The measure, promotion and further education training for a sustainable use of paints and plasters containing biocides during the application and utilization phase for architects, is in our view an important measure. Façades protection from wind driven rain by a proper architecture, will increase life-time of these products. Stakeholders proposed technical solutions such as encapsulation and top-coats additionally to reduce environmental impact.

The measure, *organized collection and disposal of residual amounts, mandated by public authorities*, is rated with the lowest score. Public authorities will be challenged by adopting the measure. Authorities have to install collection points for disposal of residuals with extra costs for public. The comparable measure, *establishment of collection systems for residues by the manufacturer / distributor* is even less accepted. Mainly manufacturers of formulated end-products (69%) refused the measures most probably due to the expected costs.

Within the survey one stakeholder underlined that the most important aspects for using preservative products in paints and plasters are the warranty for customers that façades are not attacked by algae and fungi. The stakeholder stated, "*The most important reason for paints and plasters with biocides, is caused by warranty against algae and fungal attack within 5 years by the processors and manufacturers. Although it is not protected in law, but introduced by several court cases in Germany. A clear legal regulation that applicators are not responsible for algae and fungal growth on facades would reduce the use of biocidal products in the medium to those customers who request it*".

Consequently, between all stakeholders a general agreement exists that new guidelines, standards and best practice documents for paints and plasters containing film preservatives and PT 10 products are needed. In Europe such documents could be implemented in technical standards driven by the European Committee for Standardization (CEN). Existing standards for masonry and coatings can be extended.

- CEN/TC 125 (M/116) "Masonry and related products"
- CEN/TC 298 (M/128) "Products related to concrete, mortar and grout"
- CEN/TC 128 (M/122) "Roof coverings, roof lights, roof windows and ancillary"
- CEN/TC 154 (M/125) "Aggregates"

| Category | Measures | % |
|---|--|----|
| | Placement of "standards" for sustainable use and disposal as part of professional training, e.g. for painters | |
| Training and education | Promotion and further education training for a sustainable use of paints and plasters containing biocide during the application and utilization phase for architects | |
| | Placement of "standards" for sustainable use and disposal as part of training, e.g. for semi-skilled workers | |
| Conditions of marketing and sales | Proof of advice/consulting on handling paints and plasters containing biocides for professionals by the manufacturer (safety, technical data sheet) | 74 |
| Information and awareness raising | Providing information on good practice for use and safe disposal of products containing biocides for customers in the DIY-sector | |
| | Providing multilingual information on "best practice" for the safe application and disposal for professional users | |
| Measures to reduce emissions during theuse phase | Organized collection and disposal of residual amounts mandated by public authorities | |

 Table 9:
 Ranking of recommended measures with highest risk mitigation potentials.

On national level guidelines, techniques standards and best practice documents could be implemented in the following documents, beside leaflets provided by authorities:

- VdL RL 01 (3rd revision) directive for the declaration of ingredients in paints, architectural coatings and related products
- DIN 18363 painting and varnishing work (VOB Vergabe- und Vertragsordnung für Bauleistungen -Teil C: Allgemeine Technische Vertragsbedingungen für Bauleistungen (ATV) - Maler- und Lackierarbeiten - Beschichtungen
- DIN 18558 Kunstharzputze; Begriffe, Anforderungen, Ausführung
- DIN 55945 Beschichtungsstoffe und Beschichtungen Ergänzende Begriffe zu DIN EN ISO 4618

Any initiative that provides additional information/awareness about protecting the environment, would reduce the 'point contamination issue', e.g. during the application phase. The collection and disposal of residues must be treated by local legislation on dangerous waste.

However, some stakeholders are afraid of additional burden. A statement of one stakeholder was, "as long as safe use was demonstrated under the stringent requirements of the European biocide legislation for the supported label claims, no additional restriction should be brought at other levels." For instance, if the spraying application technique is risky then it will be automatically restricted by the BPR.

CEPE supports the steps taken to improve sustainable use of film preservatives in paints and plasters belonging to PT7 and PT 10. It is however important that any further initiatives shall be evaluated with respect to risks for the environment and the changes necessarily required for the implementation of improvements. It is important to evaluate the total impact of various products and layered systems (combination of paint and render) and the risk and hazards involved.

Due to the need for additional information on the sustainable use, an ad hoc working group of different stakeholders prepared five leaflets for the UBA. The leaflets are addressing measures to reduce the use of paints and renders containing biocides and masonry preservatives⁵. All group members from industry, UBA, NGO and science, agreed on the aims. Architectures, authorities, painters, and private users are encouraged to take these information into account from planning of the buildings to the disposal of waste. New pictograms are drafted by UBA to make information available for foreign construction workers. These documents might be an example to fulfil the lack of information within short time.

8 Amount of Biocides used in Products of PT 7 and PT 10

For several biocides dossiers are submitted under PT 7 and PT 10 (Table 10). In reality, products of PT 7 and PT 10 do not contain all these substances. Therefore, manufacturers of biocides were asked for the amounts and importance of film and masonry preservatives used by a supplementary questionnaire. According to the response the biocides of (Figure 12) are the most common biocides for paints and renders (PT 7). For masonry preservatives (PT 10) it seems that only OIT and QAV are in use. This seems to be in contradiction with the dossiers submitted. Most probably, the listing of substance under PT 7 and PT 10 is based on the misunderstanding about the classification of polymeric top renders containing biocides. Such renders are often discussed as PT 10 product although the composition is similar to paints regulated under PT 7.

| PT | Active ingredients | Submitted dossier PT 7 | Submitted dossier PT 10 |
|------|--------------------|------------------------|-------------------------|
| 7 | Diuron | Х | Х |
| 7 | Isoproturon | Х | Х |
| 7 | Terbutryn | Х | Х |
| 7 | Carbendazim | Х | Х |
| 7 | IPBC | Х | Х |
| 7 | DCOIT | Х | Х |
| 7/10 | OIT | Х | Х |
| 7 | Zinc pyrithione | Х | Х |
| 10 | QAV | | Х |

Table 10: Active ingredients used in PT 7 and PT 10.

In Germany, in 2011, the biocide consumption for paints and renders (PT 7) for exterior applications was between 200 to 400 t/a and for masonry preservatives (PT 10) between 10 and 50 t/a. These amounts were reviewed carefully and are consistent with the answers of different stakeholders. Additionally, the amounts were validated against consumption data, estimated for Switzerland (Burkhardt et al. 2013). In Switzerland, in total 10 to 30 t/a of biocides are applied as film preservatives and < 2 t/a as masonry preservatives. Based on the population difference between Germany and Switzerland a factor 10 exists. Taking this factor into account, the difference in biocides use is in the same range.

The results of the consumption quantitative survey of individual biocides for PT 7 and PT 10 are shown in (Figure 12). In PT 7, the largest amounts used are 50 to 100 t/a of Diuron, Terbutryn, and OIT respectively, followed by Zinc pyrithione between 10 to 50 t/a. Less market existence is related to Carbendazime, IPBC, Isoproturon, and DCOIT with 1 to 10 t/a each. In products of PT 10 solely QAV with 10 to 50 t/a and OIT with 1 to 10 t/a are used. In comparison with PT 7 the amounts in PT 10 are nearly negligible.

⁵ www.umweltbundesamt.de/themen/chemikalien/biozide

The substances zinc oxide and zinc sulfide are not listed under BPR, but mentioned in the context of used antimicrobial additives several times by formulators. This information is in contradiction with the BPR, covering all substances for intended use in the area of antimicrobial control. Currently, the zinc compounds are used in the foreground as a whitening pigment. The amount of zinc oxide and zinc sulfide estimated by formulators is 1 to 10 t/a each.



Figure 12: Amount of biocides used in Germany for exterior façade applications in paints renders (PT 7, left) and masonry preservatives (PT 10, right).

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