DECISION SUPPORT FOR THE ASSESSMENT OF BIOCIDE USE IN FACADE COATINGS

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Dr. Manfred Klade

Bureau for Chemical Engineering

CONTENT

SUMMARY

Algae and fungi can settle on building facades as a grey-greenish to black coating. Although these "living" dirt does not impair the functionality of the building, it is perceived by residents and residents as unsightly or disturbing and represents an aesthetic problem for them. In this respect, the compact façades with hydrophobic, water-repellent system structures (exterior plaster and paint), which are widely used in residential construction, are particularly at risk. Thermal decoupling promotes the formation of condensation, which diffuses into the coating and promotes the growth of moisture-loving microorganisms in unfavourable conditions (north exposure, cold season). To prevent the latter, the hydrophobic (polymer-containing) exterior plasters and paints are treated with biocidal active ingredients. However, the active ingredients are dissolved from the plaster or paint matrix by condensation and rainwater and transported to the façade surface. This is a necessary process for the effect, but at the same time leads to washing off and entry into water and soil. In order to avoid or at least reduce the use of biocidal agents in building facades and the associated risks for processors and the environment, the following strategies are available:

1. Constructive measures in the planning phase: This means, for example, canopies or eaves as well as a favourable spatial orientation and environmental design. This can already significantly reduce the risk of infestation. The measures must be considered or implemented by architects and property developers in the planning phase.
2. Use of biocide-free coating products: If possible, mineral or synthetic resin-bound paints or plasters without biocidal film protection should be preferred when selecting the coating. External thermal insulation composite systems for façade protection are offered by manufacturers as complete packages as part of the Blue Angel eco-label (RAL-UZ 140),
3. Encapsulation of biocidal active ingredients: Since 2001, biocides have also been used in encapsulated form in façade coatings and are displacing or replacing non-encapsulated biocides from the market (e.g. for Switzerland, their share is currently estimated at around 90%). Laboratory and field tests show that encapsulation can reduce leaching from façade coatings. The magnitude of the reduction depends on the properties of the active ingredient, the type of encapsulation, the system structure and the paint or plaster formulation.
4. Avoidance of the environmental input of substances of particular concern: One of the aims of this decision-making aid is to identify or avoid active substances that are of particular concern from an environmental point of view. Remaining in the environment or degradability in environmental media is an important criterion for this. Test results on the degradability of the eight most important biocidal active substances were therefore researched and analysed. The analysis of test results for the OECD screening tests 301 A-F shows that none of these eight active substances meet the criterion "readily biodegradable". Thus, no differentiation with regard to degradability is possible on the basis of these test systems. Data from the OECD simulation tests 308 and 309 (for biodegradability in water and water/sediment respectively) show relatively short half-lives (hours or a few days) for the active substances OIT, DCOIT, IPBC & zinc pyrithione, while relatively long half-lives (hours, or a few days) for isoproturon, carbendazim, diuron and terbutryn. Due to these different half-lives, relatively shorter residence times can be assumed for the active ingredients OIT, DCOIT, IPBC and zinc pyrithione in the environment. The latter are therefore preferable to the active ingredients isoproturon, carbendazim, diuron and terbutryn. At the same time, the human toxicological properties of the substances were analysed. It was assumed that a combination of long residence time in the environment and mutagenic, carcinogenic or reprotoxic properties is of particular concern. Such a combination exists at least for the active ingredient carbendazim.

5. Overall strategy for dealing with biocidal coating products: The proposal for this overall strategy is aimed at property developers, architects and, in general, those responsible for planning and procurement. The priority is to avoid biocides in facades by means of constructive weather protection with canopies and eaves. Wherever the climatic conditions of the site allow it, the use of biocide-free coating products (plasters, paints) should be considered. If the (planning) decision is made in favour of façade protection with biocides (e.g. near bodies of water), the following mitigation measures are recommended: i) the coating products should contain the biocides encapsulated; ii) biocides with a relatively short residence time in the environment should be used in the coating products if possible. The present study categorizes the eight most commonly used biocides in this respect: According to this, the active ingredients OIT, DCOIT, IPBC and zinc pyrithione, preferred, isoproturon, carbendazim, diuron and terbutryn, on the other hand, should be avoided. This assessment is in line with the evaluation criteria of the Swiss environmental label for façade paints.

The present study focuses on the strategy of *avoiding substances of particular concern*. Since the overarching goal is to avoid the use of biocides on facades, all strategies are discussed at least in an overview. The aim of the study is to identify those biocidal active ingredients for façade protection that imply the relatively lowest hazard potential from the pool of biocidal active ingredients commonly used on the market. The study aims to be a basis for assessment and a decision-making aid for appropriate measures.

Topics and content

From a legal point of view, the biocidal active ingredients for façade protection are in a multi-year assessment procedure under the Biocidal Products Ordinance (BPR). The BPR distinguishes between 22 types of products in 4 main groups. Relevant for the present study is the main group of protective agents and within it the product type PA7 (coating protection agent*).* PA7 comprises 32 active substances, 26 of which are still in the approval process and 4 are approved. The product type PA10 (protective agent for building materials) is aimed more at the (subsequent) renovation of masonry. As far as their active ingredients are concerned, these are also contained in PA7 – with the exception of quaternary ammonium compounds (see Table 23 in the appendix). Not relevant for the study are active substances that are added to building products for the purpose of preservation and storage and are therefore assigned to the product type PA6 (protective agent for storage).

The product types PA7 and PA10 together comprise 43 active substances that have been subjected to a step-by-step risk analysis. In the first stage, the substance classification was determined for each of these 43 active substances. The classification in the form of H-phrases provides information about the hazards that the substance (can) pose. Most of the active ingredients could be assigned a classification, with 4 active ingredients - including the microorganism *Pythium oligandrum* - the CAS number required for substance identification was missing, so that no assignment was possible (see Table 25 in the appendix).

In the second stage of the hazard analysis, the substances relevant to the market were identified in the 43 active substances. The basis for this was provided by the Swiss study on *the quantity estimation of biocides in protective products in Switzerland* from 2013 [3]. In this study, the consumption quantities of film preservatives for architectural paints and plasters for outdoor use (PA7) in Switzerland in 2011 were researched on the basis of surveys of manufacturers, formulators and users. Overall, a consumption of active ingredients of between 10 and 30 tonnes was estimated on the basis of the survey, whereby this was divided into the eight active ingredients *diuron*, *terbutryn*, *carbendazim*, *2-octyl-2H-isothiazone-3-one (OIT)*, *zinc pyrithione*, *isoproturon*, *2-iodo-2-*

propynylbutylcarbamate (*IPBC)* and *4,5- Dichloro-2-octylisothiazolin-3(2H)one* (*DCOIT).* Overall, the importance of these active ingredients is assessed by the interviewees as follows: High: *Diuron*, *Terbutryn*, *OIT, Zinc Pyrithione;* Agent: *Carbendazim;* Low: *IPBC, DCOIT, Isoproturon.* This assessment is confirmed by the author of the study[1] in an interview. The future importance of the active substances is assessed as follows: increasing: *DCOIT, OIT;* Constant: *Terbutryn, IPBC, Zinc Pyrithione;* Decreasing*: Diuron, Isoproturon, Carbendazim.*

The hazard potential was analysed for these 8 active substances (see also Tables 2 to 9; Table 10, 11 & 12 summarize the results).

With regard to the risk to human toxicity , the following results: 4 active substances (OIT, DCOIT, IPBC, ZINC PYRITHIONE) have a high or very high acute toxicity; 5 active substances (OIT, IPBC, DCOIT, Carbendazim, Terbutryn) are classified as skin sensitizing; 4 active substances (isoproturon, IPBC, Diuron, zinc pyrithione) have been proven to damage organs or have the potential to do so; 2 active substances (isoproturon, diuron) are suspected of being carcinogenic; 1 active ingredient (carbendazim) is classified as proven mutagenic and 2 active substances (carbendazim, zinc pyrithione) have been shown to impair fertility and/or harm the child in the womb. Whether this hazard potential becomes relevant to health depends strongly on the life cycle and human exposure of the respective active ingredient, a corresponding analysis is beyond the possibilities of the present study. However, it is assumed that a lack of or poor biodegradability in combination with proven mutagenic, carcinogenic or reprotoxic properties is particularly questionable. This is the case for the active ingredient carbendazim.

With regard to the ecotoxicological hazard, it is found that all eight active substances are classified as "long-term aquatic hazards" (H410), differences exist with regard to M-factors[2]. Data on easy biodegradability according to OECD screening tests OECD 301 A-F could be searched for all 8 active substances. Accordingly, no active ingredient meets the requirements of the tests or cannot be assessed as *easily biodegradable*. From the available data, there is no significant bioaccumulation potential for any of the 8 active substances. Thus, the criteria "Readily biodegradable according to the OECD Screening Test" and "Bioaccumulation potential" are not suitable for differentiating individual active substances with regard to the ecotoxic hazard. For this reason, it was also investigated to what extent the active substances differ in terms of their residence time in the environmental compartments of water and water/sediment. This is estimated on the basis of half-lives (DT50) in the simulation tests OECD 308 or OECD 309 [18,19]. Corresponding data could be collected for all eight active substances. Based on the data from the simulation tests, the eight most important active substances are divided into 2 categories:

1. Low to moderate exposure due to relatively short residence times in the environmental media water or water/sediment: OIT, DCOIT, IPBC, zinc pyrithione
2. High pollution due to relatively short residence times in the environmental media water or water/sediment: isoproturon, carbendazim, diuron, terbutryn

The encapsulation of biocidal active ingredients is now state of the art, with its market share estimated at 50 to 60% for Germany and 90% for Switzerland[3]. A similar order of magnitude can probably be

[1] Prof. Dr. Michael Burkhardt from the University of Applied Sciences Rapperswil (see also interview transcript in the attachment)
[2] When classification in the hazard class hazardous to water (environmental hazards), the potency of highly toxic components in the hazard categories acute 1 and chronic 1 is additionally weighted by multiplication factors (M-factors). The higher the factor, the greater the risk to aquatic life caused by the substance.
[3] See interview Burkhardt in the appendix

assumed for Austria, but figures are missing. The encapsulation technology leads to both a reduction in the amount of biocides used in the façade coating and to a reduced leaching compared to unencapsulated active ingredients – this has been proven by laboratory and field tests. The magnitude of the reduction depends on the properties of the active ingredient, the type of encapsulation, the system structure and the paint or plaster formulation. Examples of this are cited in the present study [5], [15].

The sources considered for the present study make hardly any concrete statements about the exposure or possible health hazard of affected workers (during construction) to biocides. In principle, this should be reduced in the case of the use of encapsulated biocides.

A thermal insulation composite system as well as several façade plasters and paints from three manufacturers were subjected to a product analysis. The products were researched on the Internet and on-site research was dispensed with, for example in DIY stores. The advantage over on-site research is that manufacturers usually provide product safety data sheets and information on the Internet. Both biocide-containing and biocide-free systems are discussed. "Biocide-containing" or "biocide-free" refers to the façade plaster and/or façade paint. Relevant providers were found out from the City of Vienna (inquiry at MA34), named: The full-service providers *Baumit, STO* and *Synthesa* and beyond *Austrotherm, Röfix, Steinbacher, Isover, Rockwool* as well as *Knauf Insulation.* As examples, the three companies *Baumit, STO* and *Synthesa* thermal insulation composite systems as well as exterior paints and plasters and analysed the safety data sheets with regard to the biocides they contained. It was taken into account that pot preservatives are added to the building products. These are included in the analysis (Table 16 until Table 21) and must be distinguished from biocidal façade protection agents. The following were analyzed:

<u>1 (complete) external thermal insulation composite system (*Baumit*):</u> The system does not contain any top plaster or façade paint. Biocides contained in the components are therefore not used to protect the façade, but for pot preservation.

<u>5 façade plasters (*Baumit, STO, Synthesa*):</u> These contained the following active ingredients for façade protection: *OIT* (4x); *Terbutryn* (3x); *Zn-pyrithione* (2x); *Carbendazim* (1x); *Diuron* (1x). Concentrations are maximum for *OIT:* < 500 ppm; *Terbutryn*: < 250 ppm; *Carbendazim*: <1000 ppm. The provider *STO* points out that these are encapsulated biocides, but there are no indications of this from the providers *Baumit* and *Synthesa*.

<u>6 façade paints (*Baumit, STO, Synthesa*):</u> These contained the following active ingredients for façade protection: *Terbutryn* (4x); *Isoproturon* (3); *IPBC* (3x); *OIT* (1x). The concentrations are maximum for *isoproturon*: < 1400 ppm; *Terbutryn*: < 1000 ppm; *IPBC:* < 200 ppm; *OIT:* < 500ppm. The supplier *STO* points out that these are encapsulated biocides, *Baumit* and *Synthesa* do not provide any information on this. In addition, the supplier *STO* offers the façade paint *StoColor Dryonic*, which is advertised "without biocidal film protection". *STO* advertises the bionic principle of action in this product, which is supposed to achieve façade protection without biocides. According to the product safety data sheet, the product contains pot preservatives, but no biocidal façade protectors.

Overall, the exemplary analysis shows that the quality and completeness of the information provided in the product safety data sheets (encapsulation: yes or no, concentration information) depends on the supplier and varies. Similarly, 'biocide-free' ETICS with the 'Blue Angel' environmental label were researched (Table 22). It turns out that those from well-known manufacturers (e.g. *STO, Baumite, Caparol* etc.) in combination with the insulation system mineral wool, mineral foam and soft wood fibre.

Short recap

What short summary can be made on the basis of the present analysis, primarily with regard to the selection of façade products containing biocides? The study aims to discuss:

- Constructive and planning measures are outside the focus of the study. However, in the course of the research, there was a reference to a software (COMLEAM) that can be used to simulate the extent to which building ingredients are washed out on the basis of building, weather and fabric data. It is possible that this software could contribute to the reduction of active ingredient leaching. Testing should be considered.
- When using mineral (hydrophilic) thermal insulation systems, biocidal façade protection is usually avoidable. Systems with the "Blue Angel" environmental seal are offered by well-known manufacturers. Such system alternatives should be considered, but are likely to incur comparatively higher costs.
- There is a clear trend towards the use of encapsulated biocides in façade plasters and paints. The market share is now certainly considerable, but no figures can be given for Austria. It is proposed that:
    - In any case, suppliers declare whether they use biocidal active ingredients encapsulated or unencapsulated in their products and
    - that clients only accept or procure products with encapsulated biocides.
- Avoidance of particularly questionable active ingredients: A total of 8 biocidal active ingredients dominate the market for façade protection agents, of which 3 are algaecides and 5 are fungicides. As a rule, these are used in combination. The risk analysis carried out for the active substances shows that no active ingredient has a really harmless hazard profile, but some are particularly questionable.
- Avoidance of the environmental input of biocidal active substances of particular concern: If facades containing biocides cannot be completely avoided, then at least the active ingredients isoproturon, carbendazim, diuron and terbutryn should be avoided because of their relatively long residence time in the environment, or the active ingredients OIT, DCOIT, IPBC and zinc pyrithione should be used instead. Likewise, *carbendazim* should be avoided because of its mutagenic and reprotoxic properties.
- Biocide-free innovations: The market for biocide-containing façade plasters and paints is in a state of flux, not least because of the critical discussion and reporting. That is why products are now offered that claim fungal and algae protection without biocides. One example of this is the façade paint *StoColor Dryonic*. According to the manufacturer, the Dryonic technology transfers an evolutionary principle of action (structure of the elytra of the fog drinker beetle) to a technological solution (dry façade through appropriate microstructure).

Biocidal active ingredients

Biocidal Products Regulation

In the present study, active ingredients and products of the product types PA 7 and PA 10 are considered. Legally, these are subject to the Biocidal Products Regulation (BPR) 528/2012 [1]. The BPR distinguishes between 22 types of products in 4 main groups. Relevant for the present study is main group 2 (protective agents) and within it the product type PA7 (coating protectants*)* and the product type PA10 (protective agents for building materials).

Coating protection agents (PA7): Are products designed to protect coatings or coatings against microbial damage or algae growth in order to preserve the original surface properties of fabrics or objects such as paints, plastics, sealants, sealants, binders, covers, papers and artistic works.

Protective agents for building materials (PA10): Are products for the protection of masonry, composite materials or other building materials other than wood against infestation by harmful microorganisms and algae.

The evaluation and approval of antimicrobial agents is organized by the European Chemicals Agency ECHA, whereby the approval of a biocidal product requires the approval of the active substances contained therein. As the evaluation of active substances is a time-consuming process, transitional provisions apply to biocidal products whose active substances were used before 14 May 2000. They may also be marketed without authorisation as long as the active ingredients have not yet been conclusively assessed and approved. The status of the processing or authorisation of the active substances can be queried on the ECHA website[4]: Table 1 provides an overview of the status quo of processed, approved and unapproved active substances (as of 31.1.2017). The implementation of the BPR requires a transition phase, which will not be completed until 2024.

TABLE 1: AUTHORISATION STATUS OF ACTIVE SUBSTANCES FOR PT7 AND PT10 (21.08.2017)

Product	Active substances included in the existing substance programme	"Under Review"	"approved"	"not approved"
PA7	32	26	4	2
PA10	30	25	2	3

Biocidal products of the product types PA 7 and PA10 are currently hardly authorised according to the requirements of the BPR, as the testing of the active substances has not yet been completed (see Table 1). In the meantime, transitional regulations apply to products on the market with such active ingredients. On the basis of this, protective agents are exempt from approval on the market, regardless of their context of application. The notification of biocidal products, which is currently practiced in Austria and Germany, is not to be equated with authorisation, and information on the label on toxicological or environmental effects is made at the discretion of the manufacturer or distributor [2].

[4] https://echa.europa.eu/web/guest/information-on-chemicals/biocidal-active-substances

The processing of the evaluation of existing substances via the work programme for the systematic assessment of all active substances contained in biocidal products provides for the following deadlines:

ILLUSTRATION 1: DEADLINES FOR PRODUCT TYPES IN ACCORDANCE WITH REGULATION 1062/2014

Fristen

Produktarten	Fristen für die Vorlage des Bewertungsberichts gemäß Artikel 6 Absatz 3 Buchstabe b	Fristen für den Beginn der Erarbeitung der Stellungnahme gemäß Artikel 7 Absatz 2 Buchstabe b
8, 14, 16, 18, 19 und 21	31.12.2015	31.3.2016
3, 4 und 5	31.12.2016	31.3.2017
1 und 2	31.12.2018	31.3.2019
6 und 13	31.12.2019	31.3.2020
7, 9 und 10	31.12.2020	31.3.2021
11, 12, 15, 17, 20 und 22	31.12.2022	31.9.2023

Accordingly, final processing of the relevant product types 7 and 10 is not expected until 2021. However, the active substances are notified in different types of use, which is why at least the inherent properties of the substance (including the classifications) can be collected from the dossiers for already authorised active ingredient applications.

Biocidal active ingredients for can preservation (PA6)

Ready-to-consume aqueous-based construction products with organic (polymeric) components usually contain biocides to avoid microbial contamination. This also applies to the organic exterior plasters and paints discussed in the present study. The active ingredients used in this process are to be assigned to product type 6 and are to be distinguished from film preservatives of product type 7 with regard to the intended effect. Active ingredients or combinations of active ingredients frequently used in construction products include *2-methyl-2(H)-isothiazole-3-one; 1,2-benzisothialzone-3(2H)-one* or a mixture of *5-chloro-2-methyl-4-isothiazolin-3-one* and *2-methyl-4-isothiazolin-3-one.* Therefore, it should be noted that thermal insulation composite systems, façade plasters and paints declared as "biocide-free" do not (may) contain biocides in the sense of façade protection, but they do contain biocides in the sense of pot preservation. Pot preservatives ensure product stability during storage and are only added in low concentrations. The active ingredients for pot preservation are identified in the product analyses of the present study where necessary, but not evaluated.

Biocidal film preservatives (PA7)

The biocides in film protection are effective in polymer-bound paints and plasters against microbial damage or algae growth in order to preserve the original surface properties. The addition turns the end product into a biocide-containing product, but is not itself a biocidal product. The paints and plasters are to be protected against superficial infestation by migrating the biocides to the surface. Top plaster physically protects the masonry against direct weather influences, while top coat fulfils more of an aesthetic task and prevents dirt from adhering due to its smooth surface structure. Typically, exterior paints and plasters contain a combination of an algaecide such as *terbutryn* or *diuron* and broad-spectrum biocides such as *2-octyl-3-isothiazolinone (OIT), 4,5-dichloro-2-n-octyl-4-*

isothiazolin-3-one (DCOIT), *carbendazim* or *zinc pyrithione*. The average thickness of thin plaster is 2 to 3 mm, that of the usually double-applied paint is 0.2 to 0.3 mm.

Biocidal Protective Agents for Masonry (PA10)

In a survey of manufacturers and users conducted in Switzerland, only the active ingredients OIT and the QAV group were mentioned, no other active ingredients are used for this type of product in Switzerland [3]. Masonry protection products (PA 10) include products to protect underlying masonry, composites or other building materials against microbial damage or algae growth. These are (liquid) active ingredients that serve to disinfect the underlying substrate [14]. Some manufacturers also classify renovation solutions based on quaternary ammonium compounds (QAV) for infested masonry under PA 2 disinfectants in the event of renovation. There is therefore still a need for clarification in the product classification. With regard to the authorisation procedure under the Biocidal Products Regulation, there is a significant overlap between the active substances of product type 7 and 10 (see Table 23 in the Annex). In the present study, biocidal active substances that are only approved for the product type PA 10 – these are primarily quaternary ammonium compounds including didecyldimethylammonium chloride – are not evaluated because they are not important for the biocidal finishing of facades.

Quantity Relevance

In a Swiss study, based on surveys of manufacturers, formulators and user (associations), the following active ingredients are named as the most important in film protectors (PA7) [3,5]:

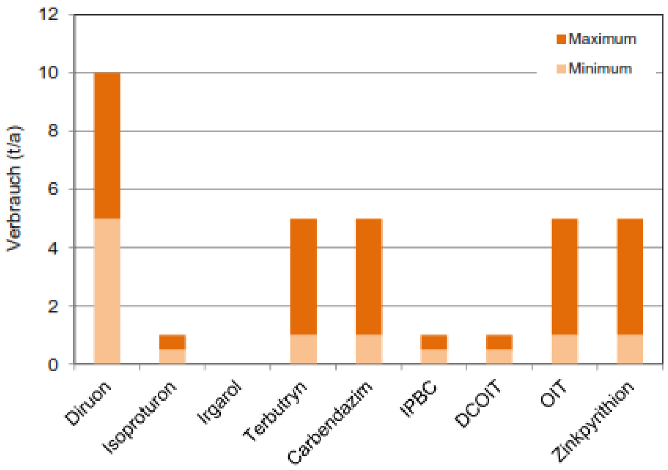
ILLUSTRATION 2: MAIN SUBSTANCES USED IN FILM PRESERVATIVES (PA7) [3]

Bedeutung	Wirkstoff PA 7
hoch	Diuron, Terbutryn, OIT, Zinkpyrithion
mittel	Carbendazim
gering	DCOIT, IPBC, Isoproturon
keine	Irgarol

Furthermore, the following consumption quantities of film preservatives for building paints and plasters for exterior applications (water-based, polymer-bound products) were estimated for Switzerland. The active ingredients *Terbutryn, Carbendazim, OIT* and *Zinc Pyrithione* are used in quantities of 1 to 5 tons per year. The amount of *Diuron* is slightly higher according to the manufacturers (

Illustration 3). From *IPBC, DCOIT* and *Isoproturon* were consumed less than 1 ton per year. This results in a consumption of 10 to 30 tonnes for biocides in film preservatives for building paints and plasters in Switzerland in 2011. For Germany, an annual consumption of 250 – 400 t of active ingredient was determined [14]. New on the market are roof paints or coated tiles with biocide finish (e.g. with *Terbutryn*) to protect tiled roofs against algae infestation [5].

ILLUSTRATION 3: CONSUMPTION QUANTITY OF FILM PRESERVATIVE [3]



In the cited study, respondents predict that *diuron, isoproturon, carbendazim* and *terbutryn will* become less important, whereas the "more degradable" active ingredients *IPBC, DCOIT,* OIT and *zinc pyrithione* will become more important. *Carbendazim* is increasingly being voluntarily avoided, as the discussion about the mutagenic and reprotoxic properties is bad for the manufacturer's image [3].

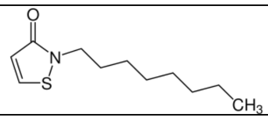
ILLUSTRATION 4: ASSESSMENT OF THE IMPORTANCE OF IMPORTANT ACTIVE SUBSTANCES ACCORDING TO [3]

Future significance*	Biocidal active ingredient
⇧	IPBC, DCOIT, OIT, Zinc Pyrithione
⇩	Diuron, Isoproturon, Carbendazim, Terbutryn

EVALUATION OF RELEVANT ACTIVE SUBSTANCES ACCORDING TO INHERENT PROPERTIES

In this section, the 8 active substances OIT, isoproturon, IPBC, DCOIT, carbendazim, diuron, zinc pyrithione *and* terbutryn *mentioned in the Swiss study [3] are* analysed and assessed with regard to their health and environmental risks. The evaluation applies the WIDES evaluation grid. (https://www.wien.gv.at/video/245332/Das-Bewertungsraster-der-WIDES-Datenbank)

TABLE 2: OIT

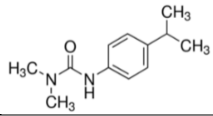
OIT (CAS 26530-20-1) 2-octyl-2H-isothiazole-3-one 		
Fungicide		
Status BPR	Product type 6, 7, 9, 10, 11, 13: under review; Product type 8: approved	
Classification (current proposal)	H301, H311, H314, H318, 1A,H317, H330, H400 (M100), H410 (M10)	OIT1
Half-lives (DT50)	Hydrolysis: > 1 year, "considered hydrolytically stable" Simulation tests: 1.1- 2.7 days (fresh water) and 3.9- 5.5 days (sea water)	OIT1 OIT2
Degradability	OECD 301D: not readily biodegradable (due to inhibition?)	OIT1
Bioaccumulation	logKow > 3.1 BCF: 507-538	OIT1
Aquatic Tox.	H400 (M100): Very toxic to aquatic life H410 (M10): Very toxic to aquatic organisms with long-term effects	OIT1
CMR & Chronic Toxicity	Genotoxicity: *OIT is not considered to be an in vivo systemic genotoxin*; Reproductive toxicity: *no evidence of adverse effects on fertility or reproductive performance*; Carcinogenicity / Chronic toxicity: *On the basis of the lack of treatment-related tumours in this study, and taking account of absence of genotoxicity and systemic toxicity in other studies, it is concluded that the potential for OIT to cause systemic carcinogenicity is very low*."	OIT2
Health-pertinence	H301: Toxic if swallowed; H311: Toxic in contact with skin; H330: Danger to life if inhaled; 1A H317: May cause allergic skin reactions; H314: Causes severe skin burns and severe eye damage	OIT1

OIT1... CHL proposal for harmonised Classification & Labelling; UK January 2018 (latest download: 12.12.2018); OIT2....BPR Assessment Report on evaluation active substance OIT (PT 8); January 2017; UK

WIDES RATING

	Acute toxicity	Irritant-corrosive effect	Sensitization, allergens potential	CMR & Chronic Toxicity	Behaviour in surface waters	
					acute	chronic
Classification / Dates	H330 (+ H314)	H314	H317	Conclusion on BPR-AR	H400 (M100)	H410 (M10)
Rating number	6	4	4	1	5	5

TABLE 3: ISOPROTURON

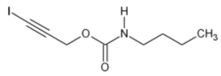
Isoproturon (CAS 34123-59-6) 3-(4-isopropylphenyl)-1,1-dimethylurea		
Algicide		
Status BPR	Product type 7, 10: under review	BPR
Classification	H351, H373, H400 (M10), H410 (M10)	ISO1
Half-lives (DT50)	Hydrolytically stable > 30 d; Water/sediment: 129.3 d (mean); Water: 61 d (average)	ISO2
Degradability	OECD 301B: not readily biodegradable	ISO1
Bioaccumulation	logKow 2.6; BCF: 2.6 – 3.6 (low potential for bioaccumulation)	ISO1
Aquatic Tox.	H400 (M10): Very toxic to aquatic life H410 (M10): Very toxic to aquatic organisms with long-term effects	ISO1
CMR & Chronic Toxicity	H351; H373	ISO1
Health-pertinence	H351: May cause cancer: STOT RE 2, H373: May damage organs with prolonged or repeated exposure (affected organ: blood); *low acute toxicity; It is not a skin or eye irritant or a dermal sensitiser*	ISO1, ISO3

ISO1... RAC opinion on CHL proposal for harmonised Classification & Labelling of Isoproturon adopted 3 June 2016 (latest download: 12.12.2018); ISO2.... CHL proposal for harmonised Classification & Labelling; Germany Nov 2015 (latest download: 12.12.2018); ISO3... Conclusion on the peer review of the pesticide risk assessment of Isoproturon. EFSA Journal 2015; 13(8):4206

WIDES RATING

	Acute toxicity	Irritant-corrosive effect	Sensitization, allergens potential	CMR & Chronic Toxicity	Behaviour in surface waters	
					acute	chronic
Reference	EFSA	EFSA	EFSA	H351, H373	H400 (M10)	H410 (M10)
Rating number	1	1	1	4	4	5

TABLE 4: IPBC

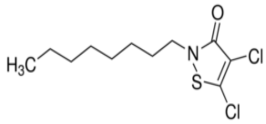
IPBC (CAS 55406-53-6) 3-iodo-2-propynylbutyl carbamate 		
Fungicide		
Status BPR	Product type 7, 9, 10: under review; Product type 6,8,13: approved	
Classification	H302, H317, H318, H331, H372 (larynx), H400 (M10), H410 (M1)	IPBC1
Half-lives (DT50)	Abiotic hydrolysis: 248 d (pH 7, 25°C); Anaerobic water-sediment: 3.3 h (12°C); Aerobic soil degradation study: 5 h (12°C)	IPBC2,IPBC3
Degradability	OECD 301 F: Not readily biodegradable; Primary biodegradable according to Zahn-Wellens Test; "*taking into account all the reported information RAC proposed that IPBC be considered as rapidly degradable according to the CLP criteria*"	IPBC1, IPBC2
Bioaccumulation	BCFfish: 48.8 (calculated); low potential for bioaccumulation	IPBC2
Aquatic Tox.	H400 (M10): Very toxic to aquatic life H410 (M1): Very toxic to aquatic organisms with long-term effects	IPBC1, IPBC2
CMR & Chronic Toxicity	Germ cell mutagenicity: not mutagenic in vitro or in vivo; Carcinogenicity: RAC supported the conclusion [ ] that no classification is warranted for carcinogenicity; Reproductive toxicity: RAC agreed with the dossier supplier that no classification for reproductive toxicity is warranted.	IPBC2
Health-pertinence	H302: Harmful if swallowed; H317: May cause allergic skin reactions; H318: Causes severe eye damage H331: Toxic if inhaled; H372: Damages organs with prolonged or repeated exposure (affected organ: larynx)	IPBC1, IPBC2

IPBC1... Harmonised classification – Annex VI of Regulation (EC) No 1727/2008 (CLP Regulation); IPBC2....... RAC opinion on CHL proposal for harmonised Classification & Labelling of IPBC adopted 28 November 2012 (latest download: 12.12.2018); IPBC3... BPR Assessment Report on evaluation active substance IPBC (PT 6); September 2013; Denmark

WIDES RATING

	Acute toxicity	Irritant-corrosive effect	Sensitization, allergens potential	CMR & Chronic Toxicity	Behaviour in surface waters	
					acute	chronic
Reference	H331	H318	H317	H372 (larynx)	H400 (M10)	H410 (M1)
Rating number	5	4	4	5	4	4

TABLE 5: DCOIT

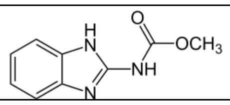
DCOIT (CAS 64359-81-5) 4, 5-Dichloro-2-octylisothiazole-3(2H)-one 		
Fungicide		
Status BPR	Product type 7, 9, 10, 11: under review; Product type 8, 21: approved.	
Classification	H302, H314, H317, H330, H400 (M100), H410 (M100)	DCOIT1
Half-lives (DT50)	Abiotic hydrolysis (pH7; 25°C): 25-71 days OECD 309: 16.5 h/ 12°C	DCOIT1
Degradability	OECD 301B: not readily biodegradable (due to inhibition)	DCOIT1
Bioaccumulation	BCF: 713 - 750	DCOIT1
Aquatic toxicity	H400 (M100): Very toxic to aquatic life H410 (M100): Very toxic to aquatic organisms with long-term effects	DCOIT1
CMR & Chronic Toxicity	Conclusive but not sufficient for classification	DCOIT1
Health-pertinence	H302: Harmful if swallowed; H314: Causes severe chemical burns and severe eye damage; H330: Danger to life if inhaled; H317: May cause allergic skin reactions.	DCOIT1

DCOIT1... CHL proposal for harmonised Classification & Labelling; Norway 08.01.2018 (latest download: 12.12.2018)

WIDES RATING

	Acute toxicity	Irritant-corrosive effect	Awareness	CMR & Chronic Toxicity	Behaviour in surface waters	
					acute	chronic
Classification / Dates	H330 (+ H314)	H314	H317	Conclusive but not sufficient for classification	H400 (M100)	H410 (M100)
Rating number	6	4	4	1	5	6

TABLE 6: CARBENDAZIM

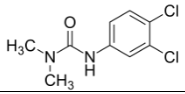
Carbendazim (CAS 10605-21-7) Methyl-benzimidazole-2-ylcarbamate 		
Fungicide		
Status BPR	Product type 7, 9, 10: initial approval in progress	
Classification	H317, H340, H360FD, H400 (M10), H410 (M10)	CAR1
Half-lives (DT50)	Hydrolytically stable at pH 5 and 7; Carbendazim is a persistent substance regarding the results of the degradation studies in water/sediment system: worst case DT50 value of 145.6 days at 12°C. In soil, carbendazim is not persistent per definition (DT_{50} < 120 d) but it tends to the formation of high amounts of non-extractable residues along with low mineralization rates.	CAR1
Degradability	Not readily biodegradable;	CAR1
Bioaccumulation	logKow:1.56	CAR1
Aquatic toxicity	H400 (M10): Very toxic to aquatic life H410 (M10): Very toxic to aquatic organisms with long-term effects	CAR1
CMR & Chronic Toxicity	Reproductive toxicity: An influence on male fertility has been established on the basis of histologically proven changes in the testicles (NOAEL: 20 mg/kg bw x d); Carcinogenicity: Carbendazim does not show a mutagenic effect, but an aneugenic effect.	CAR2
Health-pertinence	H317: May cause allergic skin reactions; H340: May cause genetic effects; H360FD: May affect fertility, may harm the child in the womb	CAR1

CAR1... Biocidal Products Committee (BPC): Opinion for approval of active substance Carbendazim (Product type:7) adopted 25 April 2018 (latest download: 14.12.2018); CAR2....GESTIS Substance Database; latest download: 14.12.2018

WIDES RATING

	Acute toxicity	Irritant-corrosive effect	Sensitisation	CMR & Chronic Toxicity	Behaviour in surface waters	
					acute	chronic
Classification / Dates	No acute toxicity	Not irritating to skin & eyes	H317	H340; H360DF	H400 (M10)	H410 (M10)
Rating number	1	1	4	6	4	5

TABLE 7 : DIURON

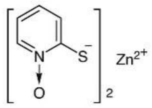
Diuron (CAS 330-54-1) 3-(3,4-dichlorophenyl)-1,1-dimethylurea 		
Algicide		
Status BPR	Product type 7, 10: initial approval in progress	
Classification	H302, H351, H373 (blood, inhalation), H400, H410 (M10)	DIU1
Half-lives (DT50)	Hydrolysis: Diuron was stable to hydrolysis in buffered, sterilized solutions at pH 5, 7 and 9 after 30 days at 25+/-1°C in the dark; Water sediment studies: Diuron was moderately to highly persistent (DT50 = 48 – 232 d); Aerobic Aquatic Metabolism: Diuron degraded with a half-life of 33 days in an aerobic non-sterile clay loam sediment.	DIU2, DIU4
Degradability	Not readily biodegradable	DIU2
Bioaccumulation	logKow: 2.89	DIU2
Aquatic toxicity	H400: Very toxic to aquatic organisms; H410 (M10): Very toxic to aquatic organisms with long-term effects; *The present evaluation shows that Diuron can have an endocrine disrupting mode of action and that it can cause adverse effects on animals, which are possibly endocrine mediated*.	DIU1, DIU3
CMR & chron. Tox	Carcinogenicity: In rats hyperplasia and neoplasia in the urothelium is observed and in mice, hyperplasia in bladder epithelium and mammae carcinomas.	DIU2
Health-pertinence	H302: Harmful if swallowed; H351: May probably cause cancer; H373: May damage organs with prolonged or repeated exposure (affected organ: blood)	DIU1

DIU1....REACH registration dossier diuron; 14.12.2018; DIU2....EFSA: Conclusion regarding the peer review of diuron: EFSA Scientific Report (2005) 25, 1-58; DIU3.... ECHA: Decision on substance evaluation pursuant to article 46(1) of Regulation of 1907/2006 (10.05.2016); DIU4... US EPA: Environmental Risk Assessment for the Reregistration of Diuron.

WIDES RATING

	Acute toxicity	Irritant-corrosive effect	Sensitisation	CMR & Chronic Toxicity	Behaviour in surface waters	
					acute	chronic
Classification / Dates	H302	REACH Dossier	REACH Dossier	H351, H373	H400	H410(M10)
Rating number	3	1	1	4	3	5

TABLE 8: ZINC PYRITHIONE

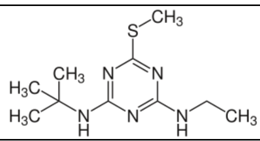
Zinc Pyrithione (CAS 13463-41-7) Pyrithione zinc (Zinc pyrithione)		
Fungicide		
Status BPR	Product type 2, 6, 7, 9, 10, 21: initial approval in progress	
Classification	H301,H318, H330, H360D, H372, H400 (1000), H410 (M10)	ZNPY1
Half-lives (DT50)	Hydrolysis: DT50 (pH 3-11): 41 d to more than a year Aerobic seawater/sediment studies: DT50 total system: 21 d (worst case)	ZNPY1
Degradability	OECD 301B: Not readily degradable	ZNPY1
Bioaccumulation	logKow: 0.99 (low bioaccumulation potential)	ZNPY1
Aquatic toxicity	H400 (M1000): Very toxic to aquatic organisms; H410 (M10): Very toxic to aquatic organisms with long-term effects	ZNPY1
CMR & Chronic Toxicity	Germ cell mutagenicity: Zinc pyrithione does not fulfil the classification criteria; Carcinogenicity: lack of data; Reproductive toxicity: classification in category 1B is proposed based on the malformations and post-implantation losses seen in three independent guideline studies in two different species; Chronic toxicity: It is proposed not to specify the route of exposure	ZNPY1
Health-pertinence	H301: Toxic if swallowed; H318: Causes severe eye damage; H330: Danger to life if inhaled; H360D: May harm the child in the womb; H372: Damages organs with prolonged or repeated exposure	ZNPY1

1…. RAC opinion on CHL proposal for harmonised Classification & Labelling of IPBC adopted 14 September 2018 (latest download: 27.02.2019)

WIDES RATING

	Acute toxicity	Irritant-corrosive effect	Sensitisation	CMR & Chronic Toxicity	Behaviour in surface waters	
					acute	chronic
Classification / Dates	H301,H330	H318	REACH Dossier	H360D, H372	H400 (M1000)	H410 (M10)
Rating number	5	4	1	6	6	5

TABLE 9: TERBUTRYN

Terbutryn (CAS 886-50-0) **2-tert-butylamino-4-ethylamino-6-methylthio-1,3,5-triazine** 		
Algicide		
Status BPR	Product type 7, 9, 10: initial approval in progress	
Classification	H302, H317, H319, H332, H400 (M100), H410 (M100)	TER3
Half-lives (DT50)	Half Life of terbutryn in pond water was 20 – 30 days. In bottom sediment corresponding value was 400 days.	TER1
Degradability	Not quickly biodegradable	TER2
Bioaccumulation	log Kow = 3.74; a BCF of 25 for catfish suggests that bioconcentration in aquatic organisms is low.	TER1
Aquatic toxicity	H400 (M100): Very toxic to aquatic organisms; H410 (M100): Very toxic to aquatic organisms with long-term effects	TER3
CMR & Chronic Toxicity	Cancer classification: Group C Possible Human Carcinogen (There is limited evidence that it can cause cancer in animals in the absence of human data, but at present it is not conclusive)	TER1
Health-pertinence	Unclear data situation; no classifications	TER1, TER3

TER1....Hazardous Substance Database (HSDB) – Terbutryn; Download 17.12.2018; TER2... Safety Data Sheet STOcolor lotusan G (Sto GmbH) 11.10.2018; latest download 18.12.2018; TER3... C&L inventory; Download 17.12.2018

WIDES RATING

	Acute toxicity	Irritant-corrosive effect	Sensitisation	CMR & Chronic Toxicity	Behaviour in surface waters	
					acute	chronic
Classification / Dates	H302, H332 (C&L inventory 50% and 10% respectively)	H319 (C&L inventory: 8%)	H317 (C&L inventory: 33%)	Unclear data situation	H400 (M100) (C&L inventory: 6%)	H410 (M100) (C&L inventory: 6%)
Rating number	3	2?	4?	?	5	6

TABLE 10: SUMMARY OF ENVIRONMENTAL DATA AND CATEGORISATIONS

	OIT	**Isoproturon**	**IPBC**	**DCOIT**	**Carben-dazim**	**Diuron**	**Zinc pyrithione**	**Terbutryn**
CAS	26530-20-1	34123-59-6	55406-53-6	64359-81-5	10605-21-7	330-54-1	13463-41-7	886-50-0
Type	Fungicide	Algicide	Fungicide	Fungicide	Fungicide	Algicide	Fungicide	Algicide
Classification of water hazard	H400 (M100) H410 (M10)	H400 (M10) H410 (M10)	H400 (M10) H410 (M1)	H400 (M100) H410 (M100)	H400 (M10) H410 (M10)	H400 H410 (M10)	H400 (M1000) H410 (M10)	H400 (M100) H410 (M100)
Source*	[1]							
Easy biodegradability	No	No	No	No	No	No	No	No
Source*								
Bioaccumulation potential	No	No	No	No	No	No	No	No
Source*								
Abiotic Hydrolysis (DT50)	> 1 year	> 30 days	248 days	25-71 days	"Hydrolytically stable"	hydrolytically stable"	41 days -> 1 year	-
Source*								
Degradability in simulation tests (water, water/sediment or soil (DT50))	1.1-2.7 days 3.9-5.5 days	61 days 129 days	3.3 h 5 h	16.5 h	145.6 days	48 – 232 days	21 days	20-30 days 400 days
Source*								
Swiss Environmental Label IV [17]	Low	Medium	Low	Low	Medium	Medium	Low	Medium
WFD Priority Substance	-	Yes	-	-	-	Yes	-	Yes

TABLE 11: HEALTH-RELATED CLASSIFICATIONS

	OIT	**Isoproturon**	**IPBC**	**DCOIT**	**Carben-dazim**	**Diuron**	**Zinc pyrithione**	**Terbutryn**
CAS	26530-20-1	34123-59-6	55406-53-6	64359-81-5	10605-21-7	330-54-1	13463-41-7	886-50-0
Type	Fungicide	Algicide	Fungicide	Fungicide	Fungicide	Algicide	Fungicide	Algicide
Health hazard classification*	H301 H311 H314 H317 H318 H330	H351 H373	H302 H317 H318 H331 H372 (larynx)	H302 H314 H317 H330	H317 H340 H360DF	H302 H351 H373 (blood, inhalation)	H301 H318 H330 H360D H372	H302 H317 H319 H332
Source Classification								

* Legend H-phrases:

H301	Toxic if swallowed.
H302	Harmful if swallowed.
H311	Toxic in contact with skin.
H314	Causes severe skin burns and severe eye damage.
H317	May cause allergic skin reactions
H318	Causes serious eye damage.
H330	Danger to life if inhaled
H331	Toxic by inhalation
H340	Can cause genetic defects
H351	Can probably cause cancer
H360D	May harm the child in the womb
H360DF	May affect fertility. May harm the child in the womb
H372	Damages the organs
H373	May damage the organs

TABLE 12: OVERVIEW STATUS BPR & WIDES REVIEWS

	OIT	Isoproturon	IPBC	DCOIT	Carbendazim	Diuron	Zinc Pyrithione	Terbutryn
CAS	26530-20-1	34123-59-6	55406-53-6	64359-81-5	10605-21-7	330-54-1	13463-41-7	886-50-0
Type	Fungicide	Algicide	Fungicide	Fungicide	Fungicide	Algicide	Fungicide	Algicide
Status BPR (PT 7&10)	review	review	review	review	review	review	review	review
Classifications - Health	H301,H311, H331, H314, H317,H318,	H351, H373	H302, H317, H318,H331, H372	H302,H314, H317, H330	H317, H340, H360FD	H302, H351, H373	H301, H318, H330, H360D, H372	H302,H317, H319, H332
Classifications - Waters	H400 (M100) H410 (M10)	H400 (M10) H410 (M10)	H400 (M10) H410 (M1)	H400 (M100) H410 (M100)	H400 (M10) H410 (M10)	H400 H410 (M10)	H400 (M1000) H410 (M10)	H400 (M100) H410 (M100)
Evaluation according to WIDES Evaluation grid[5] in the hazard categories (rating number)*								
Acute toxicity	6	1	5	6	1	3	5	3
Irritant, corrosive effect	4	1	4	4	1	1	4	2?**
Sensitization, allergenic potential	4	1	4	4	4	1	1	4?**
Mutagenic, toxic to fertility, carcinogenic, chronically toxic	1	4	5	1	6	4	6	?**
Behaviour in bodies of water (acute/chronic)	5/5	4/5	4/4	5/6	4/5	3/5	6/5	5/6
Primary database WIDES evaluation	Classification	classification, EFSA-RAR	Classification	Classification	Classification	Classification	REACH Dossier	C&L Inventory
Other								
Priority substance Water Framework Directive	-	Yes	-	-	-	Yes	-	Yes

*Hazard potential: 1:none; 2:low; 3:moderate; 4:high; 5:Very high; 6:very high+; 7:very high++; **?: insufficient database for evaluation

[5] WIDES Evaluation Grid" is the procedure used in the Vienna Disinfectant Database (https://www.wien.gv.at/wuawides/internet/Start/Overview) to create a hazard profile using assessment figures. The assessment figures are calculated in hazard categories with H-phrases or with data sets that prove the safety of a substance in specified hazard categories.

Conclusion

Tables 10 & 11 contain the classifications as well as health and environmental data of the 8 active substances, which form the basis of the conclusion.

Environmental toxicity:

With regard to the water hazard, all eight active substances are classified as "long-term water hazards" (H410), differences exist with regard to the M-factors[6]. Data on easy biodegradability according to OECD screening tests could be searched for all 8 active substances. None of the active ingredients meets the requirements of the tests and can therefore be classified as *Not easily biodegradable* . From the available data, there is no significant bioaccumulation potential for any of the 8 active substances. Thus, the criteria "Readily biodegradable according to the OECD Screening Test" and "Bioaccumulation potential" are not suitable for differentiating individual active ingredients in the application. For this reason, the extent to which the active substances behave in terms of their residence time in the environmental compartments of water, sediment or soil was also investigated. This is estimated on the basis of half-lives (DT50) in the simulation tests OECD 308 or OECD 309 [18, 19]. Corresponding data could be collected for all active substances.Table 10). The half-lives allow conclusions to be drawn about a (given or absent) easy biodegradability (Illustration 5):

ILLUSTRATION 5: CORRELATION BETWEEN BIODEGRADABILITY AND HALF-LIVES IN SIMULATION TESTS[7]

Table 5: First order rate constants and half-lives for biodegradation in surface water based on results of screening tests on biodegradability a)

Test result	Rate constant k (d-1)	Half-life (d)
Readily biodegradable	$4.7 \cdot 10^{-2}$	15
Readily, but failing 10-d window b)	$1.4 \cdot 10^{-2}$	50
Inherently biodegradable c)	$4.7 \cdot 10^{-3}$	150
Not biodegradable	0	∞

Notes on Table 5:

a) For use in exposure models these half-lives do not need to be corrected for different environmental temperatures.

b) The 10-day time window concept does not apply to the MITI test. The value obtained in a 14-d window is regarded as acceptable in the Closed Bottle method, if the number of bottles that would have been required to evaluate the 10-d window would cause the test to become too unwieldy.

c) Only those inherently degradable substances that fulfil the criteria described in note b) to Table 6 above. The half-life of 150 days reflects a present "best expert judgement".

If you sort out the values for the half-lives Table 10 the "half-life" thresholds from Illustration **5** then the result is:

- Easily degradable (< 15 days): OIT, DCOIT, IPBC

[6] When classification in the hazard class hazardous to water (environmental hazards), the potency of highly toxic components in the hazard categories acute 1 and chronic 1 is additionally weighted by multiplication factors (M-factors).

[7] ECHA Guidance on the Biocidal Products Regulation Volume IV Environment - Assessment and Evaluation (Parts B + C); Version 2.0. October 2017 (pages 62 & 63).

- Easily degradable without adhering to the 10-day window (< 50 days): Zinc pyrithione
- Inherent or non-degradable (> 50 days): Isoproturon, Carbendazim, Terbutryn, Diuron

The result correlates well with the classification of the environmental impact when the Swiss Environmental Label IV is applied in an encapsulated manner [17]. It distinguishes - also based on half-lives DT50 - between low and medium environmental pollution[8]:

- Low environmental impact (short half-life): OIT, DCOIT, IPBC, zinc pyrithione
- Medium environmental impact (mean to long half-life): isoproturon, carbendazim, diuron, terbutryn

In addition, the active ingredients *diuron, isoproturon and terbutryn are* priority substances of the European Water Framework Directive and their environmental input should therefore be avoided. On the basis of the available data on biodegradability or residence time in environmental compartments, the following categorisation is proposed for the selection of active substances:

ILLUSTRATION 6: CATEGORIZATION FOR THE SELECTION OF ACTIVE INGREDIENTS

Relatively low to moderate load due to short half-lives and assumed biodegradability	OIT, DCOIT, IPBC, Zinc Pyrithione
Relatively high exposure due to long half-lives and poor or no biodegradability	Isoproturon, Carbendazim, Diuron, Terbutryn

<u>Human toxicity:</u>

An evaluation of the substance classifications in Table 11 gives the following picture:

- 4 active ingredients (OIT, DCOIT, IPBC, zinc pyrithione) have a high or very high acute toxicity.
- 5 active ingredients (OIT, IPBC, DCOIT, Carbendazim, Terbutryn) are classified as skin sensitizing.
- 4 Active substances (isoproturon, IPBC, diuron, zinc pyrithione) have been proven to damage organs or have the potential to do so.
- 2 active ingredients (isoproturon, diuron) are suspected of being carcinogenic.
- 1 Active ingredient (carbendazim) has been proven to be mutagenic.
- 2 active ingredients (carbendazim, zinc pyrithione) have been proven to impair fertility and/or harm the child in the womb.

Whether this health hazard potential also becomes relevant depends on the life cycle and human exposure. Such an analysis is beyond the scope of the present study. It is assumed that a lack of or poor biodegradability in combination with proven mutagenic, carcinogenic or reprotoxic properties is of particular concern. In any case, such a situation exists for the active ingredient carbendazim.

[8] The "High Environmental Impact" category is intended for non-encapsulated applications

ENCAPSULATION, LEACHING AND ENVIRONMENTAL INPUT

Since 2001, biocides against algae and fungi have also been used in encapsulated form in façade coatings. In 2001, the active ingredient *zinc pyrithione* was the first biocide to be offered encapsulated as a component of a corresponding formulation, as it can be discharged relatively easily on facades under alkaline environmental conditions. In 2004, *OIT* was available in encapsulated form for use in film preservation. *OIT* has the highest water solubility among the active substances investigated here. In this respect, *OIT* is another active ingredient that can be washed out relatively easily on new façades when conventionally applied. This was followed in 2006 by the active ingredients *terbutryn* and *diuron, which are used as algaecides*. In addition to DCOIT, the encapsulated biocides available include *IPBC.* With the application of encapsulated active ingredients in paint or plaster, the high washout loss at the beginning can be reduced. With the same dosage as conventional equipment, the fouling can also be controlled over a longer period of time than before. In addition to the encapsulation of the individual active ingredient, the balanced composition of the active ingredients is also important. In this respect, the level of the dosage depends on the overall system structure and is carried out with the aim of ensuring the required minimum inhibitory concentration (MIC) on the target organisms. With the encapsulation technology, it is possible to use active ingredients whose application in the unencapsulated form was previously only possible to a limited extent due to technical factors, such as *isothiazolinones* and *IPBC.* In principle, the technologies available on the market can be used to encapsulate all available biocides for coating materials individually and in a targeted manner according to the manufacturer's specifications. In 2011, the polymer-based microencapsulation technology for façade biocides was offered by a manufacturer in Switzerland[9]. The diameter of the microparticles (polymer capsules) is 10-20 µm, with liquid biocides (*OIT, DCOIT*) embedded in slightly smaller microparticles. The biocides are available under the brand name "ACTICIDE".® These include products that contain encapsulated and unencapsulated active ingredients in combination [11]. Due to the encapsulation technique, the "unstable" active ingredients *zinc pyrithione, IPBC, OIT* and *DCOIT* in particular have gained market importance. Laboratory and field tests show that biocides are less likely to leach, especially at the beginning of the application phase. The magnitude of the reduction depends on the active ingredient (properties), the type of encapsulation, the system structure and the paint or plaster formulation, the following results from the literature can be mentioned:

In a field trial (trial period: 378 days; 58 rain events), free and encapsulated biocidal active ingredients in façade coatings were compared [15]. The initial concentration of the investigated active ingredients in the coatings was 1600 mg/m2. It was shown that the discharges are fundamentally correlated with the water solubility and the n-octanol/water distribution coefficient (logKow).

The reduction of the discharge from encapsulated to uncaulked was strongly dependent on the active ingredient (see Table 13): It was rather low for DCOIT (23% or from 13 mg/m2 unencapsulated to 10 mg/m2) and high for diuron (85% or from 187 mg/m2 unencapsulated to 78 mg/m2)

---

[9] The company Thor GmbH, Speyer/Germany, owns the patent rights for this technology (antimicrobial microparticles, DE 10 2006 030 705 A1; Coating compound with biocidal microspheres, EP 1 698 672 A).

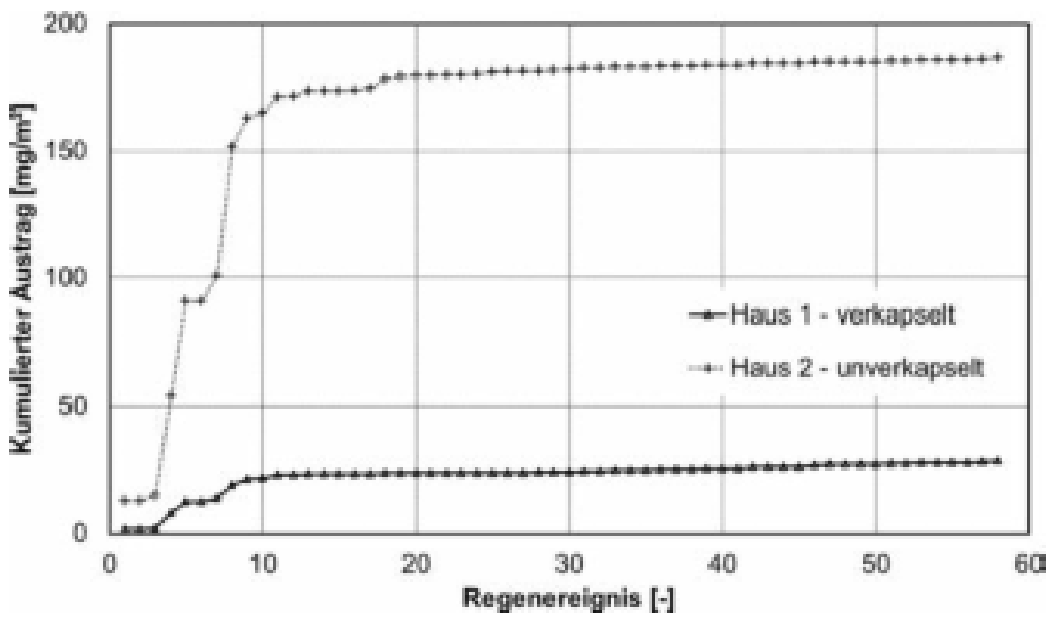
TABLE 13: ABSOLUTE AND PRO-RATA DISCHARGE (OVER 378 DAYS)

			encapsulated		unencapsulated		Reduction encapsulated / unencapsulated
	Solubility in water (mg/l)	logKow	mg/m2	%*	mg/m2	%*	
Terbutryn	25	3,5	24	1,5	59	3,7	59 %
IPBC	168	2,5	75	4,5	135	8,4	44 %
OIT	480	2,5	78	4,9	189	11,8	59 %
DCOIT	14	4,9	10	0,6	13	0,8	23 %
Diuron	35	2,8	29	1,8	187	11,7	85 %

*… Prorated discharge (%) based on 1600 mg per active ingredient and m2 during the trial period (378 days)

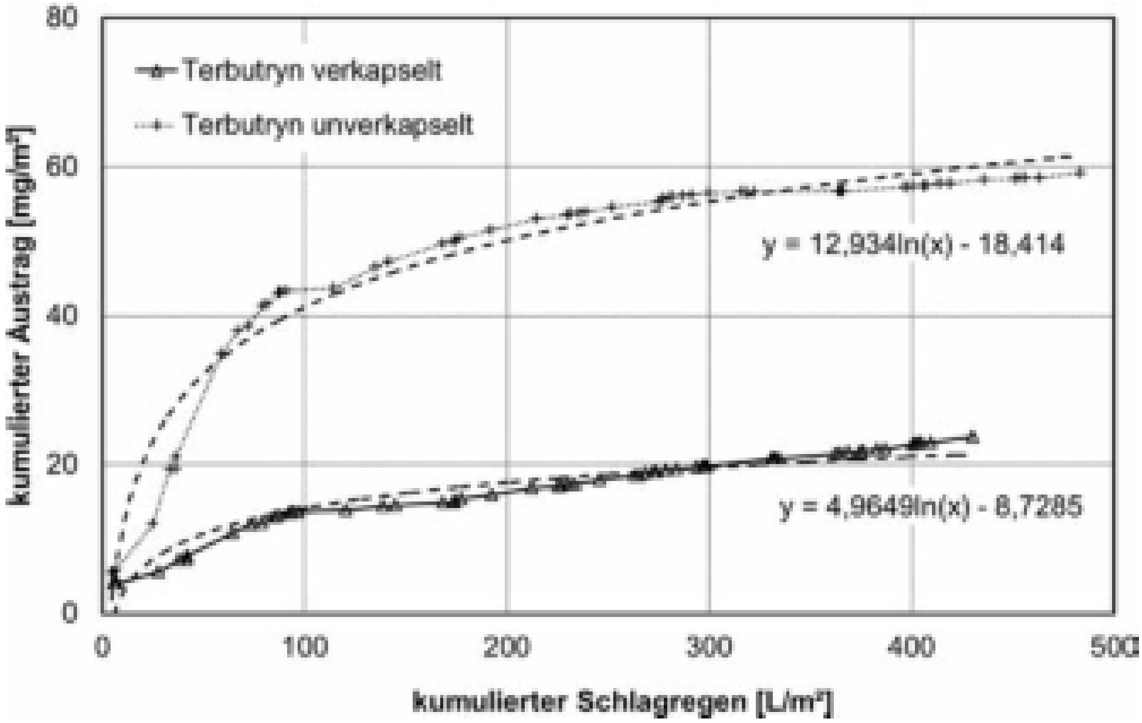
The largest discharges for all active substances took place within the first 10 to 20 rain events (initial leaching - corresponds to a period of approx. 1 to 2 months). During this time, about a large part of the total number of *Diurons* released (Illustration **7**). Even with encapsulated active ingredients, an initial leaching takes place – albeit reduced by a substance-specific factor.

ILLUSTRATION 7: DIURON DISCHARGE OVER THE TRIAL PERIOD [SOURCE: 15]



If the cumulative driving rain is used as a reference value for the cumulative discharge, an approximate logarithmic curve is obtained, for example for the active ingredient *Terbutryn* (Illustration 8). The cumulative driving rain represents the amount of water that hits a façade over the course of its lifetime and can lead to discharge. The authors assume that if the approximation function characteristic of the individual active ingredients and the façade coatings is known, the active ingredient discharge can be predicted in the future.

ILLUSTRATION 8: TERBUTRYN – CUMULATIVE DISCHARGE LOGARITHMIC APPROXIMATION [SOURCE: 15]



Since these refer to currently ongoing (experimental) work on the topic, it is assumed that the state of knowledge described above is a relatively preliminary one.

PLANNING MEASURES

Planning measures as such are not the subject of the present study, so only general principles or factors are cited. Information on the advantages and disadvantages of planning and construction measures for clients, planners, site managers and users can be found in the leaflets published by the Federal Environment Agency [13]. It stated that *it is not possible to reliably estimate the development of the infestation in advance. However, the general rule is: What is permanently dry usually remains free of fungi and algae, and what can dry quickly is less likely to be infested. Areas affected by driving rain and splashing water, as well as permanently damp areas, are particularly at risk. Therefore, structural façade protection is of particular importance. In addition, algae and fungal infestation are always due to the interaction of several factors. Some factors can be actively influenced and thus significantly minimise the risk of infestation.*

TABLE 14: FACTORS INFLUENCING ALGAE AND FUNGAL INFESTATION [SOURCE: 13]

Parameter	Higher risk of infestation	Lower risk of infestation
Layer	Sinking, Near Water	Hilly, dry
Climate	Humid, (ground) fog zone, high driving rain load,	Dry, low fog, low Driving rain load
Environment	trees and shrubs in the immediate vicinity of the façade, nearby forest, Shading, proximity to agricultural Activity (fungal spores, fertilization)	No or low vegetation, no shading
Orientation	West, North	South, East
Design and Construction	Missing or small roof overhang, inadequate water supply, lack of Drip edge formation	Pronounced constructive Moisture protection, sufficient Roof overhangs and drip edges
Surfaces-temperature	Insulated facades, e.g. plastered ETICS.	Surfaces with high Heat storage capacity, e.g. uninsulated façades or plastered masonry
Choice of material and Surfaces-execution	No paint, slow-drying materials	More suitable for the plaster system Paint, quick-drying Materials

SOFTWARE TO REDUCE AND AVOID WASHOUT

However, the COMLEAM software described below is assigned to the topic insofar as it simulates biocide leaching in the planning.At the University of Applied Sciences for Rapperswil (HSR) in Switzerland, the software COMLEAM (*COnstruction Material LEAChing Model*) was developed, which can simulate the extent to which building constituents are washed out using building, weather and fabric data. This instrument is intended to be able to predict pollutant emissions into surrounding waters even before construction. The simulation affects individual buildings up to entire settlements and uses past or current weather data. This allows manufacturing companies, planning offices, authorities and building owners to get an initial picture of the quantities washed out and environmental pollution to be detected and minimized at an early stage. The software has already been used in initial projects and has been presented at workshops and conferences and on the Internet since Nov. 2016: https://www.youtube.com/watch?v=R_ovRLZ-wj4

Construction

Consumption Estimation

A survey conducted in Switzerland in 2011 showed an annual consumption of 4,000 tonnes for organic exterior paints and 22,000 tonnes for organic exterior plasters. The quantity estimate is based on surveys of major biocide manufacturers (Ashland, Dow, Lanxess, Lonza, Thor, Troy), paint/plaster manufacturers and associations. If an average biocide concentration of 1,250 ppm for exterior paints and plasters is used, the biocide quantity is 5 tonnes in paints and 27.5 tonnes in plasters [3]. In Table 15 at the same time, an amount of active ingredient of approx. 7 tons is extrapolated in relation to the city of Vienna.

TABLE 15: QUANTITY ESTIMATION IN SWITZERLAND & EXTRAPOLATION TO VIENNA

		Switzerland [3]	Vienna (Extrapolation)**
Inhabitant	Millions	8,417*	1,867*
Organic exterior paints	(tons/year)	4.000	887
Amount of active ingredient in paints	(tons/year)	5	1,1
Organic exterior plasters	(tons/year)	22.000	4840
Amount of active ingredient in plasters		27,5	6,1

*.. according to Wikipedia; **.. Scaling factor 0.22

For the calculation of the active ingredient quantities, the study assumes an average biocide concentration of 1,250 ppm for exterior paints and plasters. In the surveys, the following concentration ranges are mentioned for the active ingredient concentrations:

ILLUSTRATION 9: AREAS OF CONCENTRATION IN ARCHITECTURAL PAINTS AND PLASTERS [3]

Wirkstoffe	Konzentration in Farben (ppm)			Konzentration in Putzen (ppm)		
	100-500	500-1000	1000-1500	100-500	500-1000	1000-1500
Diuron	□	□	○	□	□	○
Terbutryn	□	□	○	□	□	
Carbendazim	□	□		□	□	
IPBC	□	□	○	□	○	○
DCOIT	□	□		□		
OIT	□	□		□	□	
Zinkpyrithion	□	□	○	□		◇
Zinkoxid	□	□		□		
Isoproturon	□			□		

□ = häufig genannt, ○ = mittel genannt, ◇ = selten genannt.

As a rule, film protection includes a combination of two to four active ingredients with a total active ingredient concentration of around 1000 to 2000 ppm [5].

Suppliers – External Thermal Insulation Composite Systems (ETICS), Exterior Plasters & Paints

Wall paints and plasters are usually used in conjunction with external thermal insulation composite systems. An external thermal insulation composite system consists of at least four layers:

1. Adhesive layer or mechanical fastening with rails, dowels, etc.
2. Thermal insulation layer made of insulation materials (often Styrofoam)
3. Reinforcement layer of reinforcing plaster and reinforcing fabric
4. Top plaster layer for surface design and weather protection.

In practice, more than 90% of the applied EIFS consist of organic (polymer) systems and the plasters and paints used in this process (here: exterior plasters and exterior paints) are then usually equipped with biocides [14]. In the present study, both biocide-containing and biocide-free systems are discussed. "Biocide-containing" or "biocide-free" refers to the façade plaster and/or façade paint. In order to make optimal use of the limited resources, the providers relevant to the City of Vienna were found out and MA34, which is responsible for construction and building management, was contacted. The following providers were named (email Robert Friedbacher; 11.08.2017):

- The full-service providers *Baumit, STO, Synthesa*
- Also: *Austrotherm, Röfix, Steinbacher, Isover, Rockwool, Knauf Insulation*

As examples, *Baumit* (www.baumit.at), *STO* (www.sto.at) and *Synthesa* (www.synthesa.at) offered thermal insulation composite systems as well as individual components (exterior paint and plasters) and analysed them with regard to the biocidal active ingredients contained therein. The evaluation can be found in the tables Table 16 until Table 21.

Baumit GmbH (www.baumit.at)

TABLE 16: PRODUCT ENQUIRY: EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS/EXTERNAL THERMAL INSULATION COMPOSITE SYSTEM ECO

Designation according to manufacturer*	Function/Description	SDB	Biocides acc. SDB	% lt. SDB	Ppm	In product types according to BPR	Comment
Thick-layer adhesive filler	Mineral, powdered adhesive and concealer	yes	No hint				-
Dispersion adhesives	Ready-to-process, paste-like, solvent-free adhesive	yes	2-Methyl-2H-isothiazole-3-one (2682-20-4)	< 0.5	<5,000	6,12:Review 11,13:approved	Can preservation
Facade insulation board ECO plus	Facade insulation board made of EPS (expanded polystyrene)	-	-				-
Adhesive filler	Fibre-reinforced, mineral powder adhesive and concealed mortar	Yes	No hint				-
Adhesive filler coarse	Mineral powder adhesive and concealed mortar (filler)	yes	No hint				-
Adhesive filler Light	White, powdered adhesive and plaster with light aggregates	yes	No hint				-
PowerContact	Powdered Glue and Flush Plaster	yes	No hint				-
PowerFlex (FIBER FILLER)	Fibre-reinforced, ready-to-process, paste-like, organically bonded, elastic concealed mortar for exterior use (application by means of tooth trotting)	yes	Mixture of: 5-chloro-2-methyl-2H-isothiazole-3-one [EG 247-500-7] and 2-methyl-2H-isothiazole-3-one [EG 220-239-6] (3:1)	< 2.5	< 25,000	Mixture of CIT/CMIT: 2,4,6,11,12,13 (approved)	Can preservation
SupraFix	Mineral White Powdered Adhesive Mortar	yes	No hint	-		-	-
SupraGrund	Ready-to-use primer	yes	1,2-Benzisothiazole-3(2H)-one	n/a		BIT: 2,6,9,10,11,12,13 (under review)	Can preservation
Textile Glass Mesh	For reinforcement	-	-				
UniPrimer	Primer as suction compensation and adhesion promoter	yes	5-Chloro-2-methyl-4-isothiazole-3-one [EG 247-500-7] and 2-methyl-2H-isothiazole-3-one [EG 220-239-6] (3:1)	<0.0015	15	Mixture of CIT/CMIT: 2,4,6,11,12,13 (approved)	Can preservation

* http://www.baumit.at/produkte-a-z.html

Baumit GmbH (www.baumit.at)

TABLE 17: PRODUCT INQUIRY: FINISHING COATINGS / SILICONE PLASTER AND PAINT

Designation according to manufacturer*	Function/Description	SDB	Biocides acc. SDB	% lt. SDB	Ppm	In product types according to BPR	Comment
SilikonColor	Ready-to-use façade paint based on silicone resin for exterior.	Yes	2-Octyl-2H-isothiazole-3-one (CAS 26530-20-1) (= OIT) Terbutryn (CAS 886-50-0)	<0.05	< 500	OIT Terbutryn	Facade protection (no indication of encapsulation)
			Mixture of: 5-chloro-2-methyl-4-isothiazole-3-one [EG 247-500-7] and 2-Methyl-2H-isothiazole-3-one [EG 220-239-6] (3:1) CAS: 55965-84-9	<0.0015	<15	Mixture of CIT/CMIT: 2,4,6,11,12,13 (approved)	Can preservation
Silicone Top	Pasty top plaster based on silicone resin. Rubbing plaster for exterior. System component of Baumit thermal insulation composite systems. After a drying time of the construction with UniPrimer of at least 24 h, SiliconTop can be applied 1 x.	Yes	2-Octyl-2H-isothiazole-3-one (CAS 26530-20-1) (=OIT) Terbutryn (CAS 886-50-0)	<0.05 <0.005	< 500 < 50	OIT: Terbutryn	Facade protection (no indication of encapsulation)
			Mixture of 5-chloro-2-methyl-4-isothiazolin-3-one [EC No.247-500-7] and 2-methyl-2H-isothiazole-3-one [EGNr.220-239-6]	0,0015	< 15	Mixture of CIT /CMIT: 2,4,6,11,12,13 (approved)	Can preservation

STO GmbH (www.sto.at)

TABLE 18: PRODUCT QUERY: PRODUCTS / PRODUCT RANGE/FAÇADE/FAÇADE PLASTERS/FINISHING PLASTERS

Designation according to manufacturer*	Function/Description	SDB	Biocides acc. SDB	% lt. SDB	Ppm	In product types according to BPR	Comment
STO Color Lotusan G	Silicone resin façade paint on an aqueous basis. natural protection through the lotus effect and the encapsulated film protection.	yes	Isoproturon Terbutryn 3-iodine-2propinylbutylcarbamate (IPBC)	≥ 0.1 - < 0.14 ≥ 0.025 - < 0.08 ≥0.0025 - < 0.02	1000 - 1400 250 - 800 25 - 200		Facade protection - Reference to encapsulation
			Contains mixture of 5-chloro-2-methyl-2H-isothiazole-3-one [EC No. 247-500-7] and 2-methyl-2H-isothiazole-3-one [EC No. 220-239-6] (3:1), 2-methyl-2H-isothiazole-3-one	<0.0002	2	Mixture of CIT /CMIT: 2,4,6,11,12,13 (approved)	Can preservation
STO Lotusan K (MP)	Top plaster in scratch plaster structure (K) or as modelling plaster (MP) on mineral and organic substrates	yes	Terbutryn 2-Octyl-2H-isothiazole-3-one (OIT) Zinc Pyrithione	Terbutryn: <0.01 No information No information	100		Facade protection - Reference to encapsulation. In the SDS no conc. Information on OIT & ZnPyrithione
Stolit K/R/MP	Organic top plaster on masonry, insulated and VHF facades with plaster (mineral and organic substrates)	yes	Diuron 2-Octyl-2H-isothiazole-3-one (OIT)	No information No information			Facade protection – reference to encapsulation
			Mixture of 5-chloro-2-methyl-2H-isothiazole-3-one [EC No. 247-500-7] and 2Methyl-2H-isothiazole-3-one [EC No. 220-239-6] (3:1), 2-Methyl-2Hisothiazole-3-one 1,2-Benzisothiazole-3(2H)-one (BIT)	No information		Mixture of CIT /CMIT: 2,4,6,11,12,13 (approved)	Can preservation
Stolit ® QS/K/R/MP	Organic top plaster on organic and (limited) mineral substrates	yes	Terbutryn , zinc pyrithione 2-Octyl-2H-isothiazole-3-one (OIT)	≥0.0025 - < 0.025 n/a n/a	25-250		Facade protection - Reference to encapsulation

STO GmbH (www.sto.at)

TABLE 19: PRODUCT QUERY: PRODUCTS / PRODUCT RANGE/FAÇADE/FAÇADE PAINT

Designation according to manufacturer*	Function/Description	SDB	Biocides acc. SDB	% lt. SDB	Ppm	In product types according to BPR	Comment
Sto Color Silco	Silicone resin façade paint on mineral and organic substrates	yes	Isoproturon Terbutryn 3-iodine-2-propinylbutylcarbamate (IPBC)	≥ 0.025 - < 0.1 ≥ 0.025 - < 0.1 No information	250-1000 250-1000		Facade protection - Reference to encapsulation
			1,2-benzisothiazole-3(2H)-one, Mixture of 5-chloro-2-methyl-2H-isothiazole-3-one [EC No. 247-500-7] and 2-methyl-2H-isothiazole-3one [EC No. 220-239-6] (3:1) Bronopol	< 0.025 No information < 0.025	<250 <250	Mixture of CIT /CMIT: 2,4,6,11,12,13 (approved)	Can preservation
Sto Color Maxicryl	Façade paint for colour-intensive coatings on mineral and organic substrates	Yes	Isoproturon Terbutryn 3-iodine-2-propinylbutylcarbamate (IPBC)	<0.1 <0.1 No information	1000 1000		Facade protection - Reference to encapsulation
			1,2-benzisothiazole-3(2H)-one, Mixture of 5-chloro-2-methyl-2H-isothiazole-3-one [EC No. 247-500-7] 2-Methyl-2H-isothiazole-3one [EC No.220-239-6] (3:1)	<0.05 <0.0015	500 15	Mixture of CIT /CMIT: 2,4,6,11,12,13 (approved)	Can preservation
StoColor Dryonic	Façade paint with Dryonic Technology, bionic principle of action for dry facades against algae and fungal infestation, without biocidal film protection on mineral and organic, non-elastic substrates	yes	-				"without biocidal film protection"
			1,2-benzisothiazole-3(2H)-one, Mixture of 5-chloro-2-methyl-2H-isothiazole-3-one [EC No. 247-500-7] 2-Methyl-2H-isothiazole-3one [EC No.220-239-6] (3:1)	No information		Mixture of CIT /CMIT: 2,4,6,11,12,13 (approved)	Can preservation

Synthesa (www.synthesa.at)

TABLE 20: PRODUCT INQUIRY: PRODUCTS / EXTERIOR PLASTERS

Designation according to manufacturer*	Function/Description	SDB	Biocides acc. SDB	% lt. SDB	Ppm	In product types according to BPR	Comment
Capatect Carbopor Friction Plaster	The photocatalytic effect of Capatect CarboPor Textured plasters offer an active self-cleaning effect and increased protection of the Plaster against the primary infestation of microorganisms (algae and fungal infestation). Suitable as a top coat for Capatect Thermal insulation composite systems and on renovation plaster systems.	yes	Carbendazim (ISO)	< 0.1	1000		Facade protection (no indication of encapsulation)
			1,2-Benzisothiazole-3(2H)-one	< 0.1	1000		Can Preservation (?)

TABLE 21: PRODUCT INQUIRY: PRODUCTS / EXTERIOR PAINTS

Designation according to manufacturer*	Function/Description	SDB	Biocides acc. SDB	% lt. SDB	Ppm	In product types according to BPR	Comment
Carbosol façade paint compact	carbon fibre-reinforced façade paint based on silacrylic-silicone resin.	yes	-				-
			5-chloro-2-methyl-2H-isothiazole-3-one and 2-methyl-2H-isothiazole-3-one				Can preservation

BIOCIDE-FREE EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS (BLUE ANGEL)

Among other things, in order to reduce the disadvantage of contamination of rainwater by biocide leaching, biocide-free external thermal insulation composite systems with the German Blue Angel eco-label are offered, the criteria are defined in the award basis RAL-UZ 140 [4]. According to this, plasters and topcoats (of the top coat of plaster) must not contain any biocidal products to prevent surface growth (algae, fungi and lichens), and pot preservatives for paste-like preparations are to be treated in accordance with Illustration **10** but permissible.

ILLUSTRATION 10: PERMISSIBLE POT PRESERVATION FOR PASTE-LIKE PREPARATIONS IN BIOCIDE-FREE EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS

1. Folgende Wirkstoffe bzw. Wirkstoffkombinationen können alternativ zur Topfkonservierung verwendet werden:

Wirkstoff/-Kombination	**Gehalt**
a) Titandioxid/Silberchlorid	≤ 100 ppm bezogen auf Silberchlorid
b) 2-Methyl-2(H)-isothiazol-3-on/ 1,2-Benzisothiazol-3(2H)-on im Verhältnis 1:1	≤ 200 ppm
c) 5-Chlor-2-methyl-4-isothiazolin-3-on / 2-Methyl-4-isothiazolin-3-on im Verhältnis 3:1	≤ 15 ppm
d) 3-Jod-2-propinyl-butylcarbamat	≤ 80 ppm
e) 1,2- Benzisothiazol-3(2H)-on	≤ 200 ppm
f) 2-Brom-2-nitropropan-1,3-diol (BNPD)	≤ 200 ppm
g) BNPD[1)] + CIT/MIT (3:1)[3)]	≤ 130 ppm + ≤ 15 ppm
h) BNPD[1)] + CIT/MIT (3:1)[3)]	≤ 150 ppm + ≤ 10 ppm
i) BNPD[1)] + CIT/MIT (3:1)[3)]	≤ 170 ppm + ≤ 5 ppm
j) MIT/BIT[2)] (1:1) + CIT/MIT (3:1)[3)]	≤ 150 ppm + ≤ 12,5 ppm
k) MIT/BIT[2)] (1:1) + CIT/MIT (3:1)[3)]	≤ 125 ppm + ≤ 15 ppm
l) 1,2-Dibrom-2,4-dicyanbutan (DBDCB)	≤ 500 ppm
m) BIT[4)] + CIT/MIT (3:1)[3)]	≤ 150 ppm + ≤ 12,5 ppm
n) BNPD[1)] + MIT/BIT[2)] (1:1)	≤ 120 ppm + ≤ 75 ppm
o) Zinkpyrithion (ZNP) + BIT[4)]	≤ 100 ppm + ≤ 100 ppm
p) Zinkpyrithion (ZNP) + MIT/BIT[2)] (1:2 bis 2:1)	≤ 50 ppm + ≤ 150 ppm
q) BNPD[1)] + BIT[2)]	≤ 100 ppm + ≤ 100 ppm
r) Natriumpyrithion (NaP) + BIT[4)]	≤ 50 ppm + ≤ 150 ppm
s) N-(3-aminopropyl)-N-dodecylpropane-1,3-diamine (CAS 2372-82-9) + MIT/BIT[2)] (1:1)	≤ 81 ppm + ≤ 150 ppm
t) MIT/BIT[2)] (1:1) + Silberchlorid	≤ 185 ppm + ≤ 15 ppm

1) BNPD = siehe f) 2) MIT/BIT = siehe b) 3) CIT/MIT (3:1) = siehe c) 4) BIT = siehe e)

The following systems are offered as part of the Blue Angel[10]:

TABLE 22: SUPPLIER OF BIOCIDE-FREE ETICS (RAL-UZ 140; 24.7.2017)

Vendor (Manufacturer)	ETICS Hemp	ETICS Soft Wood Fibre	ETICS Mineral Foam	ETICS Mineral Wool
Caparol Paints Varnishes Building Protection	*Capatec System*	-	*Caparol-System-CS*	*Caparol System PROEXTRA; Caparol System PROEXTRA organic (B1)*
STO SE & Co		*Sto Therm Wood*	*STO Therm Cell*	*StoTherm Classic L/MW; StoTherm Classic S1; StoTherm Mineral L; StoTherm Mineral*
alsecco GmbH			*Alsecco Ecomin-Por*	*alsecco Alprotect aero; Alsecco Ecomin*
Baumit GmbH				*Baumit MineralTherm*
Alligator Farbwerke GmbH				*ALLFAtherm classic.min; ALLFAtherm expert.blu*
Brillux GmbH				*Ecotop*
Hasit Trockenmörtel GmbH				*Hasit Hasitherm MW System*
Heck Wall Systems GmbH				*Rear Multitherm MW*
Keimfarben GmbH				*Gerim AquaROYAL®-MW*
quick-mix Gruppe GmbH				*quick-mix lobatherm M; quick-mix lobatherm M nature;*
Saint-Gobain Weber GmbH (Germany)				*weber.therm A 100/200*
Saint-Gobain Weber Terranova (Austria)				*weber.therm freestyle/ prestige*
SAKRET GmbH				*Sakret WDV Sytsem Mineral Wool*

10 https://www.blauer-engel.de/de/produktwelt/bauen/waermedaemmverbundsysteme/waermedaemmverbundsysteme

Biocide-free façade plaster (example)

This is a façade paint from STO with Dryonic technology. With the Dryonic technology, an evolutionary principle of action (structure of the elytra of the fog drinker beetle) is transferred to a technological solution (dry façade through appropriate microstructure). According to the product prosect of the company STO, the elytra of the fog drinker beetle is covered with countless microscopic nubs. It is this unique surface structure that allows the beetle to liquefy fog quickly. While the hydrophilic tips allow the water to condense, the valleys in between have a water-draining effect. The beetle can collect, drain and absorb 40 percent of its own body weight in water with its carapace. This high-performance drainage technology has been translated into a new façade colour.

http://www.sto.at/de/search.html#dryonic

Ecolabel for façade paints (Swiss environmental label)

The Association of the Swiss Coatings and Paints Industry VSLF has published regulations for the allocation of an environmental label for coating materials that will apply from 1 January 2018 [17]. Its intention is:

- An eco-label designed and monitored by an independent body
- The integration of even more burdensome products.

The regulations apply to façade paints that are intended exclusively for outdoor use and are applied to mineral substrates and plasters, namely emulsion paints, 2-component silicate paints (in accordance with DIN 18363), emulsion silicate paints (in accordance with DIN 18363), emulsion silica sol paints, silicone resin paints, lime paints, natural resin paints, solvent-based façade paints, insulating paints, primers, impregnations/hydrophobic coatings, glazes and others Façade paints.

For the purpose of evaluation, the coating materials are divided into product groups according to their area of application. A graded evaluation grid applies to all coating materials with categories from A to G. The classification criteria take into account the safety of the products for humans and the environment as well as their suitability for use

Evaluation Grid and Criteria

The following overview can be downloaded[11] from the website:

Umwelt-Etikette UE IV

Version 1 Januar 2018

Anlage 1: Bewertungsraster für Fassadenfarben aussen

Kriterien/ Kategorie	wasser-verdünnbar / lösemittel-verdünnbar	aromaten-frei	VOC arm 1)	kenn-zeichnungs-frei	frei von sensibilisierenden, stark umweltgef. und CMR-Stoffen	> 95 % aus nach-wachsenden Rohstoffen 2)	Filmschutz gegen Algen- und Pilzbefall 3)	Umweltbelastung durch Filmschutz-mittel 4)	Auslobung technischer Eigenschaften 5)
A	wv	x	x	x	x	x	kein	keine	x
A-		x	x	x 6)	x	x	kein	keine	k.A.
B		x	x	x	x		kein	keine	x
C		x	x	x			x	niedrig	x
D		x					x	mittel	x
E		x					x	hoch	x
F	lv	x	x				k.A.	k.A.	x
G							k.A.	k.A.	k.A.

1) Die jeweiligen Grenzwerte sind im Reglement festgelegt
2) Definition laut Reglement: Nachwachsende Rohstoffe, mineralische Rohstoffe und Wasser
3) Produkte enthalten biozide Wirkstoffe zum Schutz von Beschichtungen (Filmschutzmittel) gemäss Reglement Kapitel 4.6.
4) Erläuterungen gemäss Reglement Kapitel 4.7.
5) Gemäss Reglement Kapitel 4.8.
6) Sonderregelung für Kalkfarben und 2-K-Silikatfarben: Kennzeichnung auf Arbeitsschutz beschränkt

[11] https://stiftungfarbe.org

In this regard, the accompanying document states:

Products in classification categories A to C should be label-free.

The following exception is accepted: lime paints are classified in category A- due to their positive ecological properties and historical use, despite being labelled with hazard symbols, provided that they meet all other criteria of category A-. The same applies to 2-component silicate paints, which make ecological sense due to their long service life as long-lasting façade protection. Lime and 2-component silicate paints are marked with the H-phrases 314, 315, 318, 319 or 335. These relate to occupational health and safety and are not relevant to the environment. In addition, lime and 2-component silicate paints are mainly intended for use by professional users who are familiar with the necessary occupational health and safety measures.

Products in classification categories A to B must not contain:

- Sensitising substances with a label H334 and/or H317

- CMR substances of category 1A and 1B

- Environmentally hazardous substances with an H400, H410 or H411 label

- Alkylphenol ethoxylates

The following exceptions are accepted:

- Aqueous ammonia solution (CAS 1336-21-6) may be used as a volatile neutralizing agent.
- According to the table below, in-can preservatives may be used up to the following limits (the total amount must not exceed 300 ppm):

Wirkstoff	Höchstwert (mg/kg = ppm)	Analysemethode
CMIT/MIT (3:1)	< 15	Headspace GC/MS
BIT/MIT (1:1) oder BIT	< 200	HPLC
OIT	< 100	HPLC oder GC/MS
Zinkpyrithion	< 100	HPLC oder GC/MS
Bronopol	< 200	HPLC oder GC/MS
Sonstige	Einzelstoffbewertung	GC/MS, HPLC o.ä.

Products in classification categories A to B must not contain biocidal active substances (film preservatives):

Products without film protection are generally not suitable for coating facades with an increased risk of algae and fungal infestation (e.g. externally insulated facades, splash water area, plinth area, etc.). These products are to be used on such areas only after confirmation of suitability by the manufacturer. Façade surfaces with an increased risk of infestation should also be protected from algae and fungal infestation by structural measures (sufficient roof overhangs, appropriate environmental design and suitable materials for the surfaces). Compared to the use of film preservatives, structural measures have a permanent effect and extend maintenance intervals.

Products in classification categories C to G may contain biocidal active substances (film preservatives) in accordance with the following table:

Kategorie	Umweltbelastung durch Filmschutz	Verkapselung o.ä.	Mögliche Wirkstoffe	Halbwertszeit DT_{50}	Höchstwert je Wirkstoff (mg/kg = ppm)
A–B	Keine	-	-	-	-
C	Niedrig	Ja	DCOIT, IPBC, OIT, Zinkypyrithion	Kurz	< 2000
D	Mittel	Ja	Carbendazim	Mittel	< 1000
			Diuron, Isoproturon, Terbutryn	Lang	< 1000
E–G	Hoch	Nicht vorgeschrieben	DCOIT, IPBC, OIT, Zinkypyrithion, Carbendazim, Diuron, Isoproturon, Terbutryn	Alle zugelassen	k.A.

The criteria document states[12] : *Biocidal active ingredients for film protection are washed out of the paint by rainwater after the façade paint has been applied and thus enter the environment. The biocidal active ingredients need a different amount of time to be biodegraded (degradation rate). The slower the degradation rate in the waters, the sooner the active ingredient is detected and the higher the environmental impact. The environmental impact of biocidal active substances has been investigated in various empirical studies. The decisive factor for the classification is the half-life DT50 in water/sediment, which has been divided into three groups: short half-life (DCOIT, IPBC, OIT, Zinkypyrithione), mean half-life (carbendazim) and long half-life (diuron, isoproturon, terbutryn). In addition, it must be taken into account whether the biocidal active ingredient is protected from rapid leaching from the dried coating material by a special treatment (e.g. by encapsulation or an equivalent technology). This treatment reduces the acute environmental impact*.

This follows:

- For category C products, only biocidal active ingredients with a short half-life may be used. In addition, the biocidal active ingredients must be protected from rapid leaching from the dried coating material by means of a special treatment (e.g. by encapsulation or an equivalent technology). This results in a low environmental impact.
- Biocidal active ingredients with a medium and long half-life may be used for category D products, provided that they are protected from rapid leaching by a special treatment (encapsulation or similar). This results in a medium environmental impact. In addition, there is a maximum value of 1000 ppm each for the biocidal active substances carbendazim, diuron, isoproturon and terbutryn for category D.
- For categories C and D, the total amount of biocidal active ingredients for film preservation in the product must not exceed 2000 ppm.
- All biocidal active ingredients may be used for products in categories E to G, even if they are not protected by encapsulation or the like. This results in a high environmental impact.

Mixtures of biocidal active ingredients are assessed on the basis of the component that has the highest environmental impact. The biocidal active substances used as film protection agents must be approved or notified for PA 7 in accordance with the Biocidal Products Ordinance. All products

[12] https://stiftungfarbe.org/bestimmungen/

containing biocidal active ingredients must be correctly labelled as treated goods in accordance with the current Biocidal Products Regulation.

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APPENDIX

TABLE 23: MICROBICIDAL ACTIVE SUBSTANCES IN PRODUCT TYPES 7 & 10 - STATUS QUO OF AUTHORISATION UNDER THE BIOCIDAL PRODUCTS REGULATION

	Mikrobizide Wirkstoffe in PA 7 & PA10; Download: 21082017			
	Bezeichnung	**CAS Number**	**Status PA 7**	**Status PA 10**
1	1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]-1H-1,2,4-triazole (Propiconazole)	60207-90-1	Approved	
2	1,2-benzisothiazol-3(2H)-one (BIT)	2634-33-5		Under review
3	2-butyl-benzo[d]isothiazol-3-one (BBIT)	4299-07-4	Under review	Under review
4	2-octyl-2H-isothiazol-3-one (OIT)	26530-20-1	Under review	Under review
5	2-Propenoic acid, 2-methyl-, butyl ester, polymer with butyl 2-propenoate and methyl 2-methyl-2-propenoate (CAS nr: 25322-99-0)/ Polymeric quaternary ammonium bromide (PQ Polymer)		Under review	
6	2-thiazol-4-yl-1H-benzoimidazole (Thiabendazole)	148-79-8	Under review	Under review
7	3-(4-isopropylphenyl)-1,1-dimethylurea/ Isoproturon	34123-59-6	Under review	Under review
8	3-iodo-2-propynylbutylcarbamate (IPBC)	55406-53-6	Under review	Under review
9	4,5-Dichloro-2-octylisothiazol-3(2H)-one (DCOIT)	64359-81-5	Under review	Under review
10	Alkyl (C12-16) dimethylbenzyl ammonium chloride (ADBAC/BKC (C12-16))	68424-85-1		Under review
11	Alkyl (C12-18) dimethylbenzyl ammonium chloride (ADBAC (C12-18))	68391-01-5		Under review
12	Alkyl (C12-C14) dimethyl(ethylbenzyl)ammonium chloride (ADEBAC (C12-C14))	85409-23-0		Under review
13	Alkyl (C12-C14) dimethylbenzylammonium chloride (ADBAC (C12-C14))	85409-22-9		Under review
14	Azoxystrobin	131860-33-8	Under review	Under review
15	Biphenyl-2-ol	90-43-7	Under review	Under review
16	Carbendazim	10605-21-7	Under review	Under review
17	Cu-HDO	312600-89-8	Not approved	Not approved
18	Didecyldimethylammonium chloride (DDAC (C8-10))	68424-95-3		Under review
19	Didecyldimethylammonium chloride(DDAC)	7173-51-5		Under review
20	Dichloro-N-[(dimethylamino)sulphonyl] fluoro-N-(ptolyl)methanesulphenamide (Tolylfluanid)	731-27-1	Approved	
21	Dimethyloctadecyl[3-(trimethoxysilyl)propyl]ammonium chloride	27668-52-6	Under review	
22	Diuron	330-54-1	Under review	Under review
23	Fludioxonil	131341-86-1	Under review	Under review
24	Nonanoic acid, Pelargonic acid	112-05-0		Not approved
25	Free radicals generated in situ from ambient air or water		Under review	
26	N-(trichloromethylthio)phthalimide (Folpet)	133-07-3	Approved	
27	p-[(diiodomethyl)sulphonyl]toluene	20018-09-1	Under review	Under review
28	Pine ext.	94266-48-5		Not approved
29	Poly(oxy-1,2-ethanediyl), .alpha.-[2-(dide- cylmethylammonio)ethyl]- .omega.- hydroxy-, propanoate (salt) (Bardap 26)	94667-33-1		Under review
30	Pyridine-2-thiol 1-oxide, sodium salt (Sodium pyrithione)	3811-73-2	Under review	Under review
31	Pyrithione zinc (Zinc pyrithione)	13463-41-7	Under review	Under review
32	Pythium oligandrum, Chromista - Stramenopila			Approved
33	Reaction mass of titanium dioxide and silver chloride		Under review	Under review
34	Silver copper zeolite	130328-19-7	Under review	
35	Silver nitrate	7761-88-8	Under review	
36	Silver phosphate glass	308069-39-8	Under review	
37	Silver sodium hydrogen zirconium phosphate	265647-11-8	Under review	
38	Silver zeolite		Under review	
39	Silver zinc zeolite	130328-20-0	Under review	
40	Sodium 2-biphenylate	132-27-4	Under review	Under review
41	tebuconazole	107534-96-3	Approved	Approved
42	Terbutryn	886-50-0	Under review	Under review
43	Triclosan	3380-34-5	Not approved	
		GESAMT	**32**	**30**
		approved	4	2
		not approved	2	3
		under review	26	25

TABLE 24: MICROBICIDAL ACTIVE SUBSTANCES IN PRODUCT TYPES 7 & 10 - RELEVANCE AND USE IN BIOCIDAL PRODUCTS

	Mikrobizide Wirkstoffe in PA 7 & PA10; Download: 21082017			
	Bezeichnung	**CAS Number**	**Quelle: Burkardt M, Dietschweiler C: Mengenabschätzung von Bioziden in Schutzmitteln in der Schweiz. [3]**	**Einträge im Verzeichnis gemeldeter Biozidprodukte (Baua) [10]; abgefragt: 21.08.2017**
1	1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]-1H-1,2,4-triazole (Propiconazole)	60207-90-1		756
2	1,2-benzisothiazol-3(2H)-one (BIT)	2634-33-5		1120
3	2-butyl-benzo[d]isothiazol-3-one (BBIT)	4299-07-4		40
4	2-octyl-2H-isothiazol-3-one (OIT)	26530-20-1	Bedeutung:hoch	1417
5	2-Propenoic acid, 2-methyl-, butyl ester, polymer with butyl 2-propenoate and methyl 2-methyl-2-propenoate (CAS nr: 25322-99-0)/ Polymeric quaternary ammonium bromide (PQ Polymer)			k.A.
6	2-thiazol-4-yl-1H-benzoimidazole (Thiabendazole)	148-79-8		102
7	3-(4-isopropylphenyl)-1,1-dimethylurea/ Isoproturon	34123-59-6	Bedeutung: gering	25
8	3-iodo-2-propynylbutylcarbamate (IPBC)	55406-53-6	Bedeutung: gering	>2000
9	4,5-Dichloro-2-octylisothiazol-3(2H)-one (DCOIT)	64359-81-5	Bedeutung: gering	307
10	Alkyl (C12-16) dimethylbenzyl ammonium chloride (ADBAC/BKC (C12-16))	68424-85-1		>2000
11	Alkyl (C12-18) dimethylbenzyl ammonium chloride (ADBAC (C12-18))	68391-01-5		1339
12	Alkyl (C12-C14) dimethyl(ethylbenzyl)ammonium chloride (ADEBAC (C12-C14))	85409-23-0		673
13	Alkyl (C12-C14) dimethylbenzylammonium chloride (ADBAC (C12-C14))	85409-22-9		208
14	Azoxystrobin	131860-33-8		0
15	Biphenyl-2-ol	90-43-7		329
16	Carbendazim	10605-21-7	Bedeutung: mittel	246
17	Cu-HDO	312600-89-8		Zulassungen abgelaufen
18	Didecyldimethylammonium chloride (DDAC (C8-10))	68424-95-3		59
19	Didecyldimethylammonium chloride(DDAC)	7173-51-5		>2000
20	Dichloro-N-[(dimethylamino)sulphonyl] fluoro-N-(ptolyl)methanesulphenamide (Tolylfluanid)	731-27-1		183
21	Dimethyloctadecyl[3-(trimethoxysilyl)propyl]ammonium chloride	27668-52-6		18
22	Diuron	330-54-1	Bedeutung:hoch	168
23	Fludioxonil	131341-86-1		0
24	Nonanoic acid, Pelargonic acid	112-05-0		77 (tw.abgelaufen)
25	Free radicals generated in situ from ambient air or water			k.A.
26	N-(trichloromethylthio)phthalimide (Folpet)	133-07-3		18
27	p-[(diiodomethyl)sulphonyl]toluene	20018-09-1		23
28	Pine ext.	94266-48-5		0
29	Poly(oxy-1,2-ethanediyl), .alpha.-[2-(dide- cylmethylammonio)ethyl]- .omega.- hydroxy-, propanoate (salt) (Bardap 26)	94667-33-1		165
30	Pyridine-2-thiol 1-oxide, sodium salt (Sodium pyrithione)	3811-73-2		510
31	Pyrithione zinc (Zinc pyrithione)	13463-41-7	Bedeutung:hoch	627
32	Pythium oligandrum, Chromista - Stramenopila			0
33	Reaction mass of titanium dioxide and silver chloride			0
34	Silver copper zeolite	130328-19-7		5
35	Silver nitrate	7761-88-8		28
36	Silver phosphate glass	308069-39-8		104
37	Silver sodium hydrogen zirconium phosphate	265647-11-8		83
38	Silver zeolite			0
39	Silver zinc zeolite	130328-20-0		68
40	Sodium 2-biphenylate	132-27-4		85
41	tebuconazole	107534-96-3		251
42	Terbutryn	886-50-0	Bedeutung:hoch	299
43	Triclosan	3380-34-5		Zulassungen abgelaufen

TABLE 25: MICROBICIDAL ACTIVE INGREDIENTS IN PRODUCT TYPES 7 & 10 - CLASSIFICATION

	Mikrobizide Wirkstoffe in PA 7 & PA10; Download: 21082017			
	Bezeichnung	**CAS Number**	**Einstufung**	**Quelle**
1	1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]-1H-1,2,4-triazole (Propiconazole)	60207-90-1	H317, H318, H332, H373, H400, H410	Risk Assessment report (PT7, Januar 2015)
2	1,2-benzisothiazol-3(2H)-one (BIT)	2634-33-5	H302, H315, H317, H318, H400	C& L inventory (harmonisiert)
3	2-butyl-benzo[d]isothiazol-3-one (BBIT)	4299-07-4	H314, H317, H410 (M10)	REACH
4	2-octyl-2H-isothiazol-3-one (OIT)	26530-20-1	H301, H311, H331, 1AH314, H317,	BPC opinion (15.12.2016); PT8
5	2-Propenoic acid, 2-methyl-, butyl ester, polymer with butyl 2-propenoate and methyl 2-methyl-2-propenoate (CAS nr: 25322-99-0)/ Polymeric quaternary ammonium			
6	2-thiazol-4-yl-1H-benzoimidazole (Thiabendazole)	148-79-8	H400 (M1), H410 (M1)	C& L inventory (harmonisiert, current proposal)
7	3-(4-isopropylphenyl)-1,1-dimethylurea/ Isoproturon	34123-59-6	H351, H373, H400(M10), H410(M10)	RAC opinion adopted on Isoproturon (6.5.2016)
8	3-iodo-2-propynylbutylcarbamate (IPBC)	55406-53-6	H302,H317,H318,H331, H400(M10),H410(M1)	Assessment report (2013); PT6
9	4,5-Dichloro-2-octylisothiazol-3(2H)-one (4,5-Dichloro-2-octyl-2H-isothiazol-3-one (DCOIT))	64359-81-5	H302,H312,1CH314,H317,H330,H335,H410 (M100)	Assessment report (2014); PT21
10	Alkyl (C12-16) dimethylbenzyl ammonium chloride (ADBAC/BKC (C12-16))	68424-85-1	H302, H311, H314, H400(M10), H410(M1)	Assessment report (2015); PT8
11	Alkyl (C12-18) dimethylbenzyl ammonium chloride (ADBAC (C12-18))	68391-01-5	H302,H312, H314, H318, H314,H400, H410	ECHA infocard
12	Alkyl (C12-C14) dimethyl(ethylbenzyl)ammonium chloride (ADEBAC (C12-C14))	85409-23-0	H302,H312,H314,H400(M10)	ECHA infocard
13	Alkyl (C12-C14) dimethylbenzylammonium chloride (ADBAC (C12-C14))	85409-22-9	H302,H312, H314,H318,H400,H410	ECHA infocard
14	Azoxystrobin	131860-33-8	H331,H400,H410	C&L inventory (harmonisiert)
15	Biphenyl-2-ol	90-43-7	H315, H319, H335, H351, H400, H410	Assessment report (2015); PT6
16	Carbendazim	10605-21-7	H340, H360FD, H400(M10), H410(M10)	CHL proposal (Germany, 29.5.2017)
17	Cu-HDO	312600-89-8	H302, H318, H373, H400(1), H410(M1)	Assessment report (2013); PT8
18	Didecyldimethylammonium chloride (DDAC (C8-10))	68424-95-3	H302,H312, H314,H318,H400,H410	ECHA infocard
19	Didecyldimethylammonium chloride(DDAC)	7173-51-5	H301, H314, H400(M10); H411	Assessment report (2015); PT8
20	Dichloro-N-[(dimethylamino)sulphonyl] fluoro-N-(ptolyl)methanesulphenamide (Tolylfluanid)	731-27-1	H315,H317, H319,H335,H400,H410	Assessment report (2016); PT7
21	Dimethyloctadecyl[3-(trimethoxysilyl)propyl]ammonium chloride	27668-52-6	H315,H319,H400,H410	ECHA infocard
22	Diuron	330-54-1	H302, H351, H373, H410(M10)	REACH
23	Fludioxonil	131341-86-1	H400(M1), H410(M1)	BPC opinion (2.3.2017); PT10
24	Nonanoic acid, Pelargonic acid	112-05-0	H315, H318, H412	Assessment report (2013); PT2 (approved)
25	Free radicals generated in situ from ambient air or water			
26	N-(trichloromethylthio)phthalimide (Folpet)	133-07-3	H317,H319,H332,H351,H400(M10)	Assessment report (2014); PT7
27	p-[(diiodomethyl)sulphonyl]toluene	20018-09-1	H300, H318, H373, H400, H410	ECHA infocard
28	Pine ext.	94266-48-5	H304, H315, H317, H319, H400, H410	ECHA infocard
29	Poly(oxy-1,2-ethanediyl), .alpha.-[2-(didecylmethylammonio)ethyl]- .omega.- hydroxy-, propanoate (salt) (Bardap 26)	94667-33-1	H302, 1BH314, H400(M10); H410(M10)	Assessment report (2015); PT8
30	Pyridine-2-thiol 1-oxide, sodium salt (Sodium pyrithione)	3811-73-2	Intermediate: H302, H311, H315, H319, H332, H400(M100), H410(M10)	REACH
31	Pyrithione zinc (Zinc pyrithione)	13463-41-7	H301, H318, H331, H400(M100), H410(M10)	REACH
32	Pythium oligandrum, Chromista - Stramenopila			
33	Reaction mass of titanium dioxide and silver chloride			
34	Silver copper zeolite	130328-19-7		
35	Silver nitrate	7761-88-8	H315,H319,H400(M1000),H410(M100)	ECHA infocard
36	Silver phosphate glass	308069-39-8		
37	Silver sodium hydrogen zirconium phosphate	265647-11-8	H400(M10), H410(M10)	C&L inventory (harmonisiert)
38	Silver zeolite			
39	Silver zinc zeolite	130328-20-0	H315,H318, H351,H360,H373,H400(M100), H410(M100)	C&L inventory (harmonisiert, current proposal)
40	Sodium 2-biphenylate	132-27-4	H302,H315,H318,H335,H400	C&L inventory (harmonisiert)
41	tebuconazole	107534-96-3	H302, H361, H400, H411	Assessment report (2013); PT10
42	Terbutryn	886-50-0	H302, H317, H319, H400, H410	ECHA infocard
43	Triclosan	3380-34-5	H315,H319, H400(M100),H410	REACH

INTERVIEW DR. MICHAEL BURKHARDT

Prof. Dr. Michael Burkhardt from the Institute of Environmental and Process Engineering (UMTEC) at the HSR University of Applied Sciences Rapperswil[13] in Switzerland is the author of numerous articles and studies on the subject of biocides as film protection agents (see also in the enclosed bibliography [3], [5], [6]). In particular, the study *Quantity Estimation of Biocides in Protective Products in Switzerland*, which he co-authored, is the data basis for the present study. On the one hand, in order to verify the statements made in the study – which are now 5 years old – for the status quo (2017) and, on the other hand, to use the technical expertise in general, Dr. Burkhardt was contacted by the author of the study by email. The list of questions below was filled out by him himself (red).

List of questions filled out by Prof. Michael Burkhardt (Received 23.8.2017)

Active ingredients: significance, degradability

In their 2013 study "Quantity Estimation of Biocides in Protective Products in Switzerland", they name the following active substances as at least of minor importance

Meaning	Study 2013	2017
High	Diuron, Terbutryn, OIT, Zinc Pyrithione	
Medium	Carbendazim	
small	DCOIT, IPBC, Isoproturon	

Would you still see this assessment as valid for 2017?

Yes, the meaning classification for all these active ingredients in paints and plasters (product type 7) is still valid.

Meaning	Study 2013	2017
Increasingly	IPBC, DCOIT, OIT, Zinc Pyrithione	DCOIT, OIT
Decreasing	Diuron, Isoproturon, Carbendazim, Terbutryn	Diuron, Isoproturon, Carbendazim
Equal		Terbutryn, IPBC, zinc pyrithione

Is this assessment still valid? Has an active ingredient(s) gained/lost importance?

In principle, the same. The importance of terbutryn, zinc pyrithione and IPBC is rather constant, with Ter and ZnPt being at high levels.

Can you tell me the sources you know / use for the degradation dates of the biocidal active substances mentioned above?

A wide variety of sources were used, because the degradability (biodegradation, photodegradation) in water and soil is broad – as with pesticides. Sources include scientific articles, "Competent Authority Reports" (ECHA; Approval dossiers (vgl. PDF) or reference books (e.g. Paulus: Directorys of Microbiocides). Occasionally I also have manufacturer data available.

Active ingredients: use, use

[13] Oberseestraße 10; 8640 Rapperswil Switzerland; michael.burkhardt@hsr.ch; Phone: +41 55 222 4870

Are the annual consumption of exterior paints/exterior plasters/average biocide concentrations and biocide quantities in paints and plasters mentioned in your study still the most up-to-date?

Yes

Would they agree that the figures they mentioned are transferable to Austrian conditions as a first approximation (with a correction factor for the respective population)?

Yes, approximately transferable. There are also German figures (see report) – they are also similar to those in CH. In CH, however, the encapsulated proportion is particularly high.

Active ingredients: Encapsulation

What is the current market penetration of encapsulated biocides in external thermal insulation composite systems (%; country-specific, EU)?

Germany: cf. UBA report (50-60%); Switzerland: approx. 90%; other countries: I don't know, but certainly much lower market penetration

How do you assess the long-term behaviour of encapsulated biocides in façade plasters/paints? Won't they still be washed out in the long term?

Yes, these are washed out so that the active ingredients can take effect. This is not problematic per se, as long as the substances do not have a harmful effect on the water. Substances with rapid degradability are therefore not very sensitive.

Façade protection in general

In your opinion, what is the most ideal approach to keeping facades free of algae and fungi? How do you estimate the additional costs involved?

Constructive measures, such as canopies. Architects, however, reject this as a restriction of freedom in design – the costs are secondary. In addition, mineral systems would be advantageous, but they are more expensive and require experienced, trained craftsmen. These are missing in construction. Enclosed is information from the UBA, which a working group helped to develop.

External thermal insulation composite systems

Use of plaster on polystyrene: There is an opinion in Vienna that this combination is not good, also with regard to disposal. Styrofoam contains, among other things, flame retardants. What is your opinion on this?

YES, this is a problem with the "old" systems with HBCD. But what are the alternatives? All systems have weaknesses. This is the result of the exclusive focus on high U-values in insulation – by planners, manufacturers and politicians. A holistic approach over the entire life cycle would be needed.

What are sensible alternatives to the combination of polystyrene and polymer-bound paints – and plasters?

Mineral wool; curtain facades with clinker bricks.

Evaluation

How is your product review intended? Is it based on the evaluation of the active ingredient and, if so, on which properties?

The planned product evaluation will be approved by the Environmental Label Foundation. At present, only the degradability of the biocides in the environment (= residence time) is to be taken into account in the first step. However, this is only one factor in addition to those relating to functionality. Next week, details are to be coordinated, so that perhaps exterior colors can be evaluated as early as 2018.

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Request (email) for the question "Product Review"

Is there already a date for the publication of the criteria for the evaluation of exterior paints and plasters.

The date is not yet known, but the aim is for everything to apply from the beginning of 2018.