TEXTE

53/2015

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

Annex III: Case study on PT 3: Veterinary disinfectants

For our Environment

Umwelt Bundesamt

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

Annex III: Case study on PT 3: Veterinary disinfectants

by

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List of Abbreviations

BAT	Best Available Techniques
BMUB	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit)
BPR	Biocidal Product Regulation
BREF	Best Available Technique Reference Documents
CA	Competent Authority
DBP	Disinfection by-Products
DEFRA	Department for Environment, Food and Rural Affairs
DLG	German Agricultural Society (Deutsche Landwirtschafts- Gesellschaft DLG)
DVG	German Veterinary Association (Veterinärmedizinische Gesellschaft e. V.)
DWA	German Association for Water, Wastewater and Waste (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.)
EC	European Commission
ECHA	European Chemicals Agency
ESD	Emission Scenario Document
FIOSH	German Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, BAuA)
HACCP	Hazard Analysis and Critical Control Points (Regulation (EC) No 852/2004)
PT	Product Type
QAC	Quaternary Ammonium Compounds
RABC	Risk Analysis and Biocontamination Control (EN 14065)
REACH	Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals
RMM	Risk mitigation measure
STP	Sewage treatment plant
TNsG	Technical Notes for Guidance
TRGS	Technical Rules for Hazardous Substances (Technische Regeln für Gefahrstoffe)

UBA	Federal Environment Agency (Germany)
UK	United Kingdom
WHO	World Health Organisation

1 Introduction

Disinfectants used for veterinary hygiene purposes (PT 3) are an important tool to control animal pathogens in animal housing and transport, animal diseases prevention, production increase and improvement of the quality of animal products (ESD PT 3, European Commission 2011). Authorities have developed legal requirements on the application of approved disinfection measures to be applied in the case of outbreaks of certain animal/livestock diseases. Disinfectants used for veterinary hygiene may specifically be designed for the disinfection of floors, walls and ceilings of stables and vehicles, containers and cages for animal transport and animal housing. Other disinfectants are used for the disinfection of animals' feet (especially hooves of dairy cows) or as non-medicinal teat dips.

2 Active Substances and target organisms

In May 2010, from all 270 active substances included in the review programme, in total 55 were supported for PT 3. The COWI study concluded that the contribution of veterinary disinfectants to the overall consumption of biocides of about 400,000 t is only 2.7% (COWI A/S. 2009).

Table 1: Active substances of PT 3 being evaluated in the Review Programme

Substance group	Substances (examples)
Non-oxidative	
Aldehydes	Formaldehyde; Glyoxal; Polymer of formaldehyde and acrolein
Phenols	Chlorocresol; Sodium p-chloro-m-cresolate
Quaternary ammonium compounds	Didecyldimethylammonium chloride
Organic acids	Formic acid ; Benzoic acid; L-(+)-lactic acid; Salicylic acid; Glycollic acid
Alkalies	Calcium dihydroxide; Calcium magnesium tetrahydroxide; Sodium hydroxid; Sodium carbonate
Amines	Chlorhexidine digluconate;, Amines, n-C10-16-alkyltrimethylene with chloroacetic acid; N-(3-aminopropyl)-N-dodecylpropane-1,3-diamine
Guanidines	Poly(hexamethylenebiguanide); Poly(hexamethylendiamine guanidinium chloride); Oligo(2-(2-ethoxy)ethoxyethylguanidinium chloride)
Metals	Silver chloride
Other	Cyanamide; Polyvinylpyrrolidone Iodine; Chlorhexidine digluconate; 2,2-dibromo-2-cyanoacetamide
Oxidative	
Chlorine based	Sodium hypochlorite; Chlorodioxide; Sodium dichloroisocyanurate dehydrate; Calcium hypochlorite; Tosylchloramide sodium; Trichlorisocyanursäure
Bromine based	
Oxygen based	Hydrogen peroxide; Peracetic acid; 2-Butanone, peroxide; Peroxyoctanoic acid

Printed active substances shown in italics are not included in the Review programme.

Up to August 2014, only 3 active substances of PT 3 (Benzoic acidPolyvinylpyrrolidone iodine and Nonanoic acid) have been approved under the EU Biocidal Product Regulation 528/2012 (BPR), according to the progress of the review programme.

Veterinary hygiene measures including cleaning and disinfection aim at preventing and eradication of animal diseases such as bovine tuberculosis and brucellosis, bluetongue, classical and African swine fever, avian influenza, salmonellosis etc. (see Annex I of Council Decision on expenditure in the veterinary field 2009/470/EC). The target organisms are pathogenic bacteria and viruses or fungi. Efficacy testing is done according to CEN standards against representative model organisms, such as the bacteria *Staphylococcus* *aureus, Salmonella typhimurum, and Pseudomonas aeruginosa*, and the fungi *Candida albicans* and *Aspergillus niger*. Sporicidal activity is tested against *Bacillus subtilis* and *Bacillus cereus*.

From the part of the stakeholders, it was indicated that stable disinfectants could be used more targeted and precisely by adapting efficacy testing to the conditions of use with respect to temperature and application duration. This would lead to possible savings of up to 50% of the total amount used.

Micro-organisms pose different problems in relation to their sensitivity to disinfectants. For example, only few disinfectants are sporicides, and problems have been encountered when disinfecting transmissible spongiform encephalopathy contaminated material (Wesche et al. 2005).

For the control and eradication of infectious diseases, the European Commission (EC) requests Member States to ensure that the disinfectants and their concentrations are officially approved by the Competent Authority (CA). Additionally, cleansing and disinfection operations must be carried out under official supervision in accordance with the instructions given by the official veterinarian, and must follow the principles and procedures laid down in specific Directives, such as Directive 2002/60/EC for the control of African swine fever.

The transmission of animal diseases might not only occur through aerosols, ingestion or direct contact but also through vectors, especially rodents and insects. In the case of zoonotic transmitted diseases also the vectors (e.g. insects, rodents) have to be monitored and controlled. Thus hygiene measures in stables often require the use of pest control agents as well as of disinfectants.

Several national lists of veterinary disinfectants with approved efficacy are often used as guides for the choice of veterinary disinfectants. In Germany, the lists of disinfectants, published by the German Veterinary Association (Deutsche Veterinärmedizinische Gesellschaft e. V. (DVG)) and of the German Agricultural Society (Deutsche Landwirtschafts- Gesellschaft (DLG)), are often referred to.[1, 2] The application of the DVG disinfectants takes place via high-pressure cleaners, steam cleaners, atomizers, or vaporizers.

Several basic chemicals such as hydrated lime (Calcium dihydroxide), Calcium oxide (quicklime), and Calcium magnesium oxide (dolomitic lime) are applied for veterinary hygiene purposes (especially for the disinfection of slurry and manure) and are referred to in disinfection guidelines in case of animal disease outbreaks (Anonymous 2007, EuLA 2009). The application of 2% Sodium hydroxide, is considered a suitable surface and equipment disinfectant, which may be used in outbreaks of the classical swine fever virus or the avian influenza (Smith 2006, Strauch and Böhm 2002, FAO 2007), although Sodium hydroxide is not supported as a biocidal product. It neither has been included in Annex I of the Biocidal Products Regulation on active substances, for which a simplified authorization procedure has been accepted. The EU-Eco-Regulation, on organic production and labelling of organic products in its implementation, refers to allowed products for cleaning and disinfection, among them Calcium oxide, Calcium hydroxide, and Sodium carbonate (Annex VII of Regulation (EC) No 889/2008). Several national guidelines from authorities, describing suitable disinfection measures to be applied in case of outbreaks of animal diseases, refer to these basic chemicals.[3]

[1] http://www.dvg.net/fileadmin/Bilder/DVG/PDF/Desinfektion-ab-August-2014/2014-08-01-TH13-Homepage-geschuetzt.pdf

[2] DLG disinfectants for milking installation, http://www.guetezeichen.de, http://www.dlg.org/reinigungsmittel.html

[3] BMUB Richtlinie über Mittel und Verfahren für die Durchführung der Desinfektion bei anzeigepflichtigen Tierseuchen, Februar 2007 http://www.bmelv.de/SharedDocs/Downloads/Landwirtschaft/Tier/Tiergesundheit/Tierseuchen/Infektionsrichtlinie.html

The contribution of animals, as a reservoir for methicillin-resistant *Staphylococcus aureus* (MRSA) and other multi-resistant human pathogens, has attained special attention. Hence, the application of good hygienic practice, Hazard Analysis and Critical Control Points (HACCP) principles, originally developed for the food industry, is required to cover the entire food chain “from stable to table” (Dwinger et al. 2007). In veterinary practice, hygiene management includes the control of sterilizers, endoscope disinfection, cleaning and disinfecting washers, the effectiveness of surface disinfection, and drinking water quality etc. Some suppliers offer hygiene certificates to their customers.

No reliable consumption data for disinfectants used in animal breeding are available. A rough estimate from a survey in 1997 brought to light that the most important quantities in Germany stem from (Kaiser et al., 1998):

- Cleaning and disinfection of milking installation (concentrates) 22000 t/a
- Iodine containing teat-dipping agents (ready for use) 3500 t/a
- Copper sulfate for claw disinfection (powder, working solution 5-10%) 1000 t/a
- Disinfection of stables (concentrates) 860 t/a
- Manure decontamination by organic active substances[4] < 1000 t/a
- Cyanamid solution (50%) for manure treatment 500 t/a

3 Users groups and mode of application

According to the Emission Scenario Documents (ESD) for disinfectants in veterinary hygiene, all applications of biocides for this product types are intended for “professional” use (EC 2011). There are consumer applications for disinfecting the surroundings of pets, which may also be attributed to PT 3.

Before disinfection, cleaning of surfaces from organic material such as faeces, urine, bedding, food, dust etc. is urgently required. Under experimental conditions, cleaning alone removes approximately 99% of bacteria, while in farm environments this figure is likely to be near 90%. Removal of a further 6-7% of bacteria is obtained in practice by disinfection, and a further 1-2% by fumigation (Fotheringham 1995). Adequate cleaning implies the removal of dust and is an important prerequisite to the disinfection success. It is also important to remember, that ineffective cleaning may make the situation worse by spreading micro-organisms to other areas may lead to their prolonged survival. Dried films of organic matter such as blood, excreta, etc., may prevent the penetration of a disinfectant. Organic matter is one of the most important environmental factors influencing the activity of disinfectants (Wesche et al. 2005).

The main mode of application for the disinfection of surfaces in animal housing and transport is spraying with high- or low pressure equipment. Disinfection with aerosol by nebulizer or vaporizer is only carried out in exceptional cases (only in small housings) (EC 2011). The most commonly used method for the disinfection of teats of dairy cows is dipping, although spraying and foaming are also applied for this purpose. Surfaces in hatcheries are mainly disinfected by aerosols, spraying or fogging. For disinfection of animals’ feet, cows usually walk through tubs containing the disinfection solution (bathing) (EC 2011).

[4] e.g. Formaldehyde, Peracetic acid, Formic acid, Calcium cyanide

4 Possible emission routes and available ESD

4.1 Emission scenario documents

Several Emission Scenario Documents (ESDs) have been published which provide an overview on the most relevant uses of disinfectants.[5]

Table 2: Overview of emission scenarios for veterinary disinfectants of PT 3

Title	Reference6	Main emission pathways
Veterinary hygiene biocidal products:		
Disinfection of all animal category housing In case of poultry housings	ESD for PT 3 (EC, 2011)	Manure→ soil → groundwater Wastewater → STP → surface water
Vehicles used for animal transport	ESD for PT 3 (EC, 2011)	Wastewater →STP → surface water
Disinfection of footwear and animals' feet	ESD for PT 3 (EC, 2011)	Manure→ soil → groundwater
Non-medicinal teat dips	ESD for PT 3 (EC, 2011)	In milking parlours →STP In stables → manure
Disinfection of milk extraction systems	RIVM report 601450 009, 2002	Outside stables →STP In stables → manure
Disinfection of hatcheries	ESD for PT 3 (EC 2011)	STP, Air
Disinfection of fish farms	No separate scenario available	Surface water

Disinfection of animal housing and disinfectants for veterinary hygiene, such as non-medicinal teat dips, footwear and animal feet, are mainly released to manure/slurry, air and agricultural soil (from spreading of manure/slurry). Agricultural run-off to surface water, as well as leaching from agricultural soil to ground-water after manure/slurry application to soil, can also lead to environmental exposure of biocides. In general, across Europe, it is prohibited to discharge waste water containing slurry, to the public (municipal) sewer, and hence liquid waste containing manure is either removed to a slurry or waste water collection tank and may subsequently be applied to land, or treated in an on-farm sewage treatment plant (STP), e.g. anaerobic digesters. Intermediate wastewater storage in collection tanks, followed by transport and treatment in mu-nicipal STP, is also common. In contrast, PT 3 products applied for the disinfection of vehicles, used for animal transport or from milking parlours outside the stable, are mainly emitted to waste water, treated in on-site STPs or in municipal STPs. Disinfectants for animal feet or footwear might be discharged either to the slurry system or to the waste water. Disinfection with chemical agents is often accompanied by physical (e.g. thermal) treatment and the temperature of the treatment area has a decisive influence on the efficiency of the disinfection process (next to other factors such as the duration, the organic load, the pH, etc.).

A guidance document of the Bavarian state office for water management, describes the requirements on wastewater discharge in rural areas. Wastewater from stables must be discharged to liquid manure. Cleaning water from milking equipment and from fish ponds may be discharged to municipal STP or to the manure storage reservoir (Anonymous 2004).

[5] http://echa.europa.eu/guidance-documents/guidance-on-biocides-legislation/emission-scenario-documents

[6] EC (2011), Van der Poel et al. (2002)

While wastewater from chicken breeding should be discharged to manure storage containers, wastewater from hatcheries may be discharged to STP (because only the eggs are incubated and no animals are kept).

The area of use will mainly be derived from the intended uses indicated by the applicant, which have to be supported by efficacy testing, but may also be restricted when risks are identified. Specific provision in the area of use could be combined with other provisions, in particular with those in the category of users and in the product design.

4.2 Emission during application / treatment phase

The dosage of disinfectants is dependent from the pre-cleaning success, the contact time, the mechanically energy applied, the temperature among other factors. According to formulators, efficacy testing of veterinary disinfectants usually takes place at environmental temperatures of 20°C, while in practice disinfectants are often applied at lower temperatures. As a rule of thumb, at environmental temperatures of 10°C the dosage of aldehydes must be increased by a factor of three and the dosage of organic acids by a factor of two to become effective (personal information of a formulator). Maintaining appropriate temperatures is therefore one option to increase the efficacy and to reduce the total amount released to the environment.

4.3 Emission during service life

No specific emissions resulting from the service life disinfectants have been identified. All emissions are attributed to the use phase during application and the end of life stage. The only excemptions are treated articles with an antibacterial claim. The active substances might leach during the service life (e.g. silver in textiles during washing). No measures to reduce these emissions have been identified.

4.4 Emission during restore end of life stage

The main emission pathway of PT 3 disinfectants is manure, followed by soil and groundwater, after the application of fertilizer to agricultural areas and STP's for certain application areas such as hatcheries. The recollection of containers with residues of concentrates of disinfectants may be one option to reduce emissions to the environment, by avoiding any emptying to these emission pathways.

5 Stakeholder survey

A questionnaire on the application and use phase of disinfectants for veterinary hygiene purposes has been drafted in order to obtain the view of stakeholders on the practicability and efficiency of potential measures. After discussing the questionnaire with experts from the German Federal Environment Agency (UBA) it was distributed to around 40 stakeholders (professional and industrial associations, users, formulators, authorities, consultants and others). The feedback rate was disappointing, but the quality and information content of the answers was good. In total 7 responses have been received, which belong to the following stakeholder groups:

- Formulators of disinfectants: 1
- Users of disinfectants 2 (veterinarian of a hatchery, institute of animal breeding)
- Industrial and professional associations 2 (IHO from German Chemical industry and German association of veterinarians DVG)
- Hygiene consultants 1 (milk hygiene expert)
- Others (research institutes) 1 (University institute for veterinary hygiene)

With respect to the understanding of stakeholders on a sustainable use of disinfectants, they provided several proposals on definitions of sustainable use which are summarized in table 3:

Table 3: Proposals for a definition of sustainable use provided by stakeholders[7]

Definitions
Successful disinfection of the target pathogen using the minimal application rate while using well biodegradable ingredients. (Veterinarian of a hatchery)
No harm to the environment, in particular no risk to drinking water, and no hazards to the users. (Expert from a hatchery)
Use of disinfectants in such kind that pathogenic germs are eliminated, that the environment is not affected excessively, and that no residues of disinfectants remain the in food. (Expert from professional associations for milk hygiene)
Use of disinfectants which are permanently and reliably effective, resource- and environment-friendly, economical, non-hazardous to health. (Expert from a university involved in veterinary hygiene)
Use only if necessary and strictly according to the manufacturer's description, and considering all risk reduction measures described in the instructions for use. (Formulator of disinfectants)
Proper application of the appropriate products for obtaining the optimal results. (Expert from an industrial association of the chemical industry)

Most stakeholders refer to the three pillar concept where the economic (protection of commodities and construction works), social (human health) and environmental protection are of equivalent importance. This is not in line with the definition used in this project that considers the environment as the guard rail for further developments.

Stakeholders were asked to indicate the selection criteria for active substances and quite uniformly replied, that disinfectants are selected according to the following criteria (in order of priority):

1. Specific effectiveness on organisms to be inactivated
2. Ready degradability of the active substances
3. Degradation of active substances in liquid manure
4. Purchase cost
5. Human health risks, e.g. through sensitising effects
6. Behaviour in the sewage treatment plants (degradation and adsorption)
7. Ecotoxic effects (classification in R50/53, R51/53, R52/53, H400, H410-413)
8. Effort for storage and disposal of residues
9. Indication in national guidelines/directives from authorities, such as the directive on disinfectants used in cases of animal disease outbreaks from the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV).
10. Local wastewater regulations, e.g. concerning the discharge and limit values.

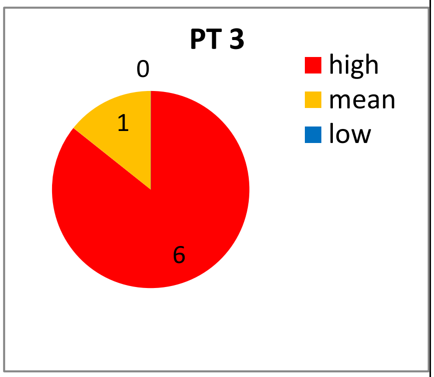
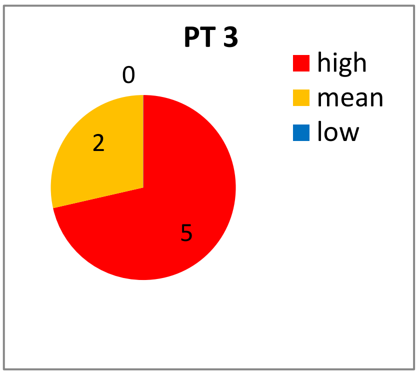
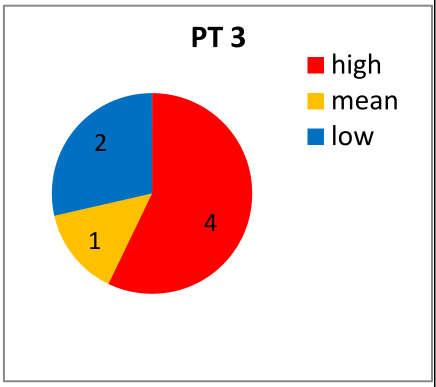
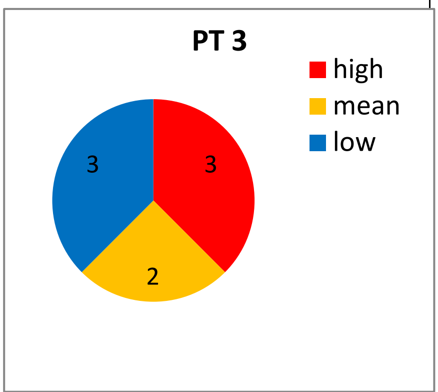
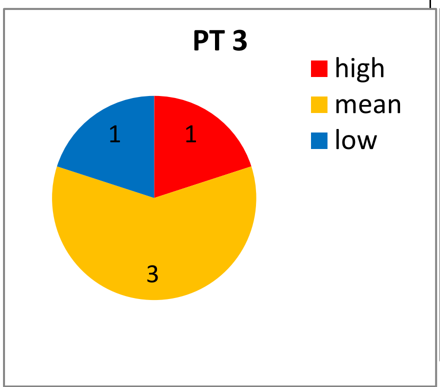
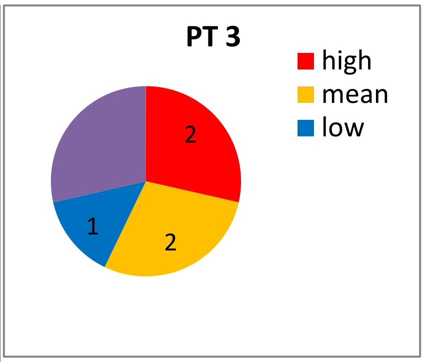
[7] In the questionnaire distributed to the stakeholders the original questions was "What do you understand on a sustainable use of biocides".

11. Quality labels, such as the DLG-labels for disinfectants in stables, from the German Agricultural Society.

The main selection criteria for disinfectants are efficacy, degradability and purchase costs followed by human health aspects. Further elements, such as behaviour in the sewage treatment plants and acute ecotoxic effects, have been attributed far lower importance.

The stakeholders were also asked to indicate their expectation about the practicability and efficiency of measures proposed to reduce environmental impacts. These measures included aspects such as further training and education, requirements for sales and control mechanism, information and awareness raising, surveillance of applications, and measures to reduce emissions during the use phase.

Table 4: Evaluation of measures to reduce environmental impacts of PT 3 disinfectants (examples)

		
Development of hygienic plans, disinfection plans and work instructions adjusted to the needs of disinfection measures	Instruction of co-workers in the company	Certification of hygiene consultants of manufacturers / retailers
		
Certification of professional users, distributors and consultants within further education and training	Anaerobic treatment of liquid manure for biogas production	Development of a classification system for environmental sound disinfectants

A qualitative evaluation of measures to which a high efficiency has been attributed, resulted in the following order of priority:

Table 5: Evaluation of measures to reduce environmental impacts of PT 3 disinfectants (examples)

Order	Measures
1	Providing information on "best practices" and safe use.
	Development of hygienic plans, disinfection plans and work instructions adjusted to the needs of disinfection measures.
2	Instruction of co-workers in the company.
	Advice to clients by manufacturers (including safety data sheets, technical leaflets, instructions for use.
	Optimization of disinfection by previous cleaning.
3	Certification of hygiene consultants of manufacturers / retailers.
4	Certification of professional users, distributors and consultants within further education and training.
	Avoidance of peak loads through discharge of concentrated solutions.
	Establishment of collection systems for residues by the manufacturer / distributor.
5	Funding of (voluntary) training measures for (private) users, e.g. on environmental sound use and disposal.
	Regulation of sales of products via the internet, e.g. through minimum standards of information requirements.
	Development of a classification system for environmental sound disinfectants.
	Integration of environmental criteria into new or existing eco- and/or quality labels.
	Replacement of poorly biodegradable / eliminable disinfectants (in sewage treatment plants) by rapidly degradable active ingredients and additives.
	Quality Assurance and Control.
	Discharge of wastewater from cleaning and disinfection to the liquid manure tank.
6	Knowledge transfer on a sustainable use of disinfectants during education and training, e.g. of farmers.
	Recording of sales volumes.
	Promotion of web-based information platforms.
	Development of standards and guidelines for private users, when disinfection measures are required and how they should be used.
	Development of technical standards and guidelines for the cleaning of instruments and equipment.
	Replacement of disinfection measures by thermal processes (incineration, flame treatment, hot air sterilization, boiling, steam sterilization, self-heating (see e.g. BMELV disinfection directive).
	Anaerobic treatment of liquid manure for biogas production.
	Intermediate wastewater storage in collection tanks followed by transport and treatment in municipal sewage treatment plants.
	Collection and disposal of residual amounts.

With respect to exemplary problematic ingredients, in PT 3 disinfectants with possible environmental impacts, stakeholders referred to chlorocresols which are effective against Coccidia, single-celled intracellular parasites, which often infest chickens or other galliforme animals. Chlorocresols are anaerobically non-degradable and may cause groundwater contamination when the manure is applied to agricultural soil.

Some stakeholders complained missing best practice documents. Currently the knowledge transfer is realised by practical work at farms but there exist few documents for training. The competence of hygiene consultants from industry differs considerably and some certification of these would improve the situation. In hatcheries the use of formaldehyde as fumigant is very common and users are worried that this active substance may not be allowed any more in the future because it is not supported in the review programme of the BPR.

In milking installations, a hygiene consultant suggested that intermittent disinfection of milking machines with steam and the use of Peracetic acid, for disinfection of milking machines and teat dips, would cause lower environmental impacts. Teats disinfection by dipping is considered more effective and less consumptive than teat disinfection with automatic or manual spraying, where up to 50% of the disinfectant is lost. Efficacy testing of dipping disinfectants should be more realistic than usually performed and should be demonstrated by neutral institutions. A list of approved disinfectants for teat disinfection, with instructions concerning the required concentrations under field conditions, should be established. A stakeholder from a professional association referred to (cross)-resistance development induced by the use of disinfectants. While some active ingredients have been deleted from the DVG list of approved disinfectants for occupational health reasons, environmental concerns have not been considered so far in detail. Several stakeholders defined misuse of disinfectants in the context of over- or under dosing, and non-observance of the temperature, the contamination of surfaces, and the surface type. Disinfection on wet or damp surfaces, the use of non-appropriate equipment, and lack of suitable use instructions has been complained by a stakeholder from industry.

6 Elements of sustainable use

6.1 Risk mitigation measures

In a project on behalf of the UBA risk mitigation measures (RMM), proposed by producers, industrial/professional users and authorities have been analysed with focus on environmental risks of veterinary hygiene disinfectants. In this context a RMM guidance document has been developed, which is discussed among competent authorities (Gartiser and Jäger 2013). It is distinguished between general RMM and specific RMM. General RMM refer to the application of best practices, good housekeeping etc. and may support a sustainable use of disinfectants. Specific RMM are derived from the environmental risk assessment and may be quantified and considered, by changing the input parameters. They are applied during product authorisation for specific products, based on the results of the risk assessment. However, a quantification of the efficiency and practicability of specific RMM, and an evaluation of the possibility of enforcement are required, in order to be quantitatively considered in regulatory decisions.

The project revealed that many disinfectant active substances are inactivated during their use or are readily biodegradable. Neutralization of the active substance(s) is a RMM which is sometimes applied to strong acids/bases or oxidising agents. Avoidance of peak loads of disinfectants to anaerobic digesters has been indicated as an RMM in order to avoid negative effects on biogas /fermentation plants. Disinfectants used for livestock breeding, mainly are released to manure. For some processes such as pig breeding, a minimum storage time of 8 weeks for liquid manure is required and compliance with these obligations is considered as a RMM if the active substances are eliminated or reduced during storage and this has been confirmed in corresponding experiments. Some disinfectants, such as those used for transport vehicles or footbaths, enter the municipal sewage treatment plant. Thus, avoidance of peak loads and biological treatment in municipal STPs, can be regarded as a RMM, for the protection of the functionality of the STP as well as for surface water after discharge of the treated effluent. Many disinfectants also contain detergents and other ingredients that may be of higher environmental concern than the active substances themselves.

The formation of disinfection by-products (DBPs) almost exclusively has been considered in the context of drinking and swimming water treatment so far. It mainly depends on the presence of organic matter and other precursors of DBP. The formation of DBP under the use conditions should be considered in the assessment of all biocidal products with oxidising active substances.

6.2 Training/Education

Training and education only applies to professional users. For consumers, only measures for awareness raising, such as information, are appropriate (see 6.4). Disinfection is only one aspect of an effective infectious disease control program in animal environments. In addition to cleaning and disinfection, also control of other pests such as insect and rodents, proper food storage, handling, preparation and distribution, are equally important. These should be implemented in a general veterinary medicine program including training of personnel, proper nutrition and feeding, routine surveillance and prophylactic medicine including vaccination, quarantine of new and sick animals, proper holding facilities, correct disposal of waste products and dead animals (Kiupel et al. 2004).

The use of disinfectants for professional uses should be integrated in good housekeeping principles as described, e.g. in the BREF on “Rearing of Poultry and Pigs” (July 2003, a revised BREF is currently being discussed). This is not applicable for private uses. Environmental aspects of manure and slurry are mainly discussed in the context of nutrients spread to fields. The principles of “Good Agricultural Practices” (GAP) should be followed when manure is used as an organic fertilizer.

Agricultural scientists receive profound knowledge in veterinary hygiene including the application of disinfectants, and there are specialist departments, such as the Institute of Environmental and Animal Hygiene and Veterinary Medicine from the University of Hohenheim.[8]

In Germany agriculturist/farmers receive a three year dual education in professional school combined with practical work in a farm and may continue to receive their master craftsman's certificate.[9] A lot of further professions such as dairy farmer, conservationist etc. exist. The selection and application of disinfectants may be considered more in detail in these professional educations. For example, Eickmann et al. (2012) presented a model for selecting appropriate veterinary disinfectants based on their proven efficacy and hazard classification focussing on human health aspects.

The European Commission developed an “Animal Health Strategy” for the European Union (2007-2013) which aimed at achieving a modern and appropriate animal health framework; better prevention, surveillance and crisis preparedness, supporting science, and innovation and research. The vision is to work in a partnership in order to increase the prevention in animal health related problems: “Prevention is better than cure”. The strategy also comprises training support in Member States for safer food (European Commission 2007).

The Commission Regulation (EC) No 889/2008 laying down detailed rules for the implementation of the Regulation (EC) No 834/2007 on organic production requires, that only products listed in Annex VII may be used for cleaning and disinfection of livestock buildings installations and utensils. Here, besides biocidal active substances, such as Sodium hypochlorite and Hydrogen peroxide Formaldehyde, Ethanol, and Peracetic acid also bulk chemicals such as lime and quicklime, caustic soda, Phosphoric acid, and Sodium carbonate are listed.

6.3 Requirements for sales of biocides

Disinfectants for veterinary purposes are mainly supplied by agricultural wholesale companies or consultants of the formulators or distributors. They often offer advice for hygiene measures and the application of disinfectants or even offer the establishment and maintenance of complete hygiene managements systems.

Consumer use disinfectants for the surroundings of pets are supplied by pet shops or building centres. The certification of suppliers and/or consultants may support a sustainable use of these products.

6.4 Awareness programmes and information

Within the “Animal Health Strategy” of the European Union, also the data base TRACES (Trade Control and Expert System) has been established as a trans-European network for veterinary health, which notifies, certi-

[8] https://www.uni-hohenheim.de/einrichtung/institut-fuer-umwelt-und-tierhygiene-sowie-tiermedizin-mit-tierklinik

[9] http://www.landwirtschaftskammer.de/bildung/landwirt/schule/index.htm

fies and monitors imports, exports and trade of animals and animal products. Economic operators (private sector) and competent authorities all over the world can use this web-based network to trace back and forth animals and animal product movements. TRACES allows inspections to be carried out on animal health (e.g. risk of epidemic animal diseases), animal welfare (e.g. animal transport) and public veterinary health (e.g. animal products for human consumption).[10] In this context it is linked with the "Rapid Alert System for Food and Feed" (RASFF) which aims to provide food and feed control authorities with an effective tool to exchange information about measures taken, responding to serious risks detected in relation to food or feed.[11]

6.5 Equipment for biocide application

In Germany some equipment for the application of disinfectants are tested and certified in a voluntary basis, by the German Agricultural Society (Deutsche Landwirtschafts- Gesellschaft DLG, http://www.dlg.org).

For cleaning of stables, often high-pressure cleaners are used. Suppliers of machinery, often refer to the mixing of concentrates in high pressure cleaners as being inaccurate and therefore recommend to mix the working solutions separately in a 200 litre barrel. When applying disinfectants in high-pressure cleaners, lower pressure (maximum of 5 bar), lower delivery rates (maximum 10-15 litres per minute), and larger droplets are recommended.[12]

Several standards describe safety requirements of high-pressure cleaners:

- DIN EN 60335-2-79 (2010): Household and similar electrical appliances - Safety - Part 2-79: Particular requirements for high pressure cleaners and steam cleaners
- DIN EN 1829 part 1 (2010) and 2 (2012): High pressure water jet machines - Safety requirements - part 1: Machines, Part 2: Part 2: Hoses, hose lines and connectors

Knapsack sprayers are also applied although to a lower extent. In Germany some (few) knapsack sprayers used for both, plant protection and pest control purposes, have a GS-certificate ("Geprüfte Sicherheit" ="Tested Safety"). Several standards for knapsack sprayers exist:

- ISO 19932-1 (2013): Equipment for crop protection -- Knapsack sprayers – Part 1: Requirements and test methods
- ISO 19932-2 (2013): Equipment for crop protection -- Knapsack sprayers – Part 2: Performance limits
- ISO 10625 (2005): Equipment for crop protection -- Sprayer nozzles – Colour coding for identification
- ISO 4254-6 (2009): Agricultural machinery -- Safety -- Part 6: Sprayers and liquid fertilizer distributors

The German Occupational Insurance Associations publishes safety guidance documents for liquid jets, where risks of accidents from the use of high-pressure cleaners of different categories (< 25 bar, 25-250 bar, > 250 bar), is described from an occupational health point of view (BGR 500 2008).

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[10] http://ec.europa.eu/food/animal/diseases/traces/index_en.htm

[11] http://ec.europa.eu/food/food/rapidalert/index_en.htm

[12] http://www.cos-ohlsen.de/hygiene/index.html

The DLG tests machinery and equipment for agricultural and municipal applications. It also tests machinery for the application of disinfectants in farms, e.g. claw cleaning procedures, or high-pressure cleaners for hot water.[13] Testing includes parameters related to the functional control and operational safety, such as the determination of volumes and its distribution (dosage), the uniformity of dosage per area, the indication of the content, the roughness of surfaces of storage containers, the cleaning and hygienic success, the noise load, and the appropriateness of maintenance procedures etc.

The ISO 20966 (2007) "Automatic milking installations- requirements and testing" describes technical provisions such as the separation of the foremilk, post milking teat applications (disinfection, skin conditioning), milk cooling/storage, and automatic cleaning and sanitizing of all surfaces in contact with milk. Monitoring systems for milk, deemed as abnormal, are also described in this standard. Cleaning and disinfection of milking installations will usually alternate between alkaline and acidic cleaning / disinfection. Acidic cleaners contain inorganic acids (Phosphoric acid, Sulfuric acid), alkaline cleaners use inter alia chlorine-based bleaching agents such as sodium hypochlorite. Dosage is automatical or manual. Accidental mixing of both cleaners / disinfectants may cause the release of chlorine gas (LSV-SpV 2009).

6.6 Further measures to reduce emission during application

Many oxidising active substances are rapidly degraded but inevitably lead to the formation of disinfection by-products (DBPs) through the reaction with organic and inorganic water ingredients. Some of them are potentially mutagenic, polar (adsorption in sludge limited) or hardly biodegradable. The disinfection of water with oxidising biocides leads to the inevitable formation of disinfection by-products (DBPs) because part of the biocides react with organic and inorganic water ingredients. The formation of DBP is mainly discussed in the context of disinfectants released to water bodies (especially during drinking water or swimming water treatment). During evaluation of active substances, DBP are not specifically addressed, but it is recommended to consider the formation of DBP before product authorisation.[14] Measures to reduce the formation of DBPs especially include the removal of precursors, such as organic matter or shifting to other non-oxidative active substances.

6.7 Measures to reduce emission during service life

No specific emissions, resulting from the service life of PT 3 disinfectants, have been identified. All emissions are attributed to the use phase during application and the end-of-life stage. The only exemptions are treated articles with an antibacterial claim. The active substances might leach during the service life. No measures to reduce these emissions have been identified.

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

The disinfectants used in animal houses for veterinary hygiene may reach liquid manure tanks, where they may be inactivated through (bio)degradation or adsorption during manure storage, before they enter soil by the use of manure as organic fertilizer.

[13] http://www.dlg.org/testsagriculture.html

[14] Assessment of disinfection by-products (DBP) - Background document for TM prepared by NL, with contributions from SE and DE, and comments from FR and IND - Main discussion points for TM II/12.

It has been suggested that veterinary drugs and biocides may be transformed in liquid manure, reducing their amount released to agricultural soils from manure application and storage (Montforts et al. 2004). A German research project developed a technical protocol for testing the behaviour of biocides in manure, using standards with 10 % dry solids for bovine manure and 5 % dry solids for pig manure. These reference-manure samples were used for the degradability testing of the 14C-labeled biocides Imazalil (PT 2, 3, 4, 13, 20) and Cyanamide (PT 3 and 18). After a storage time of 177 days in the dark at 20°C, no significant decrease of Imazalil concentration was observed. However, 77% - 90 % of the radioactivity initially applied remained in the extractable residues. In contrast, Cyanamid was significantly mineralised (16%) or bound to the dry solids and after 100 days the extractable residues accounted for 30% - 51% of the initial radioactivity (Kreuzig et al. 2010a, 2010b).

The good agricultural practice (GAP) is defined as applying the available knowledge to address environmental, economic and social sustainability for on-farm production and post-production processes, resulting in safe and healthy food, and non-food agricultural products. Regulation (EC) No 73/2009, on common rules for direct support schemes for farmers, under the common agricultural policy in Article 6, refers to the “good agricultural and environmental condition”. Member States shall ensure that all agricultural land, especially land which is no longer used for production purposes, is maintained in good agricultural and environmental condition. For this, member states shall define, at national or regional level, minimum requirements for good agricultural and environmental conditions. Annex III describes compulsory optional standards for good agricultural and environmental conditions; among them is the establishment of buffer strips along water courses, for the protection of water against pollution. Other aspects are the maintenance of organic matter and the soil structure through arable management, crop rotations, and appropriate machinery use. GAP also includes compliance with existing legislation such, as soil protection laws or regulation concerning the application of wet or dry manure as a fertiliser to agricultural soil (in Germany Bundes-Bodenschutzgesetz and Düngeverordnung).[15] The consideration of best hygiene practices in animal breeding or the use of environmental sound disinfectants is still not considered in GAP. In principle, direct payments to farmers could also support the establishment of such best practice schemes.

6.9 Specific measures to protect the aquatic/terrestrial environment

Most PT 3 applications should not lead to direct emissions of disinfectants to surface waters and soils. Thus emissions to environmental compartments mainly occur via manure or STP. Potential exceptions are disinfectants used in fish farms or soil disinfectants.

In fish farms routine disinfection should be reduced to the minimum necessary, by good management practices. The need of footwear disinfection may be omitted through disposable “pull-on” shoes. Disinfection measures are applied to emptied ponds, tanks, pipelines, outdoor areas or buildings. Usually, the water sources used, should not contain species equivalent to those raised on the farm in order to avoid the risk of water-borne diseases (Torgren et al. 1995). There is little information available, so far, about releases to surface waters or on-site water treatment techniques.

[15] Bundes-Bodenschutzgesetz BBodSchG - Gesetz zum Schutz vor schädlichen Bodenveränderungen und zur Sanierung von Altlasten, last amendment 17.3.1998.Verordnung über die Anwendung von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmittel nach den Grundsätzen der guten fachlichen Praxis beim Düngen (Düngeverordnung - DüV), last amendment 31.7.2009

In order to avoid the need of soil disinfection, the inactivation of pathogenic microorganisms and viruses such as *Salmonella, Leptospira, Micobacteria* and the foot-and-mouth disease virus etc. in feces and liquid manure, is one measure to avoid their distribution. Infected manure is therefore inactivated mainly by thermal disinfection. Thus, disinfection of soil is only required in emergency cases (Wasiak et al. 2004).[16]

6.10 Reduction of biocide use in sensitive areas

The reduction of biocide use in sensitive areas could be related to those application areas, where direct emission to surface waters or soil occurs (see 6.9). Thus, as an example, the operation of fish farms in Natura 2000 sites may not be allowed. For other application areas such as animal housing the focus is on manure storage and application of manure to agricultural soil, which should be restricted. Stakeholders indicated that PT 3 disinfectants might be used in Natura 2000 areas as a consequence of animal disease outbreaks (e.g. foot rot in sheep).

6.11 Handling and storage of biocides and their packaging and remnants

Disinfectants used for livestock breeding mainly are released to manure. For some processes, such as pig breeding, a minimum storage time of 8 weeks for liquid manure is required by the German pig breeding hygiene ordinance.[17] The general rules for storage and transport of chemicals as described in national guidelines such as TRGS 510 should be considered.[18] Most aspects concerning the handling and storage of pesticides and their packaging and remnants also apply to biocides (SVLFG 2008). For some applications, the packages might be returned to the supplier, following the example of plant protection products.

6.12 Integrated best practice approaches

The application of best hygiene practices should also consider options for alternative or biocide-free measures. This includes the application of cleaning agents such as detergents instead of biocides where possible, and/or the application of physical disinfection methods. In this case the environmental soundness of alternative ingredients should also be evaluated.

In the United Kingdom the term, “Good Biosecurity Practices”, is used which describes principles to minimise the risk of disease occurring or spreading. Thus, the health and welfare of animals is safeguarded and the viability of businesses is protected.

The Department for Environment, Food and Rural Affairs (DEFRA) has published numerous guidance documents on „Good Biosecurity Practice”.[19] Maintaining biosecurity covers the life stages from buying new stock, until the safe disposal of expired stock and animal by-products. Further aspects and principles are hygienic conditions for animals, people and buildings, clean food and water, separation of new animals from

[16] Annex V of the BPR attributes soil disinfection to PT 2 although the main applications identified refer to the outbreak of veterinary diseases.

[17] Verordnung über hygienische Anforderungen beim Halten von Schweinen, Schweinehaltungshygieneverordnung (SchHaltHygV) from 7. Juni 1999

[18] TRGS 510 Storage of hazardous substances in non-stationary containers. http://www.baua.de/en/Topics-from-A-to-Z/Hazardous-Substances/TRGS/pdf/TRGS-510.pdf

[19] http://animalhealth.defra.gov.uk/managing-disease/biosecurity.html

the rest (isolation), slurry management (e.g. spread on arable land rather than grass land for silage or grazing), and traceability and identification (identification, breeding and movement records). Good Biosecurity aims at providing a healthy stock. Furthermore, a more viable business, protects neighbours and the countryside, prevents the emergence of new diseases, reduces their spreading, cuts costs of disease prevention and treatment and improves farm efficiency. Diseases may not always be apparent, especially in its early stages and thus good hygiene practices should be maintained,especially during handling of animals or moving them between different premises. A good biosecurity routine is always essential – not just when there is an exotic disease outbreak. Good biosecurity should be routinely adopted as part of farm management in order to help to reduce the risk of exotic-, and the burden of endemic disease. The maintenance of facilities for the disinfection of boots and protecting cloths of all people entering or leaving the area of animals, as well as for the disinfection of transport vehicles and instruments, has been mentioned as an essential component of good biosecurity practice. Only approved disinfectants should be used for these purposes. The involvement of vets and consultants for developing a suitable health plan is recommended. Advice is given for poultry keepers for cleaning and disinfection after depopulation, following the outbreak of a notifiable disease of poultry, such as avian influenza. The preliminary disinfection is under the responsibility of authorities, the final disinfection under the responsibility of the owner under the surveillance of a veterinary inspector and cleansing and disinfection officer. Disinfectants and wash waters are not allowed to enter surface waters or groundwater (DEFRA 2010).

From commercial consultancy companies on hygiene quality and safety several guidelines on cattle and swine farming as well as of animal transport are being distributed.[20] These documents cover aspects of hygiene managements such as documentation, control of all incoming animals and of food, animal welfare, requirement on stables, and animal transport etc. The concept is similar to the Hazard Analysis and Critical Control Point Concept (HACCP) applied in the food industry. Disinfection measures only cover a small part within the concept.

Other companies also refer to the HACCP system for designing and implementing food safety programmes, from farm to fork. The system follows seven basic principles, which identify, monitor and control potential hazards in the food safety chain:[21]

1. Hazard analysis by identifying all potential food safety hazards at each step in the production process.
2. Identify Critical Control Points (CCPs).
3. Establish critical control limits such as water temperature, salmonella count etc.
4. Establish monitoring procedures.
5. Implement procedures to take corrective actions.
6. Verify that the system is working properly.
7. Documentation.

The DLG guideline on hygiene techniques and management for cleaning and disinfection of stables recommends a 6 step process: Primary cleaning (emptying feeding troughs and preparing all equipment for cleaning), soaking (several hours with and without detergents), cleaning (preferably with high-pressure cleaner

[20] http://www.q-s.de

[21] The Credence Poultry Disinfection Programme, preciously http://www.agil.com, now only available via www.docstoc.com/

top-down), flushing with water, drying, and disinfecting. The last disinfection step might be thermal or chemical and follows intensive cleaning (“mud cannot be disinfected”). The active substances recommended in the DLG list of approved disinfectants belong to aldehydes, chlorine or oxygen releasing products, phenols or QAC, acids or alkalis (von der Lage 2010).

The Best Available Technique Reference Document (BREF) for intensive rearing of poultry and pigs (July 2003) states that regular cleaning and disinfection of the housing equipment and all the housing surfaces, after removal of all the livestock, is necessary but does not specifically refer to the selection and use of cleaning and disinfection agents. The main environmental impacts of farming results from the manure from the animals and poor land spreading management or techniques. Good housekeeping and improved farming, manure and nutrient management may also help reducing emissions from the use of disinfectants. In the revision of the BREF, initiated in 2009, the identification of good agricultural practices for intensive rearing of poultry and pigs is envisaged.

6.13 Existing guidance documents on best practices and standards

The careful use of disinfectants is essential to minimise risks for human health and the environment. In many application areas for disinfectants good and best practice documents and training courses have been developed. Maintaining good hygiene practice and good housekeeping is a prerequisite for disinfectants being effective. Hygienic design of the equipment and the facility helps minimising the amount of disinfectant. Several good and best practice documents cover the veterinary hygiene area. Some non-exclusive examples are:

- Strauch, D., Böhm, R. 2002. Reinigung und Desinfektion in der Nutztierhaltung und Veredelungswirtschaft. Enke-Verlag Stuttgart
- Linton, A. H., Hugo, W. B., Russell, A. D. 1997. Disinfection in veterinary and farm animal practice. Blackwell Science Ltd
- Caveney, L., Jones, B., Ellis, K. 2011. Veterinary Infection Prevention and Control. John Wiley & Sons, Chichester,
- Fraise, A. P., Lambert, P. A., Maillard, J. Y 2003. Russell, Hugo and Ayliffe's Principles and Practice of Disinfection, Preservation & Sterilization. Blackwell Publishers
- Bodenschatz, W. 2012. Desinfektion - Rechtsvorschriften, Richtlinien des Robert Koch-Instituts: Desinfektion, Sterilisation, Reinigung, Schädlingsbekämpfung, Infektionsprävention. Loose page collection B. Behr's Verlag Hamburg
- Böhm, R,. Strauch, D. 1996. Desinfektion im Stall - weniger Krankheiten, mehr Leistung. Auswertungs- und Informationsdienst für Ernährung, Landwirtschaft und Forsten (ADI) Band 1163
- European Association of Zoo and Wildlife Veterinarians (EAZWV) 2010.Transmissible Diseases Handbook (4th Ed.) Chapter VIII. Guidelines for cleaning and disinfection in zoological gardens. Infectious Diseases Working Group (IDWG) http://www.eaza.net/activities/Pages/Transmissible%20Diseases%20Handbook.aspx
- WHO 1994. Guidelines on cleaning, disinfection and vector control in Salmonella infected poultry flocks. Report of a workshop on Preparation of Guidelines on Cleaning and Disinfection/Sanitation in Poultry Farms with S. enteritidis in Bakum/Vechta, Germany http://apps.who.int/iris/handle/10665/61034

- Russell, A. D., Yarnych, V. S., Koulikovskii, A. 1984. Guidelines on disinfection in animal husbandry for prevention and control of zoonotic diseases. World Health Organization. Veterinary Public Health Unit http://apps.who.int/iris/handle/10665/66405
- DEFRA 2006. Milk hygiene on the dairy farm – a practical guide for milk producers. Food Standards Agency http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=1QQUSGMWSS.0KG7U7BS1PPLWJ.
- Kiupel M., Mecklem R., Hunsinger B., Marschang R. 2004. Guidelines for Cleaning and Disinfection in Zoological Gardens. Transmissible Diseases Handbook. www.eaza.net/.../
- Mülle, W., Schlenker, G. Zucker, B.-A. 2001. Kompendium der Tierhygiene. Lehmanns media, Berlin, 187 pages
- TRGS 522 - Technische Regeln für Gefahrstoffe (2013) Raumdesinfektion mit Formaldehyd (Januar 2013)
- Gesellschaft für Versuchstierkunde, Society for Laboratory Animals Science, GV-SOLAS, Ausschuss für Hygiene, Desinfektion von Tierräumen mittels Formaldehyd oder Wasserstoffperoxid, Stand Dezember 2010

7 Indicators

In the stakeholder survey, supported by a questionnaire, the following potential indicators for observing the progress obtained in sustainable use of biocides have been indicated (by order of priority):

1. Exposure measurements on workplaces during the use of disinfectants
2. Biocide specific surveillance of ground and drinking water (e.g. number of values exceeding 0.1 μg/l)
3. Surveillance of biocide residues in food products
4. Biocide specific monitoring of effluents from sewage treatment plants
5. Biocide specific monitoring of surface waters
6. Occurrence of animal diseases, multi-resistant microbes
7. Indication of poisoning cases
8. Survey about the number of advanced training events and participants
9. Occurrence of allergens against cleaning agents and disinfectants
10. Survey among professional / consumer users
11. Survey about the number of (certified, trained) professional users
12. Hit rates on specific information web portals (e.g. www.biozid.info)

The stakeholder made some suggestions referring to the disinfection success such as, “reduction of target organisms while complying with low levels of residues”. From industrial association also the decrease of epidemic outbreaks with norovirus, and verotoxin-producing *Escherichia coli* (Enterohämorrhagische E. coli, EHEC) has been suggested as a suitable indicator. A consultant on milk hygiene referred to the results of hygiene control measures as an appropriate indicator. From industry the increase of knowledge on application machinery, as well as monitoring of disinfectants in environmental media, has been recommended as potential indicators. Surveillance of the equipment is regarded as an important measure and thus the share of inspected machinery could serve as an indicator.

Monitoring of resistance development to disinfectants is another indicator proposed by stakeholders. Especially Methicillin-resistant *Staphylococcus aureus* (MRSA) bacteria, which are important hospital germs, was mentioned as a major problem, because animal breeding facilities are considered as a possible reservoir.

The European Commission requests all member States to notify all outbreaks of serious infectious diseases, which in Germany are published in the animal health reports of the Federal States Institute on Animal Health (FLI 2012).

Within the “Animal Health Strategy” for the European Union simple and reliable indicators will help to measure progress towards the strategy’s goals, guide policy, inform priorities, target resources and focus discussion. They will be developed in consultation with stakeholders and improved over time as better veterinary and other data becomes available. They will cover both, hard indicators of animal health (e.g. disease prevalence, number of animals eliminated) and softer indicators, tracking the confidence and expectations and perceptions of European citizens (European Commission 2007).

Monitoring of residues of disinfectants from the application of biocides for the treatment of animal housing is a potential indicator. A guidance document for dietary risk assessments of residues in food products , obtained from livestock, is under development.[22]

8 Recommendations and package of measures based on the questionnaire

The following measures received the highest acceptance of at least 50% of all stakeholders, who attributed high or medium efficiency to these measures. For each category the measures are listed by their order of priority (categories are bold).

“Further training and education”

- Instruction of co-workers in the company.
- Knowledge transfer on a sustainable use of disinfectants during education and training, e.g. of farmers.
- Advice to clients by manufacturers (including safety data sheets, technical leaflets, instructions for use.
- Funding of (voluntary) training measures for (private) users, e.g. on environmental sound use and disposal.
- Certification of professional users, distributors and consultants within further education and training.

“Requirements for sales and control mechanisms”

- Certification of hygiene consultants of manufacturers / retailers.
- Development of a classification system for environmental sound disinfectants.

[22] TNsG Guidance on Estimating Livestock Exposure to Active Substances used in Biocidal Products. CA-Dec10-Doc.6.2.b

- Regulation of sales of products via the internet, e.g. through minimum standards of information requirements.

"Information and awareness raising"

- Providing information on "best practices" and safe use.
- Funding of (voluntary) training measures for users, e.g. on environmental sound use and disposal.
- Promotion of web-based information platforms.

"Surveillance of applications"

- Development of hygienic plans, disinfection plans and work instructions adjusted to the needs of disinfection measures.
- Optimization of disinfection by previous cleaning.
- Replacement of poorly biodegradable / eliminable disinfectants (in sewage treatment plants) by rapidly degradable active ingredients and additives.
- Development of technical standards and guidelines for the cleaning of instruments and equipment. Quality Assurance and Control.
- Replacement of disinfection measures by thermal processes (incineration, flame treatment, hot air sterilization, boiling, steam sterilization and self-heating (see, e.g. BMELV disinfection directive).
- Routine examination of bacterial load in the relevant areas,

"Measures to reduce emissions during the use phase"

- Collection and disposal of residual amounts.
- Intermediate wastewater storage in collection tanks, followed by transport and treatment in municipal sewage treatment plants.
- Anaerobic treatment of liquid manure for biogas production.
- Avoidance of peak loads through discharge of concentrated solutions.
- Discharge of wastewater from cleaning and disinfection to the liquid manure tank.

The most effective measures belong to information and awareness raising by providing information on "best practices", safe use, training measures by instruction of co-workers in the company, and advice to clients by manufacturers.

Several stakeholders mentioned measures to reduce emissions during the use phase which refer to the collection and disposal of residual amounts or wastewater storage and treatment.

The measures attributed to the surveillance of applications also received high acceptance. This includes the development of hygienic plans, optimization of disinfection by previous cleaning and the replacement of biocides by thermal methods or biodegradable actives.

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