Disinfection techniques and DBP's (in relation with the EC Biocide Directive and EC DWD) : Situation in Europe

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Inspiration & the next instalment of…

… presentation „Desinfection products and techniques regarding the EC-Biocide-Directive" by Dr. Hartmut Bartel (Umweltbundesamt, Germany) in Berlin (XVI ENDWARE meeting, September 2004)

H. Bartel (2004):

- **Legal framework**
  - international (DWD, Biocide Directive)
  - national (Germany)
  - others (technical standards)
- **Basic Principles of Treatment**
  - multibarrier principle
  - minimisation principle
  - the 10% rule
- **Positive list according to the German DW Ordinance**
  - approved disinfection chemicals
  - approved disinfection processes

H. Bartel (2004): Multibarrier principle

At least 4 barriers should be in place:

1. Catchment protection (e.g. through designated drinking-water protection zones) or a well protected point of abstraction (e.g. groundwater or bank filtrate)
2. Treatment processes following the technical rules
3. Extreme care when conducting work, e.g. repairs, at the distribution network, including disinfection and flushing of repaired or new segments followed by diligent sampling for quality control)
4. Storage and distribution in the domestic installations following the technical rules (i.e. using materials that are safe for the specific water quality characteristics, insulation, adequate hydraulic characteristics)

No need for disinfection is the best disinfection !

H. Bartel (2004): Minimisation principle

It implies that of the chemicals and materials used for DW treatment and distribution, as little as technically possible (and economically feasible) should migrate into finished DW.

Thus, the minimisation principle defines a **target** towards natural, anthropogenically uncontaminated DW.

This is defined in the technical rules as well as in the national DW Ordinance and serves to protect the public as well as the environment from any unnecessary contamination.

If chemicals – as little as possible !

H. Bartel (2004): The 10-%-rule

- It defines that treatment must not increase the concentration of any substance, the concentration in DW of which is regulated by a maximum limit, by more than 10 % of this limit.
- Is an internationally accepted agreement among the expert community.
- The consequence of this is that more may be dosed of a ”clean” chemical than of a ”contaminated” treatment chemical, and this gives engineers some degrees of freedom in borderline situations
- however, the minimisation principle should also be taken into account !

H. Bartel (2004):

Biocides following the EU Biocide Directive

The member states are required to permit use of biocides for DW treatment if they are approved in another member state and there are no substantial reasons not to allow their use.

Germany considers substantial reasons against notification for:

- An avoidable risk to human health through either the biocide or through insufficient disinfection
- Insufficient options to inhibit the biocide when sampling, as this is essential for safe monitoring of the microbiological status of DW at the consumer's tap

H. Bartel (2004): The „positiv" List according to German DW Ordinance

The list includes only disinfection chemicals and processes that:

- Are sufficiently effective
- Do not cause any avoidable risk/burden to human health or the environment
- New disinfection chemicals or processes only if they contain less impurities or otherwise reduce the risk/burden to human health or the environment
- Biocides only if they are registered for use in DW disinfection in another EU member state and are not assessed as risk to human health

H. Bartel (2004):

- Existing active substances and product types included in the review programme: more than 50 substances listed…

H. Bartel (2004): Existing active substances and product types included in the review programme (1)

- Reaction product of dimethyl adipate, dimethyl glutarate, dimethyl succiante with hydrogen peroxide / Perestane
- Bacillus thuringiensis subsp. Israelensis Serotype H14
- Active chlorine: mixture of hypochlorous acid and sodium hypochlorite produced in situ
- 2,2-dibromo-3-nitrilopropionamid
- Bromochloro-5,5-dimethylimidazolidine-2,4-dione
- Calcium hypochlorite
- Hexadecylpyridiniumchlorid
- Chlorine
- Chlorine dioxide
- 4-Chlor-3,5-dimethyl-phenol
- Äthanol
- Formaldehyd
- Formic acid
- 1,5-Pentandial, Glutaraldehyd
- Hexa-2,4-dienoic acid / Sorbic acid
- Homopolymer of 2-tert-butylaminoethyl methacrylate (EINECS 223-228-4)

H. Bartel (2004): Existing active substances and product types included in the review programme (2)

Iodine
Potassium (E,E)-hexa-2,4-dienoate
Dipotassium disulphite
Potassium permanganate
Pentapotassium bis(peroxymonosulphate) bis(sulphate)
Garlic ext.
Copper
Sodium chlorate
Sodium chloride
Sodium chlorite
Sodium dichloroisocyanurate Triazin, Troclosene sodium
Sodium dichloroisocyanurate dihydrate
Triazin, Troclosene sodium
Disodium disulphite
Sodium hydrogensulphite
Sodium hypochlorite
Sodium sulphite
Oligo-(2-(2-ethoxy)ethoxyethyl guanidinium chloride)

H. Bartel (2004): Existing active substances and product types included in the review programme (3)

m-phenoxybenzyl 3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate / Peracetic acid
Poly-(hexamethylendiamine guanidinium chloride)
Kaliumsulfit
Propan-2-ol
Quaternary ammonium compounds, benzyl-C12-14-alkyldimethyl, chlorides
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides
Quaternary ammonium compounds, C12-14-alkyl[(ethylphenyl)methyl]dimethyl, chlorides
Quaternary ammonium compounds, di-C8-10-alkyldimethyl, chlorides
Quaternary ammonium iodides
Sulphur dioxide
Silver
Silver chloride
dimethyl-dithiocarbamic acid sodium salt
Tosylchloramide sodium
N,N',N"-Trichloroisocyanuric acid; 1,3,5-Triazine-2,4,6(1H,3H,5H)-trione, 1,3,5-trichloro
Hydrogen peroxide

Disinfection and disinfection byproducts (DBPs): Situation in Europe

- Questionnaire prepared and (at first) distributed within the WEKNOW project: turn 2004/2005
- Completed by 28 countries:
  - 24 EU countries (not Belgium)
  - Bulgaria, Croatia, Norway and Romania
- May not be 100% true picture, but seems to be quite reliable picture

Question 1.
Do water producers in your country disinfect the supplied water on an obligatory basis?

- In 15 of 28 countries water producers are obliged to disinfect the supplied water; however, in three countries, this obligation is only applicable under specific conditions (e.g. when surface water is used or when a source is intended to supply more than 5000 population) and in one country, the obligation is presented in general as the need for microbiological quality management and not as the need for the use of a chemical disinfectant.

Questions 2 + 4.

Is there in your country a national authorization system or acceptance scheme for chemical disinfectants and disinfection methods (e.g. UV disinfection) usable in drinking water?

Is any mode of use part of the authorization (e.g. the minimum and/or maximum dose or residue)?

- In 16 of 28 countries, there is a national authorization system or acceptance scheme for chemical disinfectants and disinfection methods (e.g. UV disinfection) usable in drinking water and in 12 of these 16 countries usability conditions are specified (min. or max. dose, contact time, conditions of UV-lamps, etc.).

Question 3.
Is there in your country a national authorization system or acceptance scheme for chemical disinfectants….
If so, which disinfectants and methods are authorized/accepted for use in drinking water?

- Common: chlorine gas, sodium/calcium hypochlorite solution, chlorine dioxide (not in all countries), ozone, chloramine (not in all countries) and UV radiation [limited range x 50 active substances under Biocide Directive…]
- Rare: magnesium hypochlorite, potassium permanganate and hydrogen peroxide, combinations such as UV/H_2O_2, MIOX (Mixed Oxidants) and membrane techniques.
- Rare & in special situation (e.g. emergencies) or private wells only: NaDCC, paracetic acid etc.

Question 5.

If there is no authorization system, does it mean that water producers can use any disinfectant (method) for water disinfection?

- In nine countries such as Cyprus, Estonia, Finland, Greece, Ireland, Italy, Latvia, Malta and Portugal, water producers may use any disinfection method or product for water disinfection on condition that the treated water quality meets the national water quality requirements. Exceptions are Denmark and the Spain where approval of the method (product) from the local authority is needed.

Question 6.
Which DBPs (apart from THMs and bromate) are monitored in drinking water on an obligatory basis?

- Eight countries included additional DBPs – most often chlorite or chlorate, exceptionally ammonium, nitrite, formaldehyde, 2,4-dichlorophenol, and 2,4,6-trichlorophenol in their regulations.

Question 7.
Is any national research on new disinfection methods and DBPs in progress or has such research recently been conducted?

- In spite of the existing problems related to disinfection and DBP formation, only as few as 7 countries reported that national research on new disinfection methods and DBPs (e.g. UV radiation, hydrogen peroxide, paracetic acid, membrane techniques, haloacetic acids and brominated DBPs) was in progress in their country. Although such information may be biased by respondents' limited awareness of the advances in associated disciplines, this number is surprisingly low.

Data availability

- The questionnaire with all single answers is part (annex) of the WEKNOW Report on Disinfection and Disinfection By-products in Europe
- See http://www.weknow-waternetwork.com