EVALUATION OF THE RELEVANCE OF DISINFECTION BYPRODUCTS (DBPs) FOR THE ENVIRONMENTAL RISK ASSESSMENT OF BIOCIDES

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Introduction

Disinfectants are widely used biocidal products which are regulated by the EU Biocides Regulation 528/2012. Their scopes of applications are quite broad and include different fields such as (drinking) water, health care or food processing. Among the active ingredients used, highly reactive substances like chlorine, peroxides or ozone are common. During their application, numerous disinfection byproducts (DBPs) are potentially formed, especially if organic matter is present. The intended use also determines possible releases of the formed DBPs into the environment. This complex situation is not adequately considered in the guidance within the European Biocides Regulation at the moment. The existing "Guidance on Disinfection By-Products" [1] is limited to halogen-containing biocidal active substances and selected product types and includes only general scientific strategies for the risk assessment of DBPs. Development of a feasible regulatory toolkit to fill this regulatory gap is the objective of the present project, sponsored by the German Environment Agency (UBA). As a part the project, a literature search was conducted to identify as many potential DBP as possible and to link them to biocidal active substances. Following this theoretical approach, DBP formation was analysed in lab experiments and real samples (the latter not depicted in this poster).

Key results of literature search

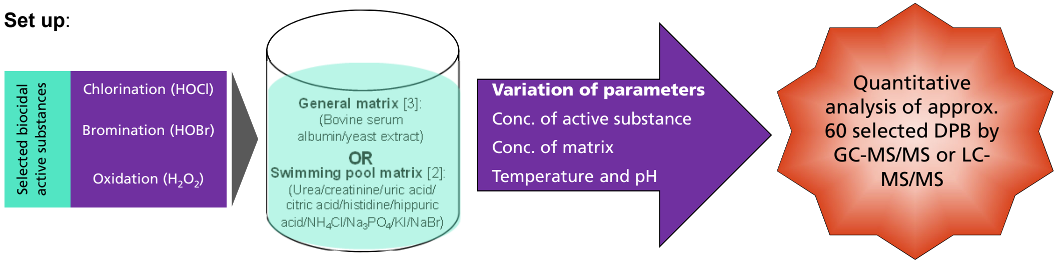
- ✓ 176 halogenated und 67 non-halogenated DBPs were identified
- ✓ A database comprising the identified DBPs and linked to active substances which are potentially competent to form DBPs was generated
- ✓ Lead active substances were selected for the experimental part of the project

Data gaps:

- ✓ Strong bias on chlorination in DPB related literature, consequently little literature on other active substances.
- ✓ No literature focusing on DBP formation during disinfection of surfaces
- ✓ Missing reaction conditions relevant for the biocidal use pattern under which the respective DBPs are formed

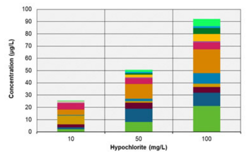
Laboratory simulations in aqueous matrix

Set up:



Selected results:

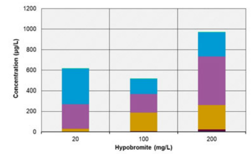
Single THM*s and HAA*s after treatment of swimming pool matrix with hypochlorite or hypobromite



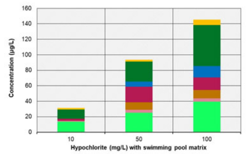
Treatment with HOCl results in large variety of different THMs and HAAs. After treatment with HOBr few brominated THMs and HAAs are formed but at surprisingly high amounts.

Reaction conditions:
Matrix conc.: 1 mg TOC/L
Temp.: 30°C
Incubation time: 24h

TCM: Trichloromethane
BDCM: Bromodichloromethane
DBCM: Dibromochloromethane
TBM: Tribromomethane
MCAA: Monochloro acetic acid
DCAA: Dichloro acetic acid
TCAA: Trichloro acetic acid
MBAA: Monobromo acetic acid
DBAA: Dibromo acetic acid
DBCAA: Dibromochloro acetic acid
BDCAA: Bromodichloro acetic acid
TBAA: Tribromo acetic acid
IAA: Iodo acetic acid
BCAA: Bromochloro acetic acid



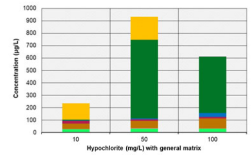
DBP families after treatment of swimming pool or general matrix with hypochlorite



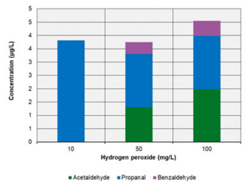
Composition and amount of formed DBP differ significantly for the tested matrices, indicating that DBP formation will depend on the particular disinfection use.

Reaction conditions:
Matrix conc.: 1 mg TOC/L
Temp.: 30°C
Incubation time: 24h

THM: Trihalomethanes
I-THM : Iodo trihalomethanes
HNM: Halonitromethanes
HAL: Haloacetaldehydes
HAN: Haloacetonitriles
HAM: Haloacetamides
HK: Haloketones
HAA+DNP: Halo acetic acids + Dalopon
HBQ: Halobenzochinones
Aldehydes

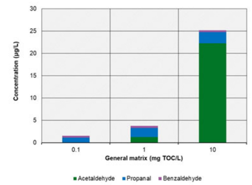


DBP after H_2O_2 treatment of general matrix with varying H_2O_2 or TOC concentration



Only aldehydes were found in laboratory simulations with hydrogen peroxide. Formation of halogenated DBP, reported in some literature [4,5], was not detected.

Reaction conditions:
Temp.: 30°C
Incubation time: 24h



Summary: The presented data is limited to DBP included in the target methods. Further DBP, not included in the methods, were likely formed but not detected. The laboratory simulations of disinfection applications indicate that design of experiments taking into account all relevant parameters influencing DBP formation is very complex. Besides the huge variety of possible DBPs, their formation will be influenced by the conditions of a particular disinfection use.

* THM: Trihalomethanes, HAA: Halogen acetic acids

Acknowledgements
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References
[1] Guidance on the Biocidal Product Regulation, Volume V, Guidance on Disinfection By-Products, Version 1.0, January 2017.
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