

# Study on Oxidation products

## Do's and Don'ts in Implementing Ozone

Arnoud de Wilt



**Royal  
HaskoningDHV**

*Enhancing Society Together*



# One study, two reports

1. Literature study on oxidation products
  - STOWA 2022-47
  - English
  - International guidance committee
    - EAWAG, RIVM, KWR
    - Drink- & Wastewater experience
  
2. Technical guideline on oxidation products
  - STOWA 2022-46
  - Dutch
  - Practical tool for Water Authorities



# Outcomes of the Literature study

- Bromate most relevant oxidation product in Netherlands
- Water matrix affects oxidation product formation
  - ⇒ Multiple factors, e.g. not just bromide concentration
- Oxidation products far less toxic compared to micropollutants (parent compounds)
- Reduction of ecotoxicity on almost all bioassays
  - ⇒ Exception possible in case of specific industrial wastewater
- Post-treatment (e.g. sand filter) not necessarily required
  - ⇒ No clear added value



# Technical guideline on oxidation products

- Three-step assessment process

- ⊕ Per step: Why > Goals > Action > Evaluation (Go / No-Go)

1. Monitoring campaign wastewater

- ⊕ Which compounds are present
  - ⊕ Possible source control (e.g. specific industry)

2. Lab testing

- ⊕ Insight in potential performance
  - ⊕ Snapshot (one / few samples)

3. Pilot testing

- ⊕ Relevant conditions for practice
  - ⊕ Assess effectivity of ozonation
  - ⊕ Determine degree of possible negative effects (bioassays)

Monitoring campaign



Lab testing



Pilot testing

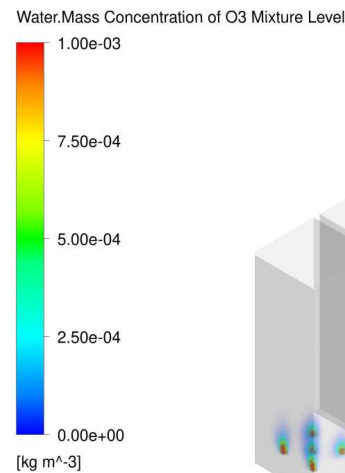


Full-scale

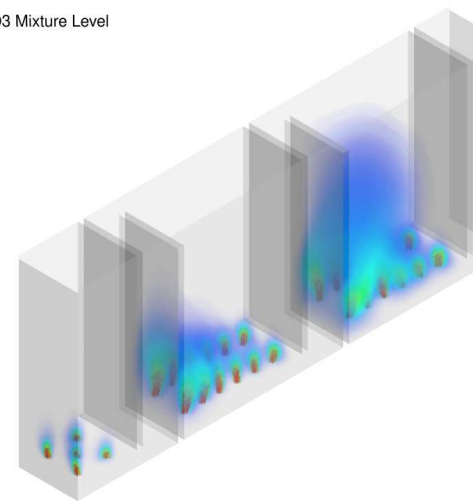


# Mitigation of bromate formation

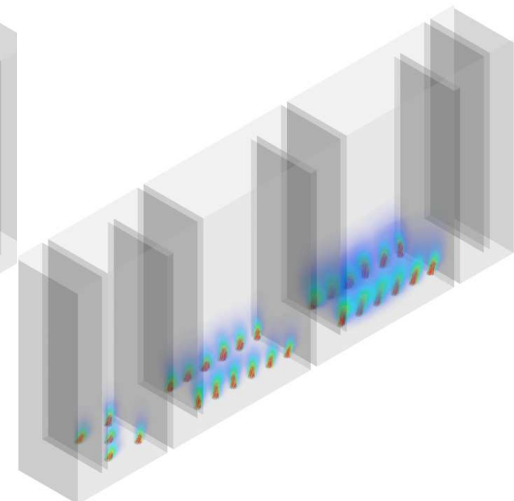
- In case of high (expected) bromate formation
- Various mitigation measures available:
  - ⊕ Reactor configuration
    - ⊕ Multiple ozone injection points
    - ⊕ Alternative reactor configuration
  - ⊕ H<sub>2</sub>O<sub>2</sub>-dosing
    - ⊕ Formation of OH-radicals
  - ⊕ Combination of technologies
    - ⊕ E.g. PAC-O<sub>3</sub>, O<sub>3</sub>-Step, MicroForce or BO<sub>3</sub>
    - ⊕ Low ozone dose



Counter-current



Co-current



# Wrap-up

- Ozonation is sustainable technology for micropollutant removal
  - ⇒ Significant improvement of water quality after ozonation
    - ⇒ Reduction of ecotoxicity on most bioassays
    - ⇒ Exception possible in case of specific industrial wastewater
  
- Bromate most relevant oxidation product in the Netherlands
  - ⇒ Relevance is directly related to very strict legislation on surface water, not related to ecotoxicity
  - ⇒ Multiple measures available to mitigate bromate formation
    - ⇒ i.a. reactor configuration, H<sub>2</sub>O<sub>2</sub>-dosing, combination of technologies
  
- Post-treatment (sand filter) not necessarily required
  - ⇒ No clear added value
  
- Please use the Technical Guideline, it's there for you



**Thank you for your attention!**

**Arnoud de Wilt**  
**Royal HaskoningDHV**  
**[arnoud.de.wilt@rhdhv.com](mailto:arnoud.de.wilt@rhdhv.com)**



**Tackling Micropollutants in Wastewater**  
**Results of the Dutch Innovation and Implementation Program**

**stowa**



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