

## Workshop 3 –Post-treatment / Ecotoxicology

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Questions for the workshop:

- What is the **goal** with post-treatment after ozonation?
- Considering the goal, what is the **validation criteria**?
- MBBR vs. Granular media as post-treatment

Practical question/point of view. Biological post-treatment – Does it work (well) with the very low nutrient levels we must achieve? Experience from Lundåkraverket pilot plant with a MBBR process after ozonation: A biofilm is formed even though there is basically “nothing” in terms of nutrients in the wastewater after the ozonation.

Here the summary of the work and it’s discussion is given (*comments/explanation of Ulf Mieke are given in italic*):

*What is the goal with post-treatment after ozonation?*

- Reduce risk of adverse environmental effects. How good are our current test (*UM: bioassays*)?
- Barriers for toxic transformation products (*UM: from primary pharmaceuticals*) and also toxic oxidation by-products (*UM: from bulk dissolved organic matter and e.g. bromide*).
- Remove transformation products.
- Reduce toxicity in the recipient ecosystem, including transformation products from pharmaceuticals and by-products.
- Side-goal: Possibility for P removal.
- What operators (e.g. NSVA) might want is to combine 0.2 mgP/l with transformation products.
- BOD removal and O<sub>3</sub> depletion. Basically detoxification. (*UM: ozonation increases the BOD slightly, in the order of 15%; no dissolved ozone should be present at the ozone reactor effluent*)

*How to validate that the goals are achieved?*

- Bioassays:
  - Validation criteria – mutagenicity
  - Bioaccumulation (fish = animal testing)
  - Long-term effects in aquatic environment?
- List of validated post-treatments:
  - How is it confirmed that it actually works?
  - Including design recommendations and operational limits
  - More bioassay data needed to validate the different post-treatments

- Recommendations of J. Völker: Use of bioassays currently underrepresented to complement to current knowledge.
- Any correlation between chemical (sum) parameters and bioassay results, which potentially could be used for supervision of post-treatment:
  - Correlation: COD and toxicity data?
- Difference between what we need to know for operation and for validation! (*UM: e.g. operator only validates to stay with the min/max operational boundary conditions given in the list of validated post-treatments*)

*MBBR – Does it make sense as a ozonation post-treatment?*

- Post-treatment for ozone can be a way to upgrade the WWTP to meet more stringent outlet demands.
- MBBR can be an alternative for ozonation post treatment if you already have a MBBR at the plant.
- If the post-treatment is built specifically for ozonation post-treatment a more detailed comparison of options is needed
  - Post treatment alternatives to be assessed:
    - MBBR
    - MBBR + micro sieve
    - Granular media (sand filter, dual media filter, biological activated carbon, granular activated carbon) → *UM: already a lot of data available in DE/CH*
    - MBBR + Granular media
  - *UM: So far, only few ecotoxicological studies have been analysing the performance of MBBRs of ozonation post-treatment*