COMBINED ADVANCED PROCESSES IN WASTEWATER TREATMENT FOR REDUCTION OF ANTIBIOTIC RESISTANT BACTERIA

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CONVENTIONAL TREATMENT
- Upon international studies, the current conventional wastewater treatment is not suited to eliminate unwanted bacteria as well as antibiotic resistance genes and contributes to their spread to the environment.
- Calculations with real data from the wastewater treatment plant (WWTP; 440.000 P.E. and 80.000-100.000 m³/d): each day 2.35x10¹⁰ facultative-pathogenic bacteria and 9.69x10¹² copies of antibiotic resistance genes reach the environment, despite activated charcoal treatment and sand filtration at the WWTP.
- Theoretically does every 23rd bacterium released contains one antibiotic resistance gene!!!

METHODS
- Normalization to 100 mL water.
- Quantification of facultative-pathogenic bacteria and clinically relevant resistance genes using qPCR.
- For validation of molecular methods, cultivation based assays were performed with taxonomic-selective agar plates.

CONCLUSION
- Ozonation is capable to reduce microbiological contaminations including ARGs/ARBs.
- Reduction efficiency is depending on the ARG carrying bacteria.
- Additional UV-treatment demonstrated a synergistic benefit with ozone.
- Both, increasing of ozone concentration as well as ozone contact time have an additional benefit in a real WWTP.
- Increasing ozone concentration is more effective than prolonged contact time. Here the production of chemical transformation products is a critical issue.
- High risk antibiotic resistances were reduced below the LOD by every parameter variation.
- Reduction efficiencies were as high as analyzed for ultrafiltration in some cases.
- Cultivation based experiments confirmed the molecular biological methods, but were less distinct.
- Reduction does not mean elimination: Post-processing regrowth can occur.

MOTIVATION
- Ultrafiltration yield the highest reduction values followed by a combination of ozone and UV-treatment.
- Ozone and UV-treatment in combination can be considered as an alternative for membrane filtration, although their efficiency by initial parameters were not as high.
- Ozone contact times and ozone concentrations/g DOC with UV were increased for further reduction increase of ARB/ARG.
- Ozone concentration was increased to 1, 1.5, and 2.0 g ozone/g DOC; ozone contact time increased from 5, 30, and 60 minutes; with each with an additional UV-irradiation of 400 J/m².

REDUCTION TO ADVANCED TREATMENT COMBINATION AND VARIATION
- Reduction efficiencies were improved by elevated ozone concentrations and contact times, in most of the cases.
- Ozone concentration of 1.5g/g DOC resulted in elimination of most facultative-pathogenic bacteria.
- Effect of a subsequent UV-irradiation is independent of previous ozone treatment.
- Cultivation experiments support the more distinct qPCR results.