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Elimination of micro-pollutants and pathogenic (antibiotic resistant) bacteria by advanced waste water treatment technologies

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Abstract

Elimination of bacteria by ozonation in combination with adsorption onto activated carbon or slow sand filtration is a possibility for advanced sewage treatment in order to improve the quality of treated sewage and to reduce the potential risk for human health and of receiving surface waters. To determine the elimination of sewage bacteria, inflowing and leaving waste water of different treatment processes was analyzed in a culture-based and qPCR approach for its content of Escherichia coli, Enterococci and staphylococci and their resistance against selected antibiotics over a period of 17 months. For Enterococci, single species and their antibiotic resistances were identified. In comparison to the standard waste water treatment process, ozonation plus adsorption onto activated carbon and/or sand filtration reduced the concentrations of total and antibiotic resistant E. coli, Enterococci and staphylococci. The discovery of new chemical pollutants and biodiversity in the aquatic environment has become a growing problem of environmental concern. Therefore, wastewater treatment plants (WWTPs) play an important role in the spread of so-called emerging viruses and antimicrobials.

Therefore, the daily loads released by WWTP are calculated including the model system for the distribution of these loads within the receiving body of water.

However, antibiotic resistant E. coli and staphylococci apparently survived ozone treatment better than antibiotic sensitive strains. Neither vancomycin resistant Enterococci nor methicillin resistant Staphylococcus aureus (MRSA) were detected by a culture-based approach. The decreased percentage of antibiotic resistant Enterococci after ozonation may be explained by a different ozone sensitivity of species: Enterococcus faecium and Enterococcus faecalis, which determined the resistance-level, seemed to be more sensitive for ozone than other Enterococcus species. Overall, ozonation followed by adsorption onto activated carbon or sand filtration led to 0.8-1.1 log-units less total and antibiotic resistant E. coli, Enterococci and staphylococci. Thus, advanced waste water treatment after common sewage treatment is an effective tool for further elimination of microorganisms from sewage before discharge in surface water.

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