Warburg WWTP

Case Study eXeno™ municipal

ANOXKALDNES

The client

Warburg WWTP (Stadtwerke Warburg GmbH Warburg) is situated in North Rhine-Westphalia, central Germany on the river Diemel. It receives municipal as well as industrial wastewater (strong seasonal fluctuations due to sugar factory inflow).

Key Figures

PE: 70 000
Flow to the advanced treatment (average dry weather, max flow): 240 - 400 m^3/h
Ozone dosage: 2-5 mg/L (DOC dependent)
Selected biological treatment: AnoxKaldnes™ eXeno™ MBBR

The Benefits of MBBR

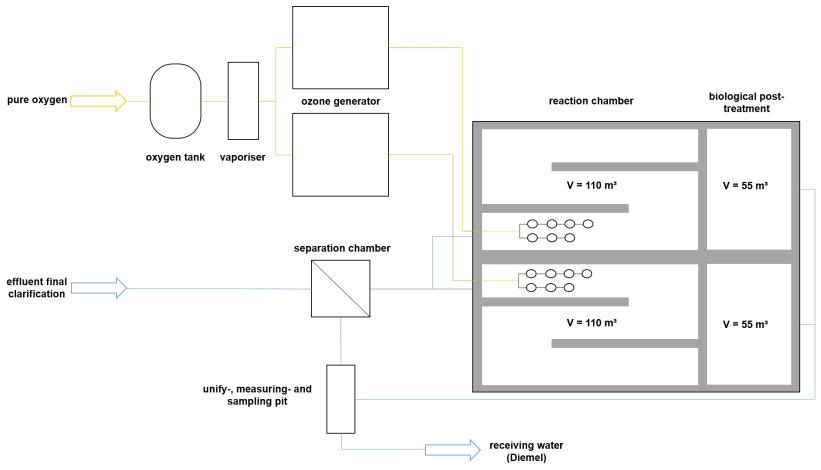
- 95% removal of ozonation transformation products (OTP)

The Client's Needs

Micropollutants such as pharmaceuticals or personal care products are emerging contaminants that are found in wastewater effluents (at ng-µg/l concentrations) as a result of uptake in households. To reduce the discharge of micropollutants into recipients associated with potential toxic effects, Warburg WWTP was upgraded with new advanced treatment technology, consisting of ozonation. However, ozonation only partially oxidizes micropollutants and as a result, ozonation transformation products (OTPs) with unknown properties can be formed. In order to minimize the risk of releasing unknown and potentially toxic OTPs into surface water, it is recommended to install a biological post-treatment after ozonation.

The Solution

The solution consisted of an ozonation step in two parallel chambers (110 m^3 each) followed by one stage AnoxKaldnes™ eXeno™ MBBR in each line (55 m^3 each). The ozone is provided via diffusers in the two chambers and the ozone dosage concentration (2-5 mg/L) is controlled by the DOC concentration in the effluent (approx. 6 mg/L). The minimum hydraulic retention time in the advanced treatment is approx. 20 min.
The AnoxKaldnes MBBR contained AnoxK™5 carriers and only mechanical mixing is present, as oxygen is received from previous ozonation step.

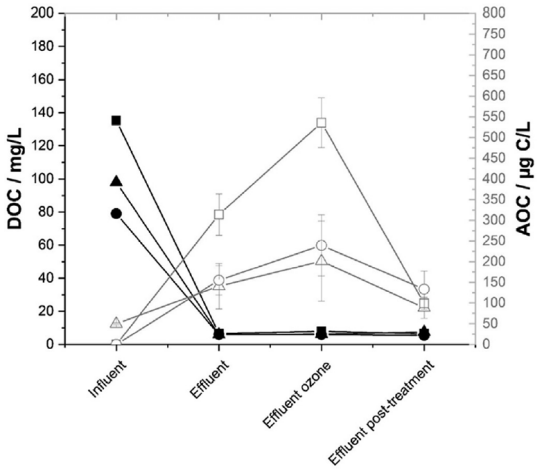


Ref: Itzel et al. (2020). Evaluation of a biological post-treatment after full-scale ozonation at a municipal wastewater treatment plant. Water Research 170 (2020) 115316

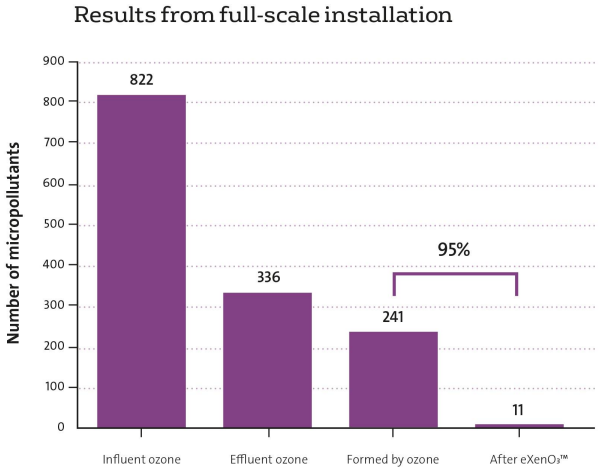
Process results

Removal efficiency of the ozonation system was measured by assessing the removal of 14 pharmaceuticals and pesticides, with elimination of >80% (24 h composite sample) at a dosage of 0.7 mgO^3/mgDOC. The process performance in terms of the removal of OTPs was assessed in two ways: by measuring the AOC (assimilable biodegradable organic carbon) through the different steps of the advanced treatment plant and by non-targeting analysis of OTPs.

AOC increased with the ozonation step, as a result of the formation of several toxic OTPs. The post MBBR was able to remove 70% of the measured AOC after ozonation (at a dosage of 0.7 mgO^3/mgDOC) by high assimilation of degradable organic carbon.



DOC (filled symbols) and AOC (open symbols) concentrations at different specific ozone doses (0.7, 0.5, 0.3 mgO3/mgDOC). Rectangle (0.7), circle (0.5), triangle (0.3). Ref: Itzel et al. (2020). Evaluation of a biological post-treatment after full-scale ozonation at a municipal wastewater treatment plant. Water Research 170 (2020) 115316



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Non-targeted analysis showed that a number of peaks (micropollutants) were removed by ozonation (approx. 60%) but simultaneously 241 peaks (i.e. OTPs) were created through ozonation. The MBBR resulted in the elimination of 95% of the OTPs created through ozonation.

Biomass developed in the MBBR was found stable over the time and under different ozone doses.
The advanced treatment at Warburg was found highly efficient in removing micropollutants and ozonation transformation products and a second plant was built in Germany (Rheda-Wiedenbrück) with the same process scheme.

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