Scientific Paper:

Science of the Total Environment (2022) 812, 152466

Effect of ozonation on the biodegradability of urban wastewater treatment plant effluent

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Abstract:

The present work aimed to study the effect of ozonation on the organic sumparameters linked to enhanced biodegradability. Laboratory experiments were conducted with the effluent of four Austrian urban wastewater treatment plants with low food to microorganism ratios and different matrix characteristics. Biochemical oxygen demand over 5 days (BOD_5) was measured before ozonation and after application of different specific ozone doses (D_{spec}) (0.4, 0.6 and 0.8 g O_3/g DOC). Other investigated organic parameters comprised chemical oxygen demand (COD), dissolved organic carbon (DOC), UV absorption at 254 nm (UV_{254}), which are parameters that are applied in routine wastewater analysis. Carbamazepine and benzotriazole were measured as reference micropollutants. The results showed a dosedependent increase in biological activity after ozonation; this increase was linked to the enhanced biodegradability of substances that are recalcitrant to biodegradation in conventional activated sludge treatment. The highest relative change was determined for BOD_5, which already occurred between 0 and 0.4 g O_3/g DOC for all samples. Increasing the D_{spec} to 0.6 and 0.8 g O_3/g DOC resulted in a less pronounced increase. DOC was not substantially decreased after ozonation, which was consistent with a low reported degree of mineralization, while partial oxidation led to a quantifiable decrease in COD (7 to 17%). Delta UV_{254} and the decline in specific UV absorption after ozonation clearly correlated with D_{spec}. In contrast, for COD and biodegradable DOC (BDOC), a clear dose-response pattern was identified only after exposure to BOD_5 measurement. Indications for improved biodegradability were further supported by the rise in the BOD_5/COD ratio. The results indicated that subsequent biological processes have a higher degradation potential after ozonation. The further reduction in biodegradable organic carbon emission by the combination of ozonation and biological post treatment represents another step towards sustainable water resource management in addition to micropollutant abatement.

Keywords: ozonation, urban wastewater, biodegradability, biochemical oxygen demand, micropollutants