Environmental sustainability of waste water ozonation

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Introduction

The EU FP6 project NEPTUNE has been going on for about 3.5 year and is now at the finalising stage. The project is related to the EU Water Framework Directive and the main goal has been to develop new and optimize existing waste water treatment technologies (WWTT) and sludge treatment methods for municipal waste water. Besides nutrients, a special focus area has been micropollutants (e.g. pharmaceuticals, heavy metals). As part of the project a holistic based prioritisation among technologies and optimisations has been done and is based on life cycle assessment (LCA). The LCAs are performed as comparative LCAs and the concept of induced impacts as compared to avoided impacts is introduced in the life cycle impact assessment (LCA) part. In total more than 20 different waste water and sludge treatment technologies have been assessed. This paper presents the LCA results from running the induced versus avoided impact approach on ozonation, and the impact of combining ozonation with sand filtration. The effect of including ecotoxicity effect end-points, for which the population survival relevance is debatable, on the estimation of ecotoxicity characterisation factors (CFs) is also shown. Furthermore, the effect on the "ozonation+sand filtration" LCA impact profile of including more micropollutants (9 metals) and phosphorus is illustrated.

Methodology

Ozonation is a post treatment technology and the waste water treated is therefore the effluent from a municipal wastewater treatment plant with conventional treatment of today but without any post-treatment, i.e. primary and secondary treatment only. Foreground data, i.e. the characteristics of this effluent (micropollutants content), is based on within NEPTUNE generated data and literature data which is also the case for the inventory data on the ozonation plant (energy consumption, concrete consumption etc.). Removal rates are based on NEPTUNE data. Background data, e.g. emissions from electricity production, is mainly from the EcoInvent 2.0 database. Consequential LCA is used, e.g. marginal for electricity production is assumed to be natural gas. Adapted EDIP97 LCA methodology is applied.

Conclusions

- Based on the given assumptions (and the expected effect of including more micropollutants) results indicate that ozonation used for removal of organic micropollutants most probably is environmentally sustainable, i.e. avoided potential impacts are higher than induced potential impacts.
- However, problems with whole effluent toxicity (WET) from a risk assessment perspective (not shown).
- Addressing the WET problem by including sand filtration significantly improves the sustainability profile (mainly due to added removal of heavy metals and to-l-P).
- Including ecotoxicity effect end-points with debatable populations survival relevance in the CFs (especially for diclofenac) have a significant impact on the impact profile for ozonation.
- Focusing on global warming a weighting factor of at least 30 – 45 is needed in order to reach a break-even between induced and avoided impacts for ozonation combined with sand filtration.

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