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Retention Soil Filter - A flexible system for advanced treatment of WWTP effluent and CSO

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Introduction

Retention soil filters (RSF) are installed as a measure to treat wastewater from combined sewer overflows (CSO) and thereby reduce hydraulic stress and pollutant load in a watercourse. The cleaning capacity of RSFs has already been the subject of past studies, with nutrient reduction rates from 75 % to 98 % reported (Frechen 2010, MUNLV 2003). Studies undertaken by the authors delivered similar results (Mertens et al. 2012, Christoffels et al. 2015). The aim of the study conducted by the Erftverband in the Aquanes Project is to demonstrate dual application of a retention soil filter in a dynamic wastewater management system: during dry weather the RSF is utilised to provide advanced treatment of WWTP effluent; in wet weather CSOs are conducted to the RSF for treatment.

Retention soil filter

The general structure of an RSF is shown in Figure 1. Wastewater percolates vertically through the sand filter body. Particulates and solutes are retained and reduced by filtration, adsorption and biochemical degradation.

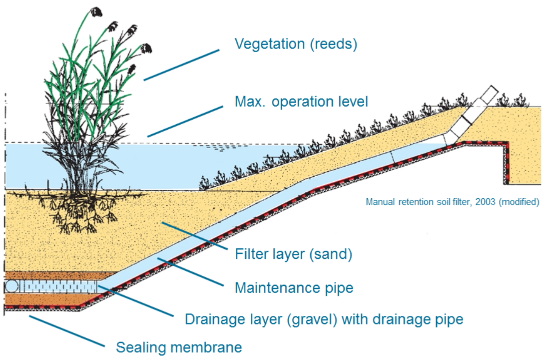

Figure 1: RSF structure (MUNLV, 2003)

The principal cleaning efficiency is tested by introducing CSO (which is usually discharged directly into the river) for treatment. Figure 2 provides an illustration of reduction in concentrations of the pharmaceutical substances diclofenac and ibuprofen. It was found that median values and the number of positive findings were reduced significantly and the maximum concentrations were capped.

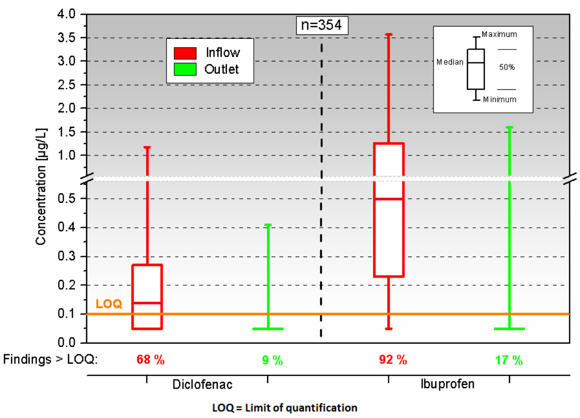

Figure 2: Reduction efficiency of RSFs, e.g. Diclofenac and Ibuprofen (Christoffels, 2015)

Innovative flow & treatment concept

A full scale retention soil filter system (size: 4500 m²) for flexible treatment of WWTP effluent or water from CSOs will be constructed at WWTP Rheinbach in Germany and operated under field conditions for 2 years (see Figure 3).

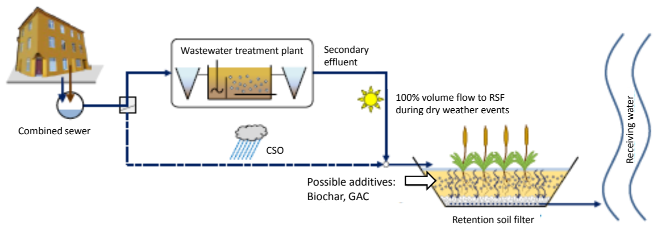

Figure 3: Schematic view of RSF system for flexible treatment of CSO and WWTP effluent

The key innovation is the flexible use of the RSF for CSO, because the biotic component of the RSF often suffers from long periods without any water flow. The innovative combination of systems for CSO treatment with WWTP effluent polishing will reduce chemical and microbiological contamination of the receiving river used for irrigation and recreational purposes. Removal capacities of the following parameters will be monitored: sum parameters such as biological/chemical oxygen demand, nutrients, heavy metals, pharmaceutical compounds, X-ray contrast media, biocides, pesticides, disinfection products, flame retardants, endocrine disrupting compounds and microbial indicators (*intestinal enterococci, Escherichia coli*).

In addition to the full scale system, pilot systems for testing of innovative substrate additions (e.g. GAC, Biochar) will be operated in columns to improve the design of other full scale RSF for optimized removal of targeted pollutants (Figure 4). Results will feed into design recommendations.

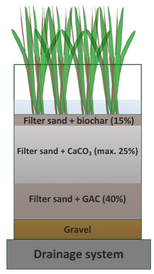

Figure 4: Substrate additives

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Planned outcomes

- Gain knowledge of reduction rates of RSF for various emerging substances under different scenarios.
- Enhancement of chemical and ecological status of a river system through advanced treatment of CSO and WWTP effluent.
- Assure the transferability of the concept to other sewer systems.
- Create new possibilities for water usage.

References:

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