Institute for Hygiene and Public Health
WHO Collaborating Centre for Health Promoting Water Management and Risk Communication

A microbiological-hygienic view on RSFs as a fourth purification stage within waste water treatment

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Environmental quality standards for surface waters

Currently limitation values for microbial contaminants are only established in applicable German regulations, if the water is indicated for certain uses, e.g. irrigation water for agricultural use (AGA 1991) or as bathing waters. Values often only include chemical trace elements (BadeGewVO, 2007; EU-BadeGewRL, 2006).

Fourth purification stage

Further treatment of wastewater in sewage treatment plants (STP) is recently under discussion. Frequently discussed methods are UV disinfection, activated carbon filtration, ozonation. Retention soil filters (RSF) are increasingly attracting attention as an extensive treatment technology for discharged combined waste water.

Methods

A retention soil filter test facility (TAPES 2016) has been set up at a municipal STP in Germany. There are three semi-technical retention soil filters with a filter area of 1.5 m² each. Two of the three filters contain original material from large-scale retention soil filter systems, which are in operation for more than ten years. The filters are fed exclusively with treated waste water from the STP effluent, by means of built-in sampling tubes; it was possible to sample individual filter layers (0.1 m, 0.3 m, 0.75 m) in addition to the inlets and outlets.

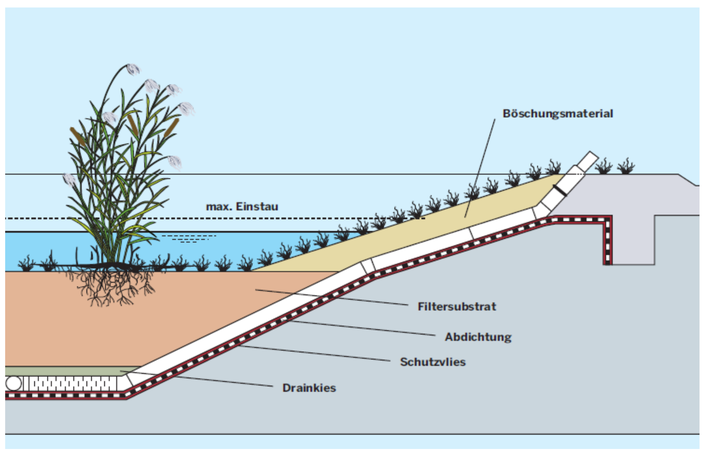


Figure 1:
Graphical representation of a retention soil filter as described in the manual for planning, construction and operation of RSF by the Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North-Rhine-Westphalia. (MKUNLV, 2015)

Methods

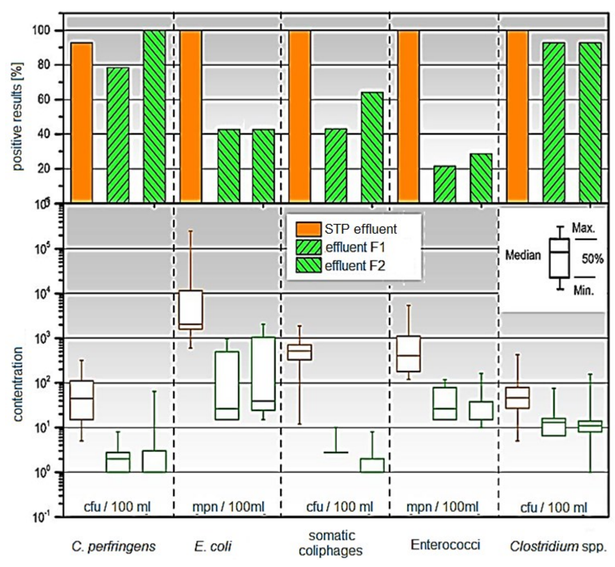
A feeding cycle took 28 hours, followed by a 56 hour dry phase.
The filters were charged with 0.03 L/s/m² wastewater effluent. This corresponds to the recommended reactor drainage of a large-scale RSF according to the RSF manual for the reduction of chemical trace elements (MKULNV 2015). It ensures the establishment of aerobic conditions in the filters during dry phases. The microbiological sampling was executed as random sampling during loading phases. The STP effluent was sampled at as the inlet of the test facility.

Figure 2:
Retention soil filter test facility (TAPES, 2016).
(Picture: Erftverband, Bergheim)

Figure 3:
Aerial view of the STP, the RSF test facility is located at the STP effluent.
(Picture: google image)

Results

For most hygienic-microbiological parameters a reduction of about 1-2 log steps by the RSF could be observed. The analysis within the filter material demonstrate that the first centimeters of the RSFs contribute to the major part of reduction (Fig. 5 and 6).



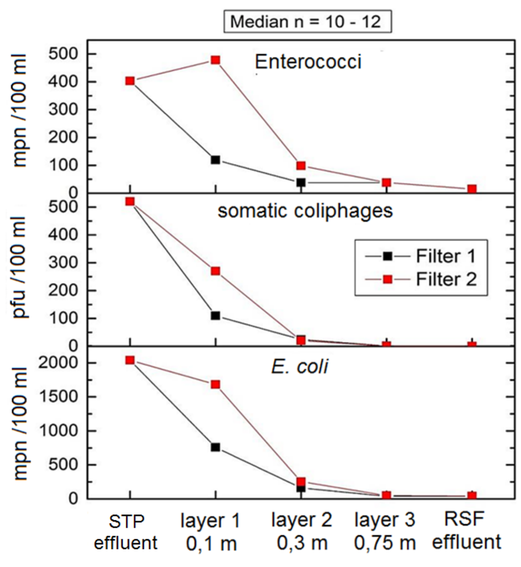


Figure 4:
Concentrations of the analyzed microorganisms at the respective effluents.

Figure 5:
Concentrations of the analyzed microorganisms within the filter layers.

Results

A further reduction was achieved by the filter passage despite the low starting concentration of microorganisms in the STP effluent. The results of the test facility are conform to the results found at large scale filters, in case operation mode are the same (Fig. 6).

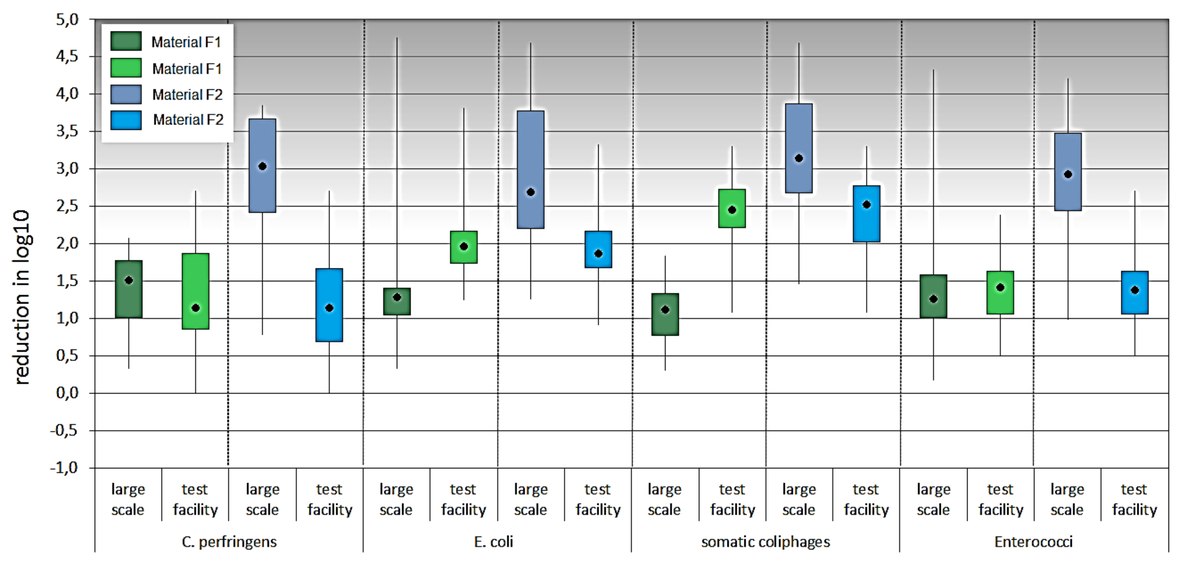


Figure 6:
Comparison of the reduction rates of the two used filter material structures in large scale RSF and used in the test facility (SWIST IV 2012; ReSMo 2016).

Conclusion

RSF achieve similar or even better reduction rates than physical-chemical treatments, which are also dose-dependent in their effect on hygienically relevant microorganisms.

Conclusion

The differences in reductions could be attributed to the different flow rates of the large scale filters and a individual formation of biofilm (F1 = 0,03 L/(s*m^3); F2 =0,015 L/(s*m^3).

References
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