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TECHNICAL BRIEF

Wastewater treatment

Improving treatment of urban effluent

A newly-completed Water Research Commission (WRC) study investigated the use of rhizofiltration as a system to treat urban effluent.

Background

Urban effluent is defined as water of poor quality that flows from human settlements into streams and rivers. This water originates from households without proper sanitation, from stormwater systems carrying effluent from illegal connections and from overflowing sewers or sewage pump stations.

During rainfall, the effect of urban effluent is more pronounced, resulting in an increased concentration of toxic substances and pathogens in water systems.

Rhizofiltration has been proposed as a promising system for the treatment of urban effluent and relies on the root zone of plants with rhizomes to improve the treatment of water in a rough filter. The roots should facilitate microbial activity by providing attachment sites for biofilm growth and introducing oxygen into the rhizosphere.

Ultimately, the process of rhizofiltration should remove, or at least reduce some of the pollutants and potentially pathogenic organisms, and consequently produce cleaner and safer surface water.

Testing of rhizofiltration

A rhizofiltration system differs from constructed wetlands:

- The percolation rate through a rhizofiltration system is an order of magnitude higher than constructed wetlands.
- The area requirement is therefore such that a rhizofiltration system could be constructed parallel to a river or stream, or within the river banks, so that it could perhaps also be referred to as 'constructed riparian zone'.

Three experimental rhizofiltration systems were constructed at wastewater treatment works in Stellenbosch, Daspoort (Pretoria) and Kingsburgh (eThekwini), each with a planted rhizofilter side, and an unplanted control side with the same rock and sand media.

The systems were 1.5 m wide, 1.5 m deep and 7.5 m long. Ultimately, a prototype rhizofilter would be of the same approximate width and depth, but longer. Results could therefore be used to scale up the treatment system. Urban effluent was made up from a mixture of settled sewage and final effluent.

Main results

Results have shown that indicator organisms were generally removed by less than one log reduction, which was less than anticipated. If therefore became clear that to optimise the system, more in-depth knowledge of the interactions between microbiological, physical and chemical processes is needed.

However, COD, total suspended solids and nitrogen were all removed significantly. Rhizofilrtation could therefore be viewed as a first coarse or rough filter in a series of natural process units.

Conclusions

In future, further thought should be given to factors impacting on the performance of the rhizofiltration system. Knowledge of these factors should be obtained from existing literature, as well as data generated during this, and future projects.

Taking cognisance of factors such as microbiological and physico-chemical parameters, seasonal changes, precipitation, presence of rhizomes, plant condition, as well as structure of filter media and tunnelling by plant roots, a functional description of the existing process should be used in designing a conceptual model.

In addition, hypotheses should be formulated explaining the performance of the rhizofiltration system in removing pathogens and excess nutrients from urban runoff. These hypotheses should subsequently be tested in a series of experiments which will include statistical analyses of data obtained while monitoring the different parameters in the experimental rhizofiltration system.

This work should be conducted with the understanding that many complex interactions occur in wetland ecosystems, such as this constructed rhizofiltration system. Where these interactive mechanisms are understood, the filter design and operation could be best optimised for eventual full-scale implementation.

Further reading:
To order the report, *Urban effluent treatment in a rhizofiltration system: Results from experiments at Daspoort, Stellenbosch and Kingsburgh* (**WRC Report No. 2004/1/15**), contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.