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Assessing clogging processes caused by biofilm growth and organic particle accumulation in constructed wetlands using time-lapse electrical resistivity tomography method

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Constructed wetlands for removing pollutants from wastewater in small communities are growing rapidly in many regions of the world. The advantages over conventional mechanical sanitation systems, where land availability is not a limiting factor, are low energy requirements, easy operation and maintenance, low sludge production and cost-effectivity. Nevertheless, with time the cleaning process can result in gradual clogging of the porous layer by suspended solids, bacterial film, chemical precipitates and compaction.

The clogging development causes decrease of hydraulic conductivity, reduced oxygen supply and further leads to a rapid decrease of the treatment performance. As the investment involved in reversing clogging can represent a substantial fraction of the cost of a new system it is essential to assess in advance the evolution of clogging process and detect potential failures in the system. Since there is a lack of experiences for monitoring the functionality of constructed wetlands time-lapse electrical resistivity tomography studies have been conducted at horizontal sub-surface flow municipal wastewater treatment wetlands of Catalonia (Spain).

The results of this research show that electrical resistivity tomography can be a very useful technique for assessing the extent of silting up processes that clog the subsurface flow constructed wetlands through the gravel layer. In the unsaturated zone, the electrical resistivity is greater at the end of the filter, since the pores contains air which is dielectric, while at the beginning of the filter the resistivity is lower because the electrical conduction of organic matter around the mineral grains. Conversely, in the saturated zone, the electrical resistivity is lower at the end of the filter, since pores contain a higher proportion of high ionic conductivity wastewater, while at the beginning of the filter the electrical resistivity is higher because of the lower porosity due to the clogging process.