

## Long term performance of constructed wetlands for tannery wastewater treatment

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Constructed wetlands (CWs) have proven, to different extents, to be an interesting option for several types of industrial wastewaters (Kadlec and Wallace, 2009; Vymazal and Kröpfelová, 2008). They are complex systems that integrate and assemble several components, such as substrate, liners, outlet and inlet structures, microorganisms and plants, playing different roles in the wetland cosmos.

An horizontal subsurface flow CW system, with *Phragmites australis* in expanded clay substrate, was established for tannery wastewater treatment, being in operation for 4 years at different hydraulic retention times. For about 1.5 year there were no relevant gains in terms of organics removal efficiency when comparing the CW unit with an unvegetated control. However, plants were resilient to the conditions imposed, presenting good propagation and development.

In general, the system provided high removal of organics from the tannery wastewater - up to 88% of biochemical oxygen demand (BOD<sub>5</sub>) (from an inlet of 420 to 1300 mg L<sup>-1</sup>) and 92% of chemical oxygen demand (COD) (from an inlet of 808 to 3100 mg L<sup>-1</sup>), and to lower extents nutrient removal (up to 69% of NH<sub>3</sub> from an inlet of 45 to 100 mg L<sup>-1</sup>). The CW proved to tolerate organic loadings up to 780 kg BOD ha<sup>-1</sup>d<sup>-1</sup>. However, if the BOD discharge limits for tannery industry are set as a goal an organic loading of about 210 kg BOD ha<sup>-1</sup> d<sup>-1</sup> should not be exceeded.

Bacterial dynamics within the system was assessed. Numerical analysis of Denaturing Gradient Gel Electrophoresis profiles showed high diversity within the system. No clear relation was established between the hydraulic retention time, time of operation and the bacterial diversity. Toxicity tests were performed to assess the effect of the tannery wastewater at the CW inlet and outlet on *Trifolium pratense* and *Phragmites australis* seed germination. The level of treatment encompassing the CW allowed for a wastewater toxicity decrease that has been revealed by several endpoints measured (germination percentage, shoot length, root elongation and biomass growth).

The system was able to deal with situations commonly found in industrial scenarios, such as fluctuations in the organic loadings and interruptions in the feed, showing robustness and resilience to the imposed conditions.

### References:

- Kadlec, R.H. and Wallace, S. 2009. Treatment Wetlands. 2nd Edition. CRC Press. Taylor & Francis Group. Boca Raton. Florida.
- Vymazal, J. and Kröpfelová, L., 2008. Wastewater treatment in constructed wetlands with horizontal sub-surface flow. Series: Environmental pollution. volume 14. Springer. Netherlands.