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Assessing the efficiency of an unplanted horizontal flow constructed wetland to reduce some emerging organic micropollutants. Preliminary results

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The presence of emerging organic contaminants (EOC) such as pharmaceutical and personal care products, pesticides or antiseptics in wastewater is an increasing concern worldwide due to their potential toxicological effects for humans and other living organisms. Because of their low concentration and persistence their removal using conventional treatment technologies is often incomplete and for this reason there is a growing interest for assessing the efficiency of alternative wastewater treatment technologies such as constructed wetlands (CWs).
CWs are engineered systems for wastewater treatment plant (WWTP) designed to take advantage of many of the same processes that occur in natural wetlands, but within a more controlled environment. CWs are a cost-effective alternative to conventional wastewater treatment plants especially in the context of small communities with less than 2000 people equivalent.
Our study has been conducted at the Verdú WWTP (Lleida, Catalonia, NE Spain). This system has a primary treatment consisting on three septic tanks in parallel with a volume of 50 m3 and three chambers each one. The primary effluent is distributed to four parallel horizontal subsurface flow (HSSF) CWs. Originally the system was planted with common reed (Phragmites australis), but currently after twelve years of service the system show evidences of clogging and then gravel bed was replaced and plants removed. After the HSSF CWs, there are two wastewater stabilization ponds (WSPs) followed by two smaller polishing horizontal HSSF CWs. Excellent overall treatment performance was exhibited on the elimination of conventional water quality parameters (93–98% average removal efficiency for TSS, COD, BOD5 and NTK), and its final effluent proved to comply with existing Spanish guidelines.
Sampling has been conducted along two years at different seasons and examined EOC substances included analgesic and anti-inflammatory drugs (ibuprofen, diclofenac, and naproxene), antidepressants (sertraline, paroxetine, fluoxetine and citalopram) and in addition carbamazepine and triclosan.
For the analysis of water samples, a 200 mL volume was filtrated through 0.45μm nylon filters, acidified, and extracted with Oasis HLB cartridges. The analytes were recovered with 3mL methanol followed by 3 mL acetonitrile. The extract was evaporated under a gentle nitrogen stream, reconstituted with 500 μL MeOH:ACN (1:1) and analyzed by LC/MS/MS.
Highest influent concentrations of studied EOCs in raw wastewater were for naproxene (ranging 2.1 - 24.76μg/L) and iboprufene (ranging 4.2 - 11.74 μg/L) and final effluent concentrations of these same compounds showed high but variable removal efficiencies depending on environmental temperature. Additionally to the reductions within the wetland beds attributed to sorption by particulate matter and biofilm, further reduction was completed at the waste water stabilization ponds by photodegradation.