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Wetland Technology: Practical information on the design and application of treatment wetlands

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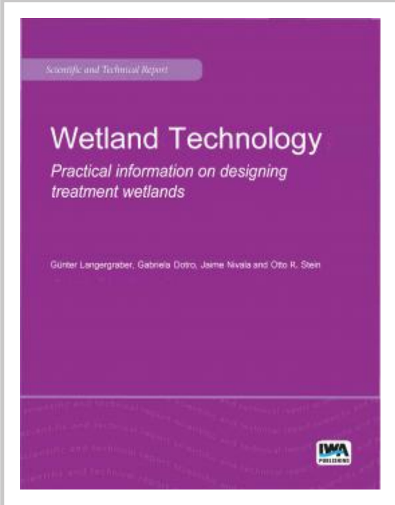

Water quality standards across the world are being re-written to promote healthier ecosystems, ensure safe potable water sources, increased biodiversity, and enhanced ecological functions. Treatment wetlands are used for treating a variety of pollutant waters, including municipal wastewater, agricultural and urban runoff, industrial effluents, and combined sewer overflows, among others. Treatment wetlands are particularly well-suited for sustainable water management because they can cope with variable influent loads, can be constructed of local materials, have low operations and maintenance requirements compared to other treatment technologies, and they can provide additional ecosystem services. The technology has been successfully implemented in both developed and developing countries.

The first IWA Scientific and Technical Report (STR) on Wetland Technology [1] was published in 2000. With the exponential development of the technology since then, the generation of a new STR was facilitated by the IWA Task Group on Mainstreaming Wetland Technology [2]. This STR was conceptualized and written by leading experts in the field. The new report presents the latest technology applications within an innovative planning framework of multi-purpose wetland design. It also includes practical design information collected from over twenty years of experience from practitioners and academics, covering experiments at laboratory and pilot-scale up to full-scale applications.

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6.11 Case study 10 – Bahco treatment wetland for effluent final polishing (Argentina)

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Project Name:	Bahco treatment wetland for final effluent polishing (Argentina)
Location:	Santo Tome, Santa Fe (Argentina)
Wastewater Type:	Metallurgical industry wastewater
Design Flow:	100 m³/day
Completion Date:	In operation since 2002
Technology:	A FWS wetland of 2,000 m^2 was constructed. It is 50 m long, 40 m wide and 0.4-0.5 m deep. A central baffle was constructed, parallel to the flow direction, dividing the wetland into two sections of an equal area and forcing the effluent to flow in "U" form, covering double the distance, resulting in a 5:1 length-wide ratio. The wetland was rendered impermeable with 6 layers of compacted bentonite, in order to achieve a hydraulic conductivity of 10^{-7} m s^{-1}. A layer of 1 m of soil was placed on top of the bentonite layer. Several locally available macrophyte species were planted into the wetland. *Typha domingensis* became the dominant species, covering the total area of the wetland. Hydraulic residence time ranged from 7 to 10 days. The effluent, after passing through the wetland, was led to a 1.5 ha pond in the factory facilities. Phreatic water meters were placed around the wetland to monitor groundwater quality, as a security measure.
Description of project need:	Bahco metallurgical industry for toolmaking needed an effluent final stage treatment. A large land area was available in the factory facilities and costs for maintance and operation of watewater treatment are limiting factors in Argentina. In addition, sewage from the factory also required a final treatment.
Description of project solution:	A FWS wetland was constructed. This type of TW was selected due to the efficiency in metal removal and the low costs for operation and maintenance. Although FWSs requires a large area, this is not a problem in this case. Industrial wastewater containing metals and sewage from the factory are treated together, both after a primary treatment (25 m^3 d^{-1} of sewage + 75 m^3 d^{-1} of industrial wastewater). Sewage improves the ability of macrophytes to take up heavy metals from wastewater.
Special benefits of using TW technology compared to other solutions:	The FWS wetland showed high removal efficiencies of Cr, Ni, Zn, Fe, COD and BOD. Treated effluent meets the Argentinian law limits for discharge. FWS performance improved with wetland maturity. Sediment and macrophyte roots were responsible for the metal removal. Metals were bound to

sediment fractions that would not release them into water while the chemical and environmental conditions of the system were maintained. Although this FWS wetland was faced with accidental events, it was capable of recovering its performance, demonstrating its robustness**.** FWS and the discharge pond provide an additional ecosystem service with a high diversity of macrophytes and have become the habitat for diverse wildlife, such as ducks, geese, coots, coypus, lizards, capybaras, turtles, etc.

Figure 25: Pictures case study - Bahco treatment wetland for effluent final polishing (Argentina).

Table 31: Performance data case study 10: Measured parameters at the inlet and outlet, and removal efficiencies (Average values in mg/L)

Parameter	Inlet	Outlet	% Removal
pH	10.4-12.2	7.9-9.3	-
Conductivity (µS/cm)	3890-8700	1400-2500	-
Fe (mg/L)	0.05-2.54	0.05-0.430	89.4
Cr (mg/L)	0.023-0.204	0.002-0.033	84.7
Zn (mg/L)	0.022-0.070	0.015-0.050	51.2
Ni (mg/L)	0.004-0.101	0.004-0.082	69.5
COD (mg/L)	27.9-154.0	13.9-42.9	74.6
BOD (mg/L)	9.8-30.9	3.0-20.1	73.2

More information: Maine et al. (2017): *Ecological Engineering* 98, 372-377.