

Scientific and Technical Report No. 27

Wetland Technology

*Practical Information on the Design
and Application of Treatment Wetlands*

Edited by Günter Langergraber, Gabriela Dotro,
Jaime Nivala, Anacleto Rizzo and Otto R. Stein



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4.11.4 Citrus wastewater

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Design objectives

The main design objectives of citrus wastewater treatment is to reduce the TSS, organic matter and essential oil concentrations. Citrus processing wastewater (water for fruit, plants, devices and floors washing, cooling, essential oil extraction and peel drying) is characterized by (Koppar & Pullammanappallil, 2013; Zema *et al.*, 2012):

- Seasonal quantitative and qualitative variability;
- Low pH (generally <5);
- High organic matter (COD ranging from about 60–170,000 mg/L);
- High TSS (up to 70,000 mg/L);
- Lack of nutrients (nitrogen and phosphorus);
- High essential oil content (up to 600 mg/L).

Processes required and TW type to be used

Citrus wastewater is usually treated in intensive biological plants, mainly represented by activated sludge systems, which can suffer due to the lack of nutrients and presence of inhibiting compounds (essential oils, polyphenols, etc.). Treatment with a combination of aerobic–anaerobic aerated lagoons and multi-stage wetlands has proved to be a valid alternative to conventional plants thanks to their higher reliability and lower energy requirements.

In aerated lagoons, citrus wastewater is usually stored in large and deep basins with storage capacities of about 50% of the annual volume of produced wastewater and hydraulic retention times longer than 3–6 weeks. Processes in the lagooning treatment include (Andiloro *et al.*, 2013):

- An equalization of quali-quantitative wastewater characteristics;
- A progressive increase of pH due to degradation of organic acids;
- A strong reduction of settleable and suspended solids due to flocculation and sedimentation processes; and
- A reduction of essential oils (EOs) concentration by the dilution effect within the lagoon and the biological degradation.

The treatment of lagoon effluent using a multi-stage wetland (HF–VF–FWS) is necessary to reduce the organic and TSS concentrations with filtration, sedimentation, mineralization and anaerobic degradation processes.

Specific considerations during design and for construction

- *Malfunctioning prevention.* High EO concentrations could inhibit biological processes. For this reason, it is advisable to treat wastewater with high EO concentrations in a separated lagoon to further improve efficiency and reliability through the whole cycle.
- *O&M.* Fertilizer may be applied on wetland surface area to promote macrophyte growth after planting.
- *Monitoring.* It is advisable to perform monitoring of pH values in the lagoon systems to evaluate a possible correction of low pH by lime addition or similar alkaline chemicals.

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 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. 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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