

# Toxicity assessment of high salinity tannery wastewater for the treatment in constructed wetlands

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## INTRODUCTION

Tannery wastewater, a primary effluent from the leather processing industry, is a matter of concern due to the complex nature of the wastewater and the problems associated with adequate treatment before discharge. The potential effects of wastewater discharge into receiving waters can be assessed using various toxicity tests where aquatic and/or terrestrial organisms are exposed to different concentrations of the effluent (Calheiros et al., 2008). The aims of this study were to assess the effects of a saline tannery wastewater on plant development using toxicity tests. We studied the effects on seed germination and seedling growth of the toxicity indicator plant species *Trifolium pratense*, and the effects on growth and development of two wetland species, *Arundo donax* and *Sarcocornia* sp. The toxicities of saline tannery wastewater before and after the wastewater had passed through two types of constructed wetland (CW) systems were evaluated.

## METHODS

Individual plants of *A. donax* and *Sarcocornia* sp. were planted in 20-L pots, in a mixture of sand and expanded clay, and watered with different dilutions of wastewater obtained from the outlet of a conventional wastewater treatment plant (WWTP) treating tannery wastewater. The plant growth and development were followed for up to one year.

Toxicity tests were conducted using seed germination and seedling growth of *T. pratense*, *A. donax* and *Sarcocornia* according to Standard Methods for the Examination of Water and Wastewater (APHA 1998) and the Organisation for Economic Co-operation and Development (OECD, 2006). Different dilutions of wastewater from the inlet (outlet of the WWTP) and outlet of an established CW were used. The tests were conducted in a plant-growth room at a temperature of 18°C.

Wastewater samples were analysed for the following parameters using Standard Methods (APHA 1998): pH, conductivity, chemical oxygen demand (COD), biochemical oxygen demand (BOD<sub>5</sub>), total suspended solids (TSS), ammonium nitrogen (NH<sub>4</sub><sup>+</sup>-N) and Chloride (Cl<sup>-</sup>).

## RESULTS AND DISCUSSION

The wastewater collected from the effluent of the WWTP treating tannery wastewater had high levels of salinity, and concentrations of organic matter, measured as COD, were higher than regulatory discharge permittance levels (Table 1). However, after the WWTP effluent had passed through the CWs the COD concentration was in compliance with the discharge limits.

Both *A. donax* and *Sarcocornia* sp. grew well in pot cultures when watered with different dilutions of the wastewater (up to 100%). However, only the indicator plant species *T. pratense* did germinate when subjected to the wastewater, but not in full-strength (100%) inlet wastewater (Table 2). In wastewater from the outlet of the CWs *T. pratense* germinated at all concentrations.

**Table 1: Characteristics of the tannery wastewater after secondary treatment in a conventional wastewater treatment plant**

Parameters	Average values
pH	8.01
Conductivity (mS/cm)	17.70
TDS (mg/L)	10864
COD (mg/L)	242
BOD <sub>5</sub> (mg/L)	49
TSS (mg/L)	106
NH <sub>4</sub> (mg/L)	1.5
Cl <sup>-</sup> (mg/L)	6200

**Table 2: Seed germination and shoot and root length (mean ± standard deviation) of *Trifolium pratense* after exposure for 23 days to different concentrations of wastewater coming from the constructed wetlands inlet**

Concentration of wastewater	Germination (%)	Shoot length (mm)	Root length (mm)
0%	90±10	43±2	34±5
10%	93±5	44±3	27±5
25%	80±6	42±7	27±1
50%	63±15	15±4	14±2
75%	20±10	13±5	10±4
100%	0	0	0

## CONCLUSIONS

An important characteristic of the wastewater used in this study is the high salinity levels. The wetland plant *A. donax* is abundant at the borders of streams in Mediterranean areas and can tolerate the high temperatures prevailing in under these climatic conditions, and *Sarcocornia* is a halophytic species and occur in high salinity environments. Both *A. donax* and *Sarcocornia* grew well in pots receiving different wastewater concentrations. This indicates that these species may be suitable for use in CWs to treat wastewaters with a high salinity content. In Morocco, *A. donax* has already been used in CWs treating sewage (El Hamouri et al., 2007).

The toxicity of the tannery wastewater were assessed using effects on root and shoot length and seed germination of *T. pratense* when fed with tannery wastewater collected at the inlet and outlet of two established CWs. The wastewater collected from the inlet of CWs inhibited the germination of *T. pratense* to different extents. However, the toxicity of the wastewater decreased after passage through the CW systems planted with *A. donax* and *Sarcocornia*.

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