BIOLOGICAL PROCESSES FOR INDUSTRIAL WASTEWATER TREATMENT – CASE STUDY IN THE LEATHER INDUSTRY

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INTRODUCTION

Industrial activities have led to the build-up of considerable quantities of wastewater in several sites. Biological treatment processes are an attractive to physical and chemical techniques, not least in terms of public acceptability, perceived lower costs in application and lessened disruption to the environment. Among them, phytoremediation is an emerging technology.

The case study here presented is a result of an investigation aimed to optimise the performance of a biological system, based on phytoremediation, to treat the effluent from a Portuguese leather industry. The productive cycle includes a series of chemical treatments, using a large number of chemicals (i.e.: acids, natural or synthetic tannins, oils, salts, etc..) with the intention to transform the animal skin (mainly from cow) in a unalterable, imputrescible product and also with the characteristics imposed by the client. The wastewater treatment from this type of industry has a high organic load and the presence in the most cases of chromium.

This industry has a small wastewater treatment plant with the conventional treatment (equalisation, neutralisation, sedimentation, trickling filters) and two constructed wetlands.

A study was followed to understand the mechanism involved in the constructed wetlands. Chemical analyses were undertaken and toxicity studies. The plants present in the system were identified. The constructed wetlands were redesigned based on EPA-Environmental Protection Agency, recommendations.

A lab-scale unit was design and build up, using a new substrate composed by expanded clay, and using three types of plants, with the intention of optimise the system.

MATERIALS AND METHODS

The chemical parameters analysed were: Biochemical Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), hexavalent and total chromium, sulphate, nitrite, nitrate and total phosphorous, this determinations were based on "Standard Methods for the Examination of Water and Wastewater, 20^{th} Edition, 1998 (S.M.E.W.W.)".

A toxicity study was carried out based on S.M.E.W.W.

The actual constructed wetland was redesigned and a lab-scale wetland is being experimented with three different species of plants based on EPA-Environmental Protection Agency and other recommendations

The plants in the actual system were identified by the Botanical Garden-Porto.

Results

The effluent composition varies with the production process. Data are based on 40 independent sampling for pH, COD, 10 independent sampling for Nitrite, Nitrate, Total phosphorous, hexavalent chromium, Total chromium, Sulphate and BOD_5, and 5 independent sampling for Aluminium and Total solids. This results are shown in table 1.

Table 1: Range of chemical parameters from the wastewater analysed at the entrance of the treatment plant

Parameter	Range
COD (mg/l)	4968 - 1568
BOD_5 (mg/l)	930 - 1180
Cr^{6+} (mg/l)	0 - 1.16
Cr total (mg/l)	0 - 8.03
Total phosphorous (mg/l)	0 - 17.0
Sulphate (mg/l)	936 - 33387
Nitrite (mg/l)	126 - 729
Nitrate (mg/l)	58.5 - 22.2
Aluminium (mg/l)	0 - 2.29
Total solids (mg/l)	144 - 1590
pH (Sorensen)	3.4 - 4.6

The most abundant plants in the actual system were identified: *Canna indica, Stenotaphrum Secundatum, Parietaria vulgaris, Parietaria vulgaris, Dactylis glomerata, Solanum nigrum, Convolvulus sepium, Chenopodium album, Silene gallica, Setaria viridis, Cyperus esculentus, Rumex obtusifolius, Echinochloa crus-galli, Typha latifólia.*
The most common plants are: *Canna indica*

lab-scale unit
Three plants are being study: Phragmites autralis, Typha latifolia and Canna indica.
Four tanks with the dimiensions of: 1,2*1*0,6 m are being used each one with a diferent plant and the fourth as a control.
The substrate is expanded clay - Filtralite

Discussion

The conclusion of the studies of the new design is that the caudal for the actual constructed wetland exceeded their capacity, that's why the treatment is not efficient, so it would be need a greater area to treat this wastewater. What we pretend with the lab-scale is precisely study the best plants, substrate and treatment area for this type of effluent.
In the lab- scale unit, plants are still in a adaptation phase, but the chemical studies to analysed the evolution of the system are going to be carried out soon.
Also a microbiologic study is going to take place.

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