

TREATMENT OF WASTEWATERS CONTAMINATED WITH HEAVY METALS USING AEROBIC GRANULES IN A SEQUENCING BATCH REACTOR



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INTRODUCTION

Aerobic granular sludge is a young technology used for the biological treatment of wastewaters. Aerobic granules have several advantages when compared to conventional activated sludge systems, such as excellent settling properties, high biomass retention, simultaneous COD, N and P removal and ability to deal with high organic loading rates. Recent studies have reported that aerobic granules seem to be more resistant to the presence of toxic components in the wastewater than activated sludge, due to their compact and protective structure. A highly toxic group of environmental contaminants is heavy metals (HM), and their hazardousness is increased due to their persistence. Zinc, a member of this group, is naturally present in water. However, high Zn concentrations are toxic to humans and animals, and specially to plants. The main process of Zn contamination of water is mining, but some industrial activities (galvanic industries, battery production, paint and fertilizer production and application) also represent a focus of contamination to which the best treatment solutions are still yet not always found

OBJECTIVES

Investigate the robustness and performance of a laboratory scale sequencing batch reactor (SBR) towards **intermittent loads of 50 mg Zn L⁻¹** in wastewater (initial COD of **331 mg O₂ L⁻¹** based on acetate).

EXPERIMENTAL SET-UP

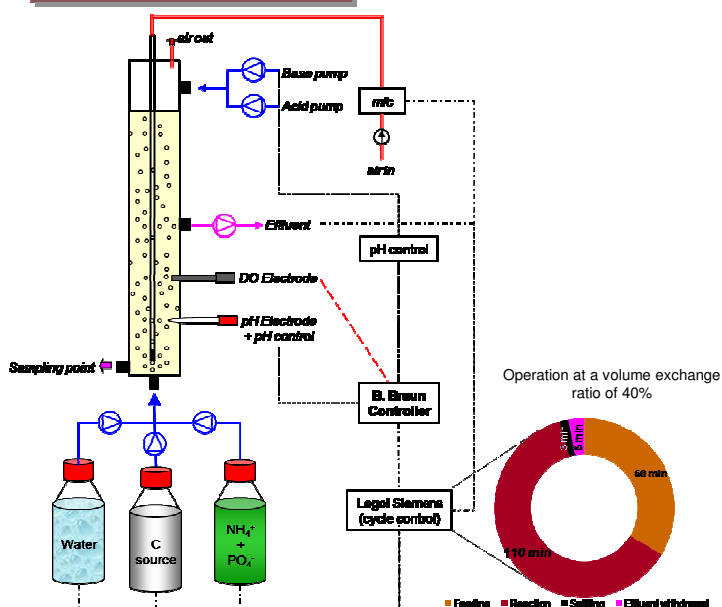
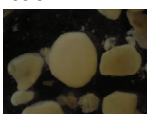


Figure 1 Schematic representation of the SBR and cycle profile.

RESULTS

Samples of biomass were taken and analysed at the beginning and after shock loading of Zn; the appearance of the granules and its Zn contents are shown in the Figures below.



101 mg Zn/kg dry weight

5059 mg Zn/kg dry weight

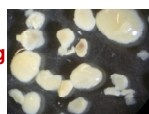


Figure 3: Detail of the granules after 118 cycles (x12)

The high content of metal in the final biomass indicates that **Zn** was probably **removed from the wastewater via accumulation in the granules**.

COD, Zn, phosphates and suspended solids (total and volatile) levels during reactor operation are shown, respectively, in Figures 4, 5, 6 and 7; values shown as “In” represent samples taken after **63 min of operation (feeding stage)** and values shown as “Out” represent the levels for the **outlet of the treatment process**. When Zn contaminated inlet was applied, results of corresponding cycle are shown in **red (Out)** and **pink (In)**.

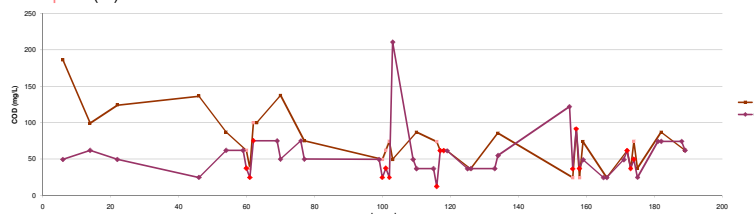


Figure 4: Chemical oxygen demand (COD) levels in the In and Out samples (mg/L)

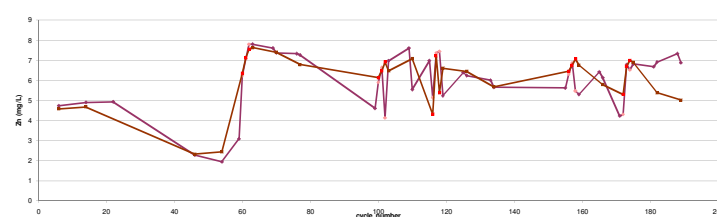


Figure 5: Zn levels in the In and Out samples (mg/L)

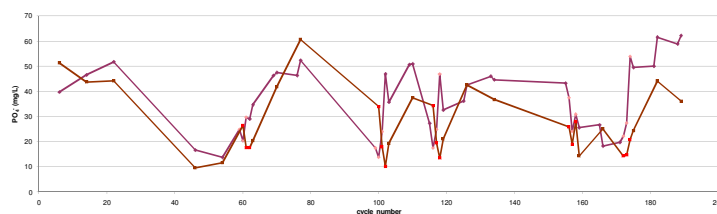


Figure 6: PO₄ levels in the In and Out samples (mg/L)

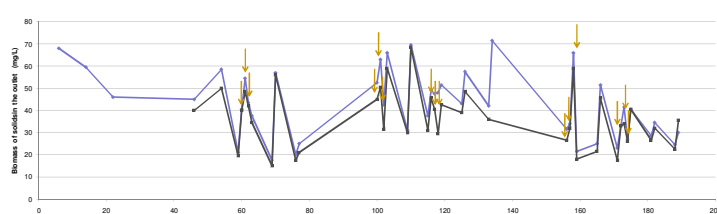


Figure 7 Total and volatile suspended solids (TSS and VSS respectively) in the Out samples (mg/L)

- Generally **COD_{in} > COD_{out}** and any **fluctuations were not related to the application of Zn**; COD levels in the outlet were generally lower than 150mg/L (that in the Portuguese legislation is indicated as the maximum value for the discharge of wastewaters)

- **Zn** levels increased slightly after the first application and had a slender **variation between ca. 4 and 8 mg/L** (below the maximum of 10 mg/L that in the Portuguese legislation is indicated for waters used in agriculture);

- **Zn_{in} ≅ Zn_{out}** demonstrating that the removal and immobilization of Zn in the granules occurred mostly in the feeding stage

- Increases in TSS and VSS occurred after Zn applications with rapid return to the base values; additionally, biomass increased during the experiment (data not shown) indicating a good response of the biomass to the applied stress

FUTURE PROSPECTS

The increase of the levels of Zn in the inlet and the application of other metals, namely Cd and multi-metal contaminations are envisaged.

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