

## PHYTOEXTRACTION OF MERCURY, ARSENIC AND LEAD IN CONSTRUCTED WETLANDS PLANTED WITH *Juncus effusus*, *Typha latifolia* AND *Cyperus alternifolius*

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### Introduction

A lot of heavy metals are sent to the environment as a result of activities associated with mining in Colombia and this has contaminated water resources with the presence of mercury (Hg) in bodies of water near the mining districts of the country (Cordy *et al.*, 2011), arsenic (As) in irrigation districts of important regions with agricultural potential (Alonso *et al.*, 2014), lead (Pb) and cadmium (Cd) in sediments from the Magdalena River, which is one of the source of water and food more important in Colombia with approximately 75 percent of the population concentrated on the sub-basin (Tejeda-Benitez *et al.*, 2016). In order to reduce the levels of metals in the water column, different types and configurations of constructed wetlands have been evaluated, and adsorption, absorption, precipitation and deposition have been accepted as the removal mechanisms for these contaminants. In this study, the accumulation of Hg, As and Pb in plant species *Cyperus alternifolius*, *Typha latifolia* and *Juncus effusus* was used to determine their ability to phytoextraction in constructed wetlands systems.

### Methods

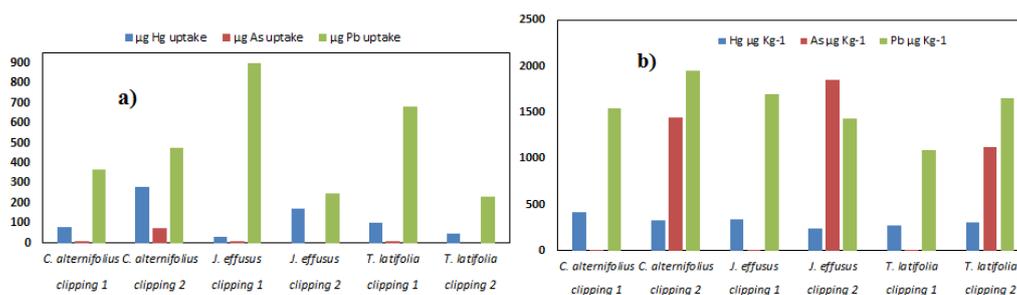
Constructed wetland system with horizontal subsurface flow consisted of rectangular fiberglass containers with dimensions 0.80 x 0.40 x 0.80 meters (length x width x height), filled with gravel (porosity = 0.4225, D60 = 10 mm, D10 = 7.5 mm) to a height of 0.40 m. The mode of operation in batch with hydraulic residence time of 10 days, keeping the level of the water column 5 cm below the gravel. Constructed wetlands were planted with *C. alternifolius*, *T. latifolia* and *J. effusus*, in a greenhouse located at the University of Cordoba, Colombia (8 ° 47 '32.0 "N, 75 ° 51' 41.9" W).

River water doped at a concentration of 500 µg L<sup>-1</sup> of Hg, 500 µg L<sup>-1</sup> of Pb and 100 µg L<sup>-1</sup> of As was used to supply the systems. Two prunings were made during the assay in which all plant material to 10 cm of gravel surface was cut. Water samples to the inlet and outlet of wetlands were evaluated every 10 days, while the accumulation of metals on the support material was determined by monthly intervals, and the accumulation in plant tissue was evaluated every two months coinciding with time when prunings were performed.

Quantification of Hg in the gravel and the plant material was performed by thermal decomposition with a direct mercury analyzer (DMA-80), while the water was performed by cold vapor atomic absorption. Measurements of Pb and As were performed by graphite furnace and hydride generation atomic absorption, respectively.

## Results

In figure 1, accumulation of Hg, Pb and As in plant tissue (a) and substrate (b) after two pruning is observed. Low levels of As accumulated in the pruned tissue (less than 50  $\mu\text{g}$ ) were found, accumulations of Hg were moderate (less than 200  $\mu\text{g}$ ), and Pb levels were higher in all species evaluated (over 400  $\mu\text{g}$ ). The accumulation of Hg, Pb and As in the gravel is shown as the concentration ( $\mu\text{g Kg}^{-1}$ ) of these in figure 2b, with significant differences ( $p < 0.05$ ) between pruning and plant species. Masses removed from the water column was higher than 99% for Pb and Hg, with all plants, however, removals of As were significantly lower ( $p < 0.05$ ), especially in systems planted with *J. effusus*



**Figure 1.** (a) Absorption Hg, Pb and As in the tissue after two pruning activities, (b) concentrations

## Conclusion

The use of macrophytes in order to remove Hg, As and Pb of contaminated water, can mean an accumulation of metal on plant tissue. In this study, the evaluation of three species planted in constructed wetlands showed a low accumulation in plant tissue, ( $\text{As} < \text{Hg} < \text{Pb}$ ), in contrast, an increase in the concentration of the substrate for each metal was observed, which promoted the significant decrease of these in the water column.

## References

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