



# A PHYTOREMEDIATION CASE STUDY - THE UPTAKE OF ZINC, LEAD, ARSENIC AND MERCURY IN PLANT INDIGENOUS TO A PORTUGUESE POLLUTED SITE

Ana P. G. C. Marques<sup>(1)</sup>, António O.S.S. Rangel and Paula M. L. Castro  
 Escola Superior de Biotecnologia, Universidade Católica Portuguesa  
 Rua Dr. António Bernardino de Almeida, 4200-072 Porto, Portugal  
 (1)amarques@mail.esb.ucp.pt

## PHYTOREMEDIATION AS AN OPTION TO THE ESTARREJA POLLUTION PROBLEM

Pollution of the environment has increased dramatically since the birth of the industrial revolution. The off-site migration of contaminants, when not controlled, can cause serious damage on ecosystems and affect public health. These and other reasons bring up the need for new solutions of remediation. Phytoremediation is an emergent technology that uses plants to remove, degrade or immobilize the contaminants, offering a low cost method for soil remediation.

The region of Estarreja is known for its strong industrial complex. For many years, several of these industries have discharged its solid residues in an improvised park in the surrounding area, and conducted its wastewaters into a stream nearby ("Esteiro de Estarreja"). Therefore, the levels of Pb, Zn, As and Hg, in the sediments of this stream, to a depth of 50 cm, are above the limits established by EC Directive 86/278/EC<sup>1</sup>.

Toxic metals contamination, by their long term persistence in the environmental compartments, poses a major environmental and human health risk. Metals are a special environmental problem: they can not be destroyed, so they have to be removed and recycled, which, adding to the proliferous vegetation that, nevertheless, remains on the banks of the stream, brings up phytoremediation as an option for rehabilitation of such sites..

The experience in this field suggests that collecting plant species existing in contaminated soils may be effective for selecting potential plants to use in phytoremediation. The purpose of this study is to identify plant species endemic to this site and to determine their ability to uptake heavy metals. Four plant species - *Phragmites australis* (common reed), *Convolvulus* sp (creeper), *Rubus ulmifolius* (dewberries) and *Solanum nigrum* (black nightshade)-, present in a larger amount, were collected near the former exit of the industrial wastewaters and tested for the content of the above metals.

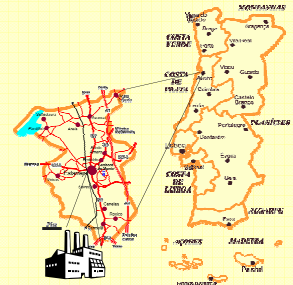


Fig.1: Location of the studied region



Fig.2: General view of the stream



Fig.3: General view of *Solanum nigrum* present in the area



Fig.4: Sample of *Rubus ulmifolius* collected in the area of the stream



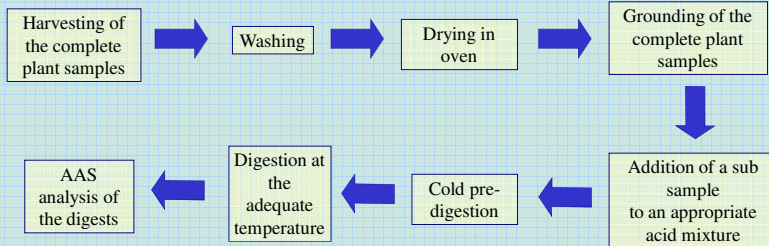
Fig.5: Sample of *Convolvulus* sp. collected in the area of the stream



Fig.6: General view of *Phragmites australis* present in the area

## MATERIALS AND METHODS

The analytical procedure occurred according to the following scheme.



## RESULTS AND CONCLUSIONS

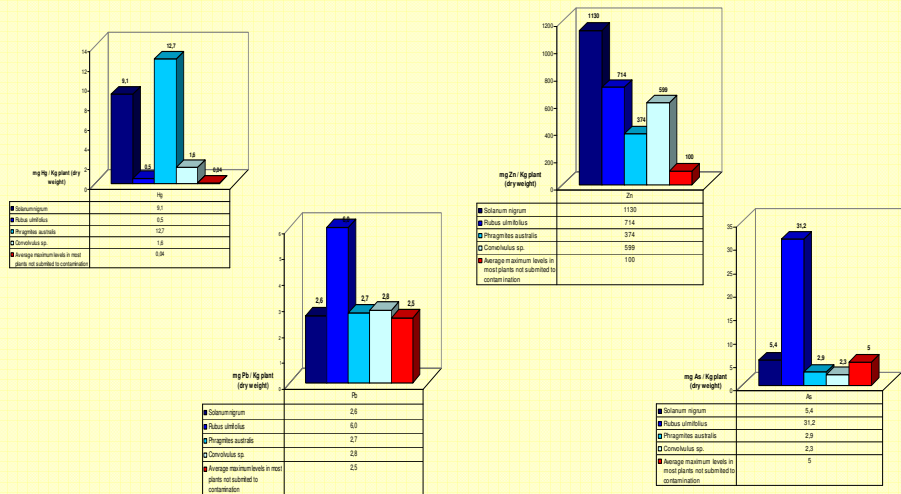
- Pb does not seem to be significantly accumulated in any of the plants.

- However, high levels of Zn were detected in all of them, especially on *S. nigrum* (1130 mg/Kg on a dry weight base).

- *Rubus ulmifolius* had a high level of As (31.2 mg/Kg on a dry weight base), when comparing with literature values for non-contaminated sites<sup>2</sup>.

- The levels for mercury are very fickle, but quite high when comparing with the ones registered for plants indigenous to non-polluted sites<sup>2</sup> and even with other experiments of phytoremediation in contaminated sites. The highest level of Hg was registered for *P. australis* (12.7 mg/Kg on a dry weight base).

Note: Average values are shown



## FUTURE WORK

The next steps of the study will comprise a larger plant sampling area along the stream, with the determination of the metals level in different parts of the selected plants: root, shoot and leaves. It will also include the determination and comparison of total and bioavailable metal levels in the soils adjacent to the plant samples and the determination of the existence of mycorrhizae fungi on the plants root and their effect on metal uptake.

## REFERENCES

- Atkins WS (1999) Environmental Impact Study. IPAMB. No. 595. Lisbon .
- Irwin R.J., M. VanMouwerick, L. Stevens, M.D. Seese and W. Basham (1997) Environmental Contaminants Encyclopedia. National Park Service, Water Resources Division, Fort Collins, Colorado. Distributed within the Federal Government as an Electronic Document

## ACKNOWLEDGMENTS

The authors wish to thank Câmara Municipal de Estarreja for the provision of access to the site. Armando Machado from Instituto Botânico do Porto identified the plant species. Fátima Silva helped performing the FA-AAS, FI-CV-AAS and FI-MH-AAS determinations. Dr. Ildikó Toth helped in the EA-AAS determinations. Ana Marques had the support of an FCT grant SFRH/BD/7030/2001.