

FRACTIONATION AND SPECIATION OF METALS IN LAKES FORMED BY ABANDONED CLAY PITS FROM INDUSTRIAL EFFLUENTS (SANTA GERTRUDES, SÃO PAULO, BRAZIL) USING THE DIFFUSIVE GRADIENT IN THIN FILMS (DGT) TECHNIQUE

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ABSTRACT

Mining activities, particularly tailings and effluents, have caused serious environmental challenges worldwide. In Brazil, clay extraction in the Ceramic District of Santa Gertrudes (CDSG) has resulted in abandoned mines that pose risks to the environment and human health. In the 90s, in the region known as the region of the lakes of Santa Gertrudes, it was discovered that several ceramic industries had contaminated the lakes with toxic metals present in their industrial effluents and waste. In the present study were analyzed the concentrations of Al, Cd, Co, Cu, Mn, Ni, Pb, and Zn in these lakes and used the DGT technique to assess their lability and bioavailability, conferring one of the pioneering studies in order to evaluate the real impact caused by contamination by residues of ceramic production in aquatic environments. A speciation analysis was also performed using MINTEQ software. The results showed the presence of metals associated with ceramic residues in total, dissolved, and labile fractions. Zn, Ni, and Cu were found in labile form as “free” ions and may present a risk in terms of bioavailability. However, most total concentrations were within the limits established by the national environmental agency.

Keywords: Metal speciation; DGT; ceramic wastes; passive sampling; bioavailability.

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INTRODUCTION

In Brazil, on Ceramic District of Santa Gertrudes, in the mid 90's, the Environmental Agency of São Paulo State (CETESB, 2005) detected that ceramic industries were discharging effluents containing toxic metals into the lakes. Previous works evaluated the total and dissolved concentration of metals and this study aimed to infer about the labile form and potential bioavailability of these metals through direct sampling of water, passive sampling by DGT technique, and chemical speciation.

MATERIALS AND METHODS

Five lakes were selected for water sampling and application of DGT devices. For metal content, the samples were analyzed by ICP–MS, for major anions were determined by ion chromatography (IC), while the cations were determined by ICP OES. Speciation modeling was undertaken using the visual MINTEQ v 3.1 software.

RESULTS AND DISCUSSION

Higher concentrations for dissolved and total contents were more pronounced for Al, Cu, Mn and Pb. Considering all fractions, it turns out that the most labile metals present in the lakes area were Zn, Ni and Cu. In terms of bioavailability assessment, it can be suggested that these elements clearly present a potential of high bioavailability at the study site. This finding is due to the verification of the occurrence of their labile fractions and the speciation that indicated their presence in the form of “free” ions in lake waters.

CONCLUSIONS

This study investigated ceramic residues in Santa Gertrudes lakes using water sampling and geochemical modeling. Results showed low concentrations of metals, with Zn, Cu and Ni in labile form presenting possible risks, and further studies on soils, sediments and groundwater are recommended.

REFERENCES

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