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LEAD IMMOBILIZATION BY BRAZILIAN PHOSPHATE ROCK

Nº 272_ Remediation

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ABSTRACT

The worldwide use of heavy metals without previous treatment discard has been the main reason of soil contamination. Therefore the soil works as a sink of heavy metals that can move through the soil and contaminate the groundwater resulting in a public health threat.

Lead in situ immobilization by phosphate rock is a new remediation technology with low costs that has been tested with success to control contaminated soils.

Thus the main objective of this work is to evaluate a remediation technology to control soil lead availabilities using Brazilian phosphate rock (PR).

The experiments are carried out using two representative soils of Brazil (an oxisoil and an ultisol). After two months of incubation (80% field capacity), the contaminated soils (7500 mg Pb/Kg) were mixed with phosphates in 3 different treatments: T1- 100% H_3PO_4, T2- 100% PR and T3- 50% H_3PO_4 + 50 % PR. In order to determine the mobility and bioavailability of lead, sequential extraction using Tessier methodology and toxicity characteristic leaching procedure (TCLP) were performed on soils samples. pH and X-ray diffraction were also evaluated.

The preliminary results suggested that the phosphate treatment had succeeded to control lead-Pb availability in soil.

INTRODUCTION

High concentrations of lead have been observed in several kinds of soil. Therefore, soil sometimes works as a deposit of this toxic element and this element can move into the soil and contaminate the groundwater resulting in a public health threat.

In Brazil, due to the lack of strict laws, and also the lack of information or misinformation of some poor inhabitants, we have many lead-contaminated sites and few perspectives to have this problem solved. Lead *in situ* immobilization by phosphate rock is a new technology that has been tested with success for remediation of contaminated soils (Ma et al, 1995 and Ma and Rao, 1997). Many studies have been done proving that lead phosphates like pyromorphite are formed when Pb-contaminated soil is treated with phosphate compounds (Cao et al, 2003 and Melamed et al, 2003).

The objective of this work is to suggest *in situ* immobilization technology that is less expensive and disruptive to treat lead contaminated soil using Brazilian phosphate rock. The effectiveness will be evaluated as well.

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EXPERIMENTAL

We have chosen two representative soils of Brazil, Argissolo Vermelho-Amarelo (RJ-Ultisol), which is prevalently Kaolinitic (48% clay and 0,3% organic mater), and Latossolo Vermelho (LV-Oxisol) rich in iron oxi-hydroxides (64% clay and 3,4% organic matter).

The soils were contaminated with 7500 mg L^{-1} of lead. After a five-month incubation period, they were mixed with phosphates in 3 different treatments: T1- 100% H_3PO_4, T2- 100% phosphate rock and T3- 50% + H_3PO_4 + 50 % PR. Along this experiment aliquots were withdraw and analyzed by sequential extraction procedure (Tessier et al, 1979), toxicity characteristic leaching procedure (TCLP) and X-ray diffraction (XRD).

RESULTS AND DISCUSSION

Figure 1 shows that in the untreated soils (T0) the lead was associated to the most available fractions (water soluble, exchangeable and carbonated bound). After all treatments the water-soluble fractions decreased. Among the treatments, T1 was the most effective in converting Pb from the most available fraction to the residual fraction, followed by T3 and T2. This can be attributed to the fact that when H_3PO_4 is additioned, the P was ready available for formation of lead phosphate, besides the acidity promotes the dissolution of the carbonate-associated Pb for precipitation of stable pyromorphite (Mavropoulos et al, 2002). Figure 2 shows that the acid applications reduced the pH to near 2.5 for both soils while for the mixture acid-phosphate rock the pH was near to 3.2. Considering those first results, obtained 60 days after the application of P, it is probable that the time was too short to permit a best efficiency of the phosphate rock.

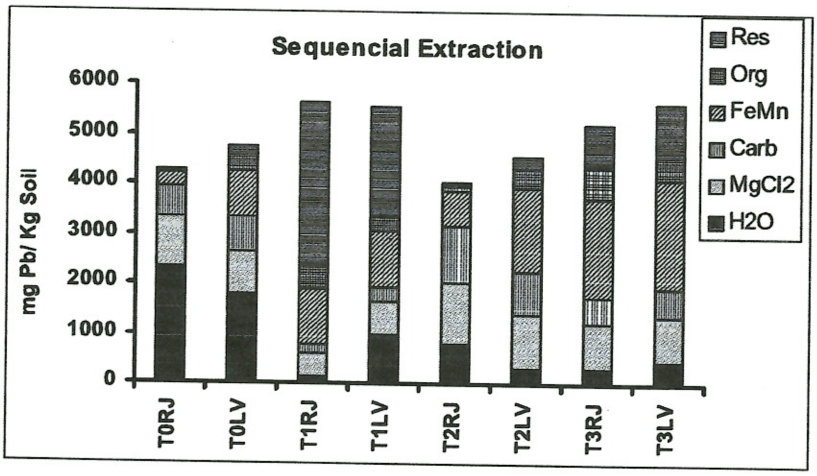

Figure 1: Pb concentrations in each fraction.

From the results for TCLP (Figure 3) and Sequential Extraction (Figure 1) we can observe that the more Pb content in the residual fractions, less Pb is extractable by TCLP. Thus, we can conclude that all treatments were efficient to reduce the lead bioavailability.

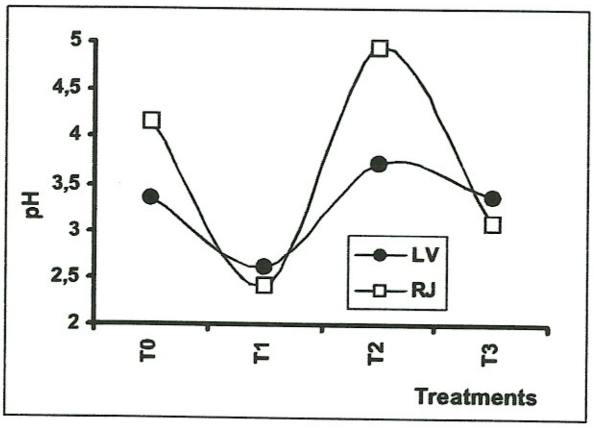

Figure 2: pH values of T0, T1, T2 and T3 for LV and RJ soils.

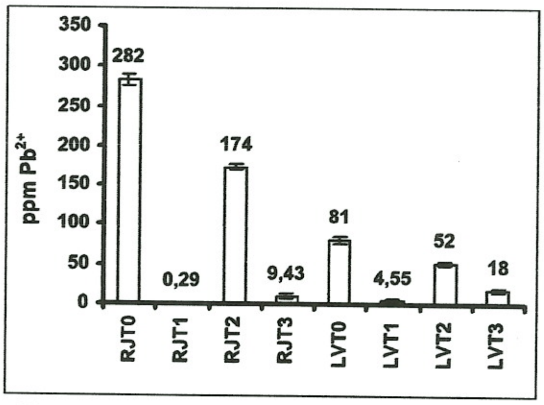

Figure 3: Toxicity Characteristic Leaching Procedure (TCLP).

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