SOIL SYSTEM STUDIES

Flues, M.; Camargo, I.M.C.; Ortiz, N.; Fungaro, D.A.

Centro de Química e Meio Ambiente - IPEN/CNEN-SP

Keywords: soils; diagnostic; risk; remediation.

The purpose of this group is to develop methods for metal soil contamination diagnoses, risk assessment and remediation techniques. These studies are carried out on a main project "Evaluation of the contamination of the soil nearby a coal fired power plant (CFPP)", with the partnership of the "Companhia Carbonífera Cambuí" (PR) and (Funding agency: FAPESP).

Metal soil contamination diagnosis

During this period diagnostic methods were established for determination of total [by x-ray fluorescence wavelength dispersive (WD-XRFS)], partial [by HNO₃ conc digestion EPA 3051; ICP-OES], bioavailable [by EDTA-NH₄ extraction; ICP-OES], and exchangeable [by Ca(NO₃)₂ extraction] concentration of metals in soil. The combination of these four techniques allows the evaluation of the soil contamination and the availability of metals in soils for plants and groundwater.

This methodology was applied to various ongoing projects. In our main project entitled "Evaluation of the contamination of the soil nearby a coal fired power plant (CFPP)", we found that the operation of CFPP for 35 years without a proper filter caused an increase in the natural soil metal concentration within 1-km of the facility. Higher concentrations were observed for Zn, Cd and As. The high levels of As and its pronounced toxicity make it into a critical pollutant in this case, especially in the prevalent wind direction (NW) (FIG.1).

In the second project, "Influence of highways in the soil quality in subtropical forest, State Park of Cantareira" (partnership-Instituto Florestal (SP)), no influence from the highways in this metals concentration in soil could be observed. According to studies the usual metals pollutants due to highways influences are Pb, Cd, Zn and Ba.

Another project studied the mobility of toxic metals in soil, leached from household batteries (alkaline and zinc-carbon) disposed on 40cm soil column. Zn and Mn showed a high tendency to be retained at the upper layer of the soil column, due to the soil characteristic and the high pH level of the batteries.

Risk Assessment

The values of the partial Arsenic concentrations in soil determined in our main project are above the intervention values adopted by CETESB. Such higher values can cause human health risk. The risk calculated for this metal by the C-Soil (risk evaluation model) showed a risk value of 10-4. This value can be associated with higher risk for cancer as currently adopted by CETESB.



FIGURE 1 - Arsenic soil concentration in the prevalent wind direction (NW).

Remediation

Materials with low particle size have been studied as non conventional adsorber (like magnetite and zeolite) to remove toxic compounds from aqueous solutions and contaminated clay and soil suspensions.

The study of low cost magnetic adsorber material to fix and remove toxic solubilized compounds from lixiviated products of waste deposits or the direct discharge in soil surface, a possibility to promote low cost remediation technology to recover a "abandoned" or without a defined responsible contaminated area. (Funding agency: FAPESP)

The effect of synthetic zeolites on stabilizing soil contaminated with metallic ions using 0.01 mol L⁻¹ CaCl₂ leaching solution in batch experiments was investigated. The zeolitic materials are synthesized from coal ashes by hydrothermal treatment with alkaline solution. Zinc leaching was reduced by more than 80% using a minimum of 10% additive. The additive enhances the sorption capacity of the soil and reduces leaching. The higher cation exchange capacity of the zeolite/soil mixtures and higher pH is responsible for stabilizing metals in soil.

A partnership was established in 2003 with International Center of Science and High Technology-ICS and United Nations for Industrial Development-UNIDO to the development of Darts-Decision Aid for Remediation Technology Selection, a managing system to help decision makers in selecting the most appropriate technology for a specific contaminated site.