



The Fractionation and Speciation of Arsenic in a Contaminated Soil

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INTRODUCTION

As fractionation and speciation in polluted soil were studied and a remediation technique was tested. In terms of speciation, we discovered that As (V) predominates over As(III), with organic arsenic accounting for more than 40% of total arsenic. The fractionation of As was studied using two consecutive extraction methods and a poor mobility was discovered. Then we investigated the feasibility of extracting As from soil using phosphoric acid and cleaning washing effluents with montmorillonite sorption. The extraction and adsorption effectiveness of Cr, Cu, Fe, Mn, Ni, Pb and Zn, whose total concentrations and fractionation in the soil are described here, were also examined.

Arsenic pollution is a potentially major problem all around the planet. The US Environmental Protection Agency (EPA) ranks inorganic arsenic as the number one toxin on its list of prioritized pollutants. This element is found in surface and subterranean water bodies, as well as numerous foods and soils. Copper smelting, coal combustion, herbicide, pesticide and rodenticide use, as well as waste incineration, steel/glass manufacture and pressurized wood processing, are all primary As anthropogenic sources. Weathering of primary and secondary As-bearing minerals produces naturally occurring As in soils.

DESCRIPTION

The toxicity of arsenic-containing compounds to mammals varies according to their valence state, form (inorganic or organic), physical state (gas, solution or powder) and factors such as solubility, particle size, rates of absorption and elimination and the presence of impurities that may facilitate the element's intake into organisms. According to recent study, arsenic in drinking water may be more hazardous than previously thought.

The US limit for arsenic in drinking water was reduced from 50 ppb to 10 ppb (130 nM) in 2001, while the EU limit was recently reduced from 10 to 5 ppb. Chronic arsenic exposure, particularly inorganic arsenite (As(III)) and arsenate (As(V)), has been linked to a variety of physiological problems and malignancies.

Arsenic can be found in the terrestrial and aquatic environments in the form of inorganic As(III) and As(V) compounds (H_3AsO_3 , $HAsO_4^{2-}$, $H_2AsO_4^-$) as well as organic forms (Mono Methylarsonic Acid, MMA, Di Methyl Arsonic acid, DMA). The proportions of As(III) and As(V) in soil change with redox conditions and pH. Arsenate exists as monovalent or bivalent anions in the usual pH range of soils, whereas arsenite is uncharged until the pH is extremely alkaline. Organic As species like as MMA and DMA can result from bio methylation.

Arsenic toxicity is determined by its chemical form: Inorganic species are more toxic than organic species, with arsenite being more toxic than arsenate. As a result, both quantitative determination and speciation of this element are required. Furthermore, it is now widely accepted that, in addition to total concentrations, the mobility and availability of arsenic and other potentially hazardous elements must be evaluated in order to understand their behavior in soils and avoid potential harmful dangers. The availability of inorganic pollutants (such as As, Zn, Pb and Cd) is affected by physical, chemical and biological factors such as pH, soil texture, microbial activity and the presence of cultivars.

Extraction using appropriate reagents is frequently used to investigate it. In the case of metals, single extractions with water, diluted acetic acid, neutral salts and Ethylene Di Amine Tetra Acetic Acid (EDTA) are commonly used to assess the proportion of metals weakly bound to the matrix

as the preliminary indication of possible pollutant release into the environment or uptake by plants. Furthermore, sequential extractions are performed using reagents of varying chemical characteristics in order to detect fractions of elements with varying labilities.

Several sequential extractions schemes for metals have been developed; in particular Tessier's scheme is one of the most widely used and it has been extensively applied to aquatic sediments, soils and sludges.

While there are numerous sequential extraction strategies for cations, only a small amount of work has been done on oxyanions such as As. Some extraction strategies, which are primarily based on P extraction procedures, recognize the anionic behavior of As in soils and sediments. Remediation of As-contaminated sites has become an essential concern in order to protect animal and human health. Arsenic-contaminated soils have occasionally been

dug and disposed of as hazardous waste in controlled type landfills.

Containment, capping and solidification/stabilization have also been used to treat contaminated soils. However, because of the possibility of arsenic leaking from treated soils, these procedures do not sufficiently mitigate environmental concerns.

CONCLUSIONS

- The A.C.N.A. soil contains high concentrations of arsenic and of the considered metals (Cr, Cu, Fe, Mn, Ni, Pb and Zn), as a consequence of the former industrial activities in the site.
- The results of the speciation scheme showed that As(V) slightly prevails over As(III) whereas more than 40% of total arsenic is in organic form, probably because the soil is heavily polluted by organic substances.