West Africa InterPore Chapter Meeting & Symposium

Report of Contributions

Contribution ID: **2** Type: **not specified**

Use of zero valent iron nanoparticle for in situ chemical reduction of hexavalent chromium in contaminated soils

Friday, 27 October 2023 10:30 (15 minutes)

In the environment, chromium is mainly found in two oxidation states: Cr(VI) and Cr(III). Cr(VI) is relatively mobile in the environment and is extremely toxic, mutagenic [1,2], teratogenic [3] and carcinogenic [4,5]. In contrast, Cr(III) exhibits relatively low toxicity [6] and is a necessary nutrient for humans and animals [7,8]. Therefore, the reduction of Cr(VI) to Cr(III) is environmentally friendly, and can be used for the remediation of Cr(VI) contaminated sites. Thus, the in situ chemical reduction of hexavalent chromium by the nanoparticle of zero valent iron (nZVI) in contaminated soils near a galvanic zone in northern Italy characterized by an excessive presence of Cr(VI) and other heavy metals has made the object of our research. Experiments were performed on soil samples collected from an industrial site where a nickel contamination, caused by a long-term productive activity, was also verified. The influence of reducing agents amount with respect to chromium content and the effectiveness of deoxygenation of the slurry were discussed. The soil was fully characterized before and after each test, and sequential extractions were performed to assess chemico-physical modifications and evaluate metals mobility induced by washing. Results show that the reducing agent successfully lowered the amount of Cr(VI) in the soil below the threshold allowed by Italian Environmental Regulation for industrial reuse. Cr(VI) reduction by colloidal nZVI proved to be effective: the civil reuse of soil [Cr(VI) < 2 mg/kg] was only achieved using colloidal nZVI within 60 min adopting a nZVI/Cr(VI)) molar ratio of 30. The reducing treatment resulted in an increase in the amount of chromium in the oxide–hydroxide fraction,thus confirming a mechanism of chromium-iron hydroxides precipitation. In addition, a decrease of nickel (Ni) and lead (Pb) content in soil was also observed when acidic conditions were established.
Keywords: Hexavalent chromium, Contaminated soil, Chemical reduction, Nano zero-valent iron.
Références

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Primary author: Mr GUEYE, Mouhamadou Thierno (Cheikh Anta Diop University of Dakar)

Presenter: Mr GUEYE, Mouhamadou Thierno (Cheikh Anta Diop University of Dakar)

Contribution ID: **3** Type: **not specified**

Phosphates from the Kotchari deposit, Burkina Faso.

Friday, 27 October 2023 14:15 (20 minutes)

Samples of phosphorites from different occurrences of the Kotchari deposits, Burkina Faso, were studied. They are phosphorites that are fine-grained with small quantities of clay. The chemical analyses by XRF indicate a CaO content of 35.98 to 41.33 wt%. and a P2O5 contents of 26.85 to 30.75 wt%.

The XRD patterns shows that the major phases are Carbonate-Fluorapatite (Francolite), Hydroxyapatite and alpha-Quartz. They coexist with minor phases that are Wavellite and Maricite. Small quantities of phyllosilicates, smectite and Illite, are also detected. The quantities of phases were obtained by Rietveld refinements with the MAUD software, using reference phases from usual databases. The obtained fits are satisfactorily, although the significant occurrence of peaks overlapping and broadening. In this study, quantitative Rietveld analysis has shown its effectiveness in accurately identifying and quantifying the mineralogical composition of phosphorites.

FTIR analyses further validate the identification of mineral phases. They show typical bands from phosphates groups in structures. Bands of carbonates groups are also detected and a band is correlated with the occurrence of structural F in Francolite. The relative Intensities of some bands from P-O bonds are related to the crystallinity index of main phosphate minerals. Values of the crystallinity index are slightly above the medium values, that is correlated with the partial substitution of carbonate groups in phosphate crystallographic sites, and with the occurrence of structural Fluor ions. The economic importance of the Kotchari deposits for soil fertilization in agriculture is recognized, and they were the subject of successive mapping and survey works. However, the medium crystallinity index is a disadvantage since it reduces the kinetic of phosphor assimilation in agricultural soils, needing complementary researches.

Primary authors: Dr SORGHO, Brahima (Professor); Mr ZOUNGRANA, Jean baptiste (PhD)

Co-author: Prof. BLANCHART, Philippe (Professor)

Presenter: Mr ZOUNGRANA, Jean baptiste (PhD)

Contribution ID: **4** Type: **not specified**

Simulation of water transfers at the Soil-Plant-Atmosphere interface in unsaturated soil

Atmospheric conditions such as air temperature, wind speed, evapotranspiration, and relative humidity have an influence on the surface soil moisture. This communication presents a modelling of water transfers in unsaturated soil, as well as the numerical simulation of these transfers. The model takes into account the physical and hydrodynamic characteristics of unsaturated soils that interact with atmospheric parameters.
Literature research has contributed to the development of a physical model and a mathematical model based on mass and energy transfers as well as the thermodynamics of irreversible processes. The results obtained allow for predicting, using a computational code, the spatiotemporal evolution of soil water content based on atmospheric conditions and physical characteristics (density, porosity, particle size) as well as soil hydrodynamics (desorption isotherm, soil-water characteristic curve, saturated permeability, unsaturated permeability). Understanding the evolution of this water content over time and space is important data that contributes to optimal plant water management.

Keywords: Atmospheric conditions, Surface soil moisture, mathematical modelling, simulation, hydrodynamics

Primary author: Mrs GANDEMA/DA, Fatoumata (Laboratoire de Matériaux, Héliophysique et Environnement (LAMHE))

Co-authors: Dr OUÉDRAOGO, François (Laboratoire de Matériaux, Héliophysique et Environnement (LAMHE)); Dr TARPILGA, Moussa Dit Corneille (Laboratoire de Matériaux, Héliophysique et Environnement (LAMHE)); Prof. NAON, Bétaboalé (Laboratoire de Matériaux, Héliophysique et Environnement (LAMHE))

Presenter: Mrs GANDEMA/DA, Fatoumata (Laboratoire de Matériaux, Héliophysique et Environnement (LAMHE))

Contribution ID: **5** Type: **not specified**

Evolution of stresses and deformations in a road embankment in unsaturated, low-swelling soil subjected to hydro-mechanical pressures

We present simulation results of the evolution of stresses and strains in an unsaturated low-swell soil road embankment subjected to hydro-mechanical pressures using the finite element code CODE_BRIGHT. We assume that this bitumen-bearing backfill follows the Barcelona thermo-elasto-plastic model (BBM-TEP). This model describes the thermo-hydro-mechanical (THM) behavior of unsaturated fine soils based on variations in net stress and suction. Using this simulation, the analysis focuses on the collapse of road structures, generally due to the poor quality of the materials used, but also to natural phenomena such as capillary rise, and anthropogenic phenomena such as overloading. The paper shows that imbibition by upwelling induces an increase in the degree of saturation of over 50% in the lower part of the structure, and deformations of up to ten centimetres in amplitude when surcharges are added to the embankment surface. This paper also highlights the behavior of unsaturated soils, such as the decrease in void index with increasing effective stress or suction, and the increase in suction with increasing effective stress.

Keywords: low-swelling soil, road fill, hydro-mechanical pressures, stresses, deformations.

Primary author: Mr SOUMAILA, GANDEMA (Université Josep KI ZERBO Ouagadougou)

Co-author: Dr BAWINDSOM KEBRÉ, Marcel (Université Joseph Ki Zerbo ·Physique)

Presenter: Mr SOUMAILA, GANDEMA (Université Josep KI ZERBO Ouagadougou)

Contribution ID: **6** Type: **not specified**

Comparative assessment of the concentration of radioactive materials in natural sources relevant to mining activities in the Niger Republic using two measurement techniques

Abstract \n\nNaturally Occurring Radioactive Materials (NORMs) have always been present in a variety of concentrations in every part of the earth's mantle and in the tissue of every living being.\nNatural radioactivity can be found almost everywhere; in soil, public water supplies, soil and atmosphere. NORMs give rise to a measurable exposure to human beings. In the present study, soil samples and water sample were collected from two different sites in Niger Republic COMINAK and SOMAIR. The soil samples have been analysed using high resolution gamma-ray spectrometry and Neutron Activation Analysis. Water samples were analysed using high-resolution gamma-ray spectrometry only. From the measured gamma-ray spectra, the activity concentrations were determined for two series (238U and 232Th) and one non-series (40K) radio nuclides. The activity concentrations of 238-U and 232-Th were determined from the average concentration of nuclides [Pb-214 (295.2keV; 19.20%), Pb-214(351.9keV; 37.10%), Bi-214 (609.3keV; 46.90%), Bi-214 (1120.2keV; 15.04%) and Bi-214 (1764.49 keV; 15.90%)] and [Pb-212 (238.6keV; 43.6%), Pb-212 (300.09 keV; 3.18%), and Ac-228 (911.2keV; 25.8%), Ac-228 (968.9keV; 15.8%), Ac-228 (338.32 keV; 11.27%)] respectively. The activity concentrations of 40-K were determined directly by measurement of the gamma-ray transitions at 1460.8keV (100%).\nThe obtained results confirm that one of the samples (soil COMINAK) is more radioactive than the soil SOMAIR samples and the results are going closer for the two techniques NMGS and TNAA except the thorium in the soil sample for SOMAIR.\n\n\n\nKeywords:\nNORM, Gamma-ray spectrometry, Neutron Activation, Uranium mining

Contribution ID: **7** Type: **not specified**

Mining Problems in Africa

Friday, 27 October 2023 10:15 (15 minutes)

Mining activities in Africa have significant environmental and health concern due to the improper disposal of mining waste. This waste contaminates soil, water and ecosystems posing a serious risk to biodiversity and local communities. To tackle these challenges, innovative waste management strategies are needed. In this study, heavy metals like copper, lead, and zinc from mining waste materials were bio-leach in a controlled bioreactors with Bacillus subtilis as metal binding bacteria. The pH, temperature, nutrient levels, and metal concentrations were determined by constant sampling. The measured concentration of heavy metals, was lead (Pb), copper (Cu), and zinc (Zn), with concentrations measured at 26.4 mg/kg, 8.55 mg/kg, and 91.79 mg/kg, respectively. The pH of the bioleaching system was adjusted and maintained at an acidic level (around pH 2) to create optimal conditions for the selected bioleaching microorganisms. The temperature was within 30℃ to 50℃, ensuring that the temperature favored microbial activity with adequate oxygen supply was maintained throughout the experiment, supporting the microbial oxidation of metal sulfides. Over the course of the bioleaching process, regular sampling and analysis of the leachate indicated a substantial reduction in heavy metal concentrations. After 30 days of bioleaching, Pb concentrations decreased to 24.74 mg/kg, Cu concentrations decreased to 6.62 mg/kg, and Zn concentrations decreased to 86.88 mg/kg. Analysis of the solid residues revealed significant changes in mineralogy and chemical composition. X-ray diffraction (XRD) analysis showed the transformation of metal sulfides into less insoluble forms. In conclusion, the bioleaching experiment successfully reduced heavy metal concentrations in mining waste, making it a promising method for managing and remediating contaminated mining sites. This study suggests that further optimization and scale-up of this process could lead to environmentally friendly solutions for mining waste management.

Contribution ID: **8** Type: **not specified**

Enhancing Precipitation Data Accuracy in Burkina Faso: A Comparative Analysis of Satellite-Based Products and Ground Measurements, with Soil Moisture Integration

Friday, 27 October 2023 10:45 (15 minutes)

Primary author: Dr BAWINDSOM KEBRÉ, Marcel (Université Joseph Ki Zerbo ·Physique)

Presenter: Dr BAWINDSOM KEBRÉ, Marcel (Université Joseph Ki Zerbo ·Physique)

Contribution ID: **9** Type: **not specified**

Advanced Characterization of Disordered Mesoporous Solids

Friday, 27 October 2023 13:30 (15 minutes)

Primary author: Dr ENNINFUL, Henry (Universität Leipzig)

Co-authors: Prof. ENKE, Dirk (Universität Leipzig); Prof. VALIULLIN, Rustem (Universität Leipzig)

Presenter: Dr ENNINFUL, Henry (Universität Leipzig)

Contribution ID: **10** Type: **not specified**

Fluid Phase Equilibria in Geometrically Disordered Mesoporous Materials

Friday, 27 October 2023 13:45 (15 minutes)

Primary author: Dr ENNINFUL, Henry (Universität Leipzig)

Presenter: Dr ENNINFUL, Henry (Universität Leipzig)

Contribution ID: **11** Type: **not specified**

Energy recovery from low-value agricultural residues for biochar production during cooking using a multifunction family oven

Friday, 27 October 2023 14:00 (15 minutes)

Presenter: Dr TARPILGA, Moussa dit Corneille (Laboratoire de Matériaux, Héliophysique et Environnement (LAMHE))