Soil Science Divisions

Ammomnium Adsorption Characteristics of a Clinoptilolite from Horri, Khorassan Province, Ilam, A. M. AY
d., J. L. BOETTGER, I. D. DULLEY, and P. T. ROLOSA, Utah State University.

Clinoptilolite has an unusually high selectivity for ammonium (NH4). The mineralogy and NH4 adsorption properties of different size fractions (>75µm, 20-50µm, 2-20µm) of a Clinoptilolite from northern Utah were characterized. Mineralogical, chemical, and physical properties were determined using x-ray diffraction, thermal analysis, SEM, and wet chemical techniques. Total cation-exchange capacity and the cation exchange of internal and external sites were determined using various ion exchange methods. Competition between NH4 and K for exchange sites on the zeolite were determined using batch equilibrium experiments. Kinetics of NH4 adsorption of the various size fractions were determined using a stirred column flow system. Results indicate that the rate of NH4 adsorption and NH4 selectivity are controlled by particle size.

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Dispersibility of Fly Ash-Amended Southeastern U.S. Soils.
R. L. ARNOLD and W. P. MILLER, University of Georgia. Water dispersible clay has been used as an index of soil crusting, runoff, and erosion, and is consistently high in many soils of the southeastern U.S. Soil amendments, relatively high rates of fly ash, proposed as a disposal option for coal-fired power plants, may alter soil dispersibility by its effect on exchangeable cations, soil solution salt content, and pH. In this study, a range of Southeastern U.S. soils was treated with fly ash materials, and effects on clay dispersion determined using a water dispersion test. For alkaline ashes, pH increased especially on sandy soils, as did dispersion. On clayey soils amended with alkaline ash, there was less increase in pH and less effect on dispersion, especially at 5% addition rates, whereas soluble soil increased caused reflocculation. Acidic ashes had little effect on dispersion, but the increased cations in non-dispersive soils by alkaline ashes. Increased dispersion of ash amended soils may enhance crusting, runoff, and erosion, and should be considered in management of these soils.

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Environmental Applications of Scanning Probe Microscopy.

Over the last decade, the sequential development of scanning tunneling microscopy and atomic force microscopy, i.e., scanning probe microscopy (SPM), provides the capability to image the morphology of many surfaces at the nanoscale level. The application of these techniques to date has focused mainly on the study of surfaces of semiconductors and complex biological macromolecules and not on the surfaces of environmental materials. In this presentation, we briefly review recent research results on the development of a combined electrochemical and microscopy apparatus (ECM), the techniques currently used in sample preparation, and the problems and imaging fine-divisional particles at the nanoscale range. We present images that demonstrate the capability of SPM to define not only the surfaces but also the surface morphologies of phyllolitites and of humic substances at different morphology scales, but also the morphologies of reaction products resulting from biogeochemical transformation processes. We also review the development of the capability of ECM to enhance understanding of real-time metal reduction interactions in the presence of environmental surfaces and to improve subsequent evaluations of the reversibility of such reactions.

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Soil Environmental Chemistry Technology Development.
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Soil management of plant essential chemical elements has changed over the last half century from applications of Lechler's "Theory of Minimums" to correct the most limiting plant nutrients. Maximum crop yields and maintenance of water quality requires simultaneous nutrient evaluation of many elements. Working with Dr. M. P. Low on sol-gel transformations in clay, we found that for equal concentrations of Na, plant uptake and Na activities were greater in soils than in gel. This direct evidence for the validity of using chemical potential or ionic activity data to predict plant availability of ions led to investigations to measure bioavailability of trace metals that pose threats to the food chain from land application of sewage sludges. The chelator EDTA was chosen for use to render a simultaneous "small exchange" for metals in soils. From the chosen combinations of DTPA, CaCl2, MgCl2, KCl, and pH combined with results for plant experiments at that plant uptake of an ion, relates closely to pH the negative logarithms of the activity of ion, I, associated with DTPA with modifications for the labile availability (RAST). This investigation led to the Baker Soil Science (BSS) that is now under consideration as an official ASTM method. For lettuce grown at varying distances from a zinc smelter: RA = 1.49 [I]BSS - 0.49 [I]RAST + 11.48 [I]RAST - 25.2 pBSS - R2 = 0.87.

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Root Bloomage To Assess Acid Soil Chemical Constraints for Alfalfa and Snapbeans. V. C. BALIGAR, R. J. WRIGHT, K. D. RITCHIE, B. K. WOOLUM, and R. B. CLARK, USDA, ARS, Beltsville, MD.

Root biosassay technique has shown to be a reliable method to assess chemical constraints of acid soil to cereal root growth. Ten limed and unlimed acid soils were used in root biossary to assess chemical constraints on root growth of Al-tolerant (T) and Al-nontolerant (NT) cultivars of alfalfa and snapbeans. In both species/cultivars, the average long axis root length (ARL) was negatively correlated with exchangeable and extractable Al, Al saturation, concentration and activities of soil solution Al, activities of Al(10OH)24 and Al(10OH)3. The ARL in both species/cultivars gave positive relationships with soil and soil solution pH, exchangeable Ca, Ba saturation, exchangeable bases, and soil solution cation ratios. Aluminum extracted by 0.01 M CaCl2 or 1 N KCl was a better predictor of phytotoxic Al than soil solution Al detected by aluminon and pyrocatechol violet. Root biosassay appears to assess the acid soil chemical constraints and inter- and intra-specific differences in alfalfa and snapbeans.

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The study of sorption-desorption kinetics of pesticides on soil is typically done on a time scale of hours. Batch equilibrium techniques, which are relatively simple methods, can be used to measure the rate of sorption occurring in the first few hours. However, flow techniques are often superior because they typically yield results which give more accurate predictions of behavior under field conditions. The development of a flow technique using a differential volume reactor packed with soil to measure sorption-desorption kinetics of herbicides on soils will be presented. Uniform dispersion of soil into the soil column by use of radial channels in the reactor makes this an improved flow method over those previously described.

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Fractal theory postulates that geological materials possess a noninteger, fractal dimension describing length/surface/volume relations and particle size distribution. Over 10,000 sand grains, composed largely of quartz, separated from several horizons of soils derived from glacial outwash were examined for their fractal dimension using a new method of image analysis. The development of a flow technique using a differential volume reactor packed with soil to measure sorption-desorption kinetics of herbicides on soils will be presented. Uniform dispersion of soil into the soil column by use of radial channels in the reactor makes this an improved flow method over those previously described.

Chemical Estimation of Electron Lability in Field Soils. R. M. Bartlett**, Univ. of Vermont, and Bruce James, Univ. of Maryland.

Because measured redox potentials are confusingly mixed in heterogeneous non-equilibrium soils and because most oxidized species of nitrogen, sulfur, manganese, iron, carbon, and hydrogen are not electroactive, meaningful thermodynamic interpretation of electrode potentials measured in aerobic soils are