
The modern view of colloidal behavior in water is based on the DLVO theory that hypothesizes strictly repulsive long-range interactions among like-charged particles. However, numerous phenomena of colloidal behavior cannot be explained by this theory. An alternative description of the fundamental forces involved in the formation of dispersions was outlined in 1938 by Langmuir, and supported theoretically and experimentally much later by Sverdrup and others. The long-range attractive force, and explains phenomena such as transitions between ordered (nematic) and disordered phases of colloidal suspensions. Langmuir’s theory describes static systems, whereas clay particles in suspension are in dynamic (Brownian) motion and subject to interparticle steric hindrance, which influence the properties of dispersions and gels. The colloid theory of Onsager explains the existence of apparent long-range interparticle forces and ordering in dispersions by steric effects rather than requiring long-range forces. It is suggested that a better description of colloid behavior can be reached by replacing the DLVO model with the Langmuir and Onsager perspectives, i.e., by a model in which a long-range attractive electrostatic force is counteracted by osmotic repulsion, and colloid effects explain apparent anomalies in suspension properties such as viscosity.

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Kinetic and Speciation of Ni Sorption on Beidellite. F.S. GILLOT, University of Delaware;... D.L. SPARKS.

Spectroscopic studies have shown that Ni sorption on Al-bearing clay minerals can result in the formation of a Ni-Al layered double hydroxide (LDH). Spectroscopic factors may influence the formation of these phases on clay minerals, including reaction pH and the presence of other layers in the mineral. In investigations of these phases, we have performed Ni sorption studies on beidellite, an aluminosilicate with tetrahedral substitution. Nickel sorption kinetics on beidellite were monitored at pH 6, 6.8, and 7.5 from 15 min to 21 days. At pH 6, extended x-ray absorption fine structure (EXAFS) spectroscopy showed the absence of LDH phases after 24 h. At pH 7.5 and a reaction time of 75 minutes, the predominant phase was Ni-Al hydroxide with a small degree of Ni substitution in the structure, as indicated by the Ni-Ni bond distance. After 24 h, a Ni-Al LDH phase was observed as indicated by the decrease in the Ni-Ni bond distance (NiNi=3.06 Å, this value being indicative of a LDH phase). To support these findings, we will present diffuse reflectance spectroscopy (DRS) results since this technique is sensitive to the presence of Al in the LDH structure. Specifically, one observes a shift of the Ni (nu) band from 14,180 cm⁻¹ to 15,300 cm⁻¹ when an Al-bearing precursor is used, indicating that the presence of Al plays an important role in the kinetics and mechanisms of Ni sorption on Al-bearing phyllosilicate.

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Partition coefficients for polar organic compounds on clay minerals are needed in order to develop better predictive models. Column methods traditionally used to determine partition coefficients for these analytes on clay minerals have been limited due to the low permeability of the clay mineral matrix. In this work, a novel technique was developed using subcritical water chromatography with on-line electrospray ionization-mobility spectrometry (ESI-MS) for probing clay mineral systems. Subcritical water, attained through increased temperature and pressure, allows for a less viscous and more permeable mobile phase in our chromatographic system. Pure clay minerals were used as the stationary phase in small volume columns (e.g. less than 1 mL) and polar herbicide analyses were introduced into the column using a flow-through injection. Initial partition coefficient information gained from kaolinite columns show good agreement between published Kd values for the herbicides prometryn and terbutryn. Future work is planned using traditional methods in order to compare our results to those obtained in whole soils where multiple factors control the sorption of polar organic compounds.

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Implication of Biosolids on Adsorption and Desorption of Cd in Soils. Z. LI, J.A. RYAN, USEPA.

Adsorption isotherms for soils from long-term biosolids-field experiments and their inorganic fractions were obtained by equilibration of the samples with cadmium nitrate. The samples with adsorbed Cd were then equilibrated with a 0.01 M calcium nitrate (pH 6) to obtain desorbed Cd. Results showed that biosolids increased Cd adsorption and the increased adsorption associated with biosolids application was not limited to the organic matter addition from biosolids, rather the biosolids application also altered the adsorptive properties of the inorganic fraction. Further, biosolids-amended soils exhibited a greater retention for Cd than the control soil. The control soil released 100% of the adsorbed Cd into solution, whereas the biosolids amended soils released 60% to 70% of the adsorbed Cd, and biosolids released only 15% of the adsorbed Cd. Desorption of Cd by the inorganic fraction followed a similar trend. Fractionation of Cd indicated that adsorbed Cd was mainly in the exchangeable fraction for the control, while a great portion of adsorbed Cd was in the closely-bound fraction for the biosolids-amended soils. Biosolids increases adsorption of Cd on soils, and Cd binding with biosolids-amended soils is stronger than that with the control. The strong affinity of Cd on biosolids-amended soils was not dependent upon the organic matter associated with biosolids.

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Ferrrous Iron Treatments of Soils Contaminated with Arsenic-Containing Wood Preserving Solutions. T.J. MOORE, AERL; C.M. RIGHTMIRE, AERL; R.K. VEMPATI, Prodey, Inc.

This poster discusses results of efforts to remediate As-contaminated soil from a former timber-treating plant. The Rocker Timber Framing Site is located along Silver Bow Creek approximately 7 miles west of the Butte Mining District, MT, USA. Contaminated soil resulted in the groundwater plumes that contained up to 2.5 mg L⁻¹ As, predominantly as As(V). The objective of this study was to evaluate the effectiveness of Fe(II) treatment with and without CaCO₃ for chemical stabilization of As-contaminated soils. Laboratory treatability studies were conducted on samples of saturated (AS1) and vadose zone (AV1) soils. Initial concentrations of total As in AS1 and AV1 soils were 683 and 4814 mg kg⁻¹, respectively. Water-soluble As concentrations were 15.4 and 554 mg L⁻¹, respectively. Batch equilibration was performed by adding 10 g of soil into 20 vessels and adding increasing amounts of FeSO₄. Treatability studies were run with and without CaCO₃. Solution concentrations of As in both the soils decreased significantly; and the effect was more dramatic in CaCO₃-treated soil amendment. Sequential extraction of treated soils illustrated that As was relatively stable. Non-CaCO₃ treated soils developed acidity at high FeSO₄ treatments and released other metals contained in the soils, e.g., Cu and Zn. The CaCO₃ treatment was effective in preventing metal dissolution.

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Comparison of Sequential Extraction Procedures for Partitioning of Arsenic on Soil and Sediment Minerals. C.J. PAUL, R.G. FORD, USEPA.

The objective of this study was to identify the mineral phases which control arsenic mobility and provide a better understanding of the complex hydrogeochemical processes controlling the transport, fate and exposure of arsenic in aquatic environments. Processes that can remove arsenic from the solution phase include adsorption onto clays and other minerals or co-precipitation, most often with iron oxides or sulfides. Single step and sequential extractions were performed to determine the amount of arsenic associated with different iron phases. Arsenic associated phases were categorized as 1) feas-