Geophysical Research Abstracts
Vol. 18, EGU2016-13003, 2016
EGU General Assembly 2016

Kinetics of biosorption of hazardous metals by green soil supplement

Hemlata Bagla and Roshan Khilnani
K. C. College, Department of Nuclear and Radiochemistry, Mumbai, India (hemabagla@gmail.com)

The process of metal retention by soil may include ion exchange, adsorption and precipitation. These reaction mechanisms have been defined through fitting the data into different equilibrium and kinetic models. The natural organic matter in soil consists of various fractions like macro-organic material, plant residues, soil biomass and stable humus. Most of the organic matter is dominated with large amount of humic substances. Humic fractions in soil are known to have indirect and direct effects on plant growth and crop production. Humic substances increase the cation exchange capacity, providing a strong buffer capacity to resist sudden drastic chemical changes in soil which enhance soil fertility and environmental quality. The cation-humic interactions exert control on the reactivity of the cation, influencing its bioavailability in the soil system. The investigation of metal concentrations adsorbed with time can be useful to estimate the metal bioavailability in soil. Understanding how metals interact and compete for adsorption sites is of great interest to those involved in environmental remediation. Cow Dung is bio-organic, complex, polymorphic fecal matter of the bovine species, enriched with 'Humic acid' (HA), 'Fulvic Acid', etc. The HA in Cow Dung has been successfully extracted using neutralization reaction and its presence was confirmed by comparison with FTIR spectra of standard HA (IHSS). Since, dry Cow dung powder (DCP) is being added as a soil supplement to enhance the quality of soil, it is important to understand the kinetics associated with it.

This work reports kinetic studies of various toxic and hazardous elements such as Cr(III), Cr(VI), Sr(II), Cd(II), Hg(II) and Co(II) adsorption by dry Cow dung powder. Kinetic experiments demonstrated rapid metal uptake. The Kinetic biosorption data were obtained by Batch experiments to explore the rate of biosorption by DCP at optimum parameters and varying the time of reaction from 1–30 min. The dynamics of the biosorption in terms of the order of the rate constant were studied applying different kinetic models such as First order, Second order, Pseudo-first order, Pseudo-second order and the intra particle diffusion model. But among these models best fitting model was Lagergren pseudo second order model. The correlation coefficients of all the elements have R2 values close to 1 indicating the applicability of pseudo second order model to the present system. The applicability of this model suggested that biosorption of elements under study, on DCP was based on chemical interactions between metals and active sites of biosorbent.

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