

Contents in Context

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Cadmium—A Priority Pollutant

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Cadmium is an environmental contaminant with consequences for human health and the maintenance of biodiversity in affected ecosystems. This essay provides an overview of recent developments in the field, highlighting the timeliness of a broader, ecosystem-based approach to cadmium research.

The Protective Role of Dietary Calcium Against Cadmium Uptake and Toxicity in Freshwater Fish: an Important Role for the Stomach

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Contamination of freshwater ecosystems by cadmium is of increasing concern with accumulation and toxicity in aquatic animals occurring through both waterborne and dietary routes. Increases in water calcium ('hardness') levels protect against waterborne uptake. Physiological research on freshwater fish has demonstrated that this occurs because cadmium moves through the calcium uptake pathway at the gills. Surprisingly, elevated dietary calcium also protects against waterborne exposure by down-regulating the calcium uptake pathway at the gills, and against dietary exposure by reducing cadmium uptake through the gastrointestinal tract. In both cases, the stomach is the critical site of action.

Subcellular Partitioning and the Prediction of Cadmium Toxicity to Aquatic Organisms

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There is a considerable interest in predicting cadmium (Cd) toxicity to aquatic organisms, largely stemming from environmental Cd pollution and the need to establish water quality criteria to protect aquatic ecosystems. Chemistry-orientated models have been developed over the past decades to predict Cd toxicity, focusing on identifying which Cd forms are present in the aquatic environment, and investigating their interaction with the biological site of action. Understanding the cellular fates of Cd may provide an alternative method to predict Cd toxicity, as the complex cellular interactions of Cd within the organisms can, in this way, be addressed.

Thermodynamic and Kinetic Aspects on the Biosorption of Cadmium by Low Cost

Materials: A Review

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The toxicity of cadmium in waters can be decreased by using a wide variety of low-cost biomaterials. A number of such investigations are reviewed here and the models used to describe the process of biosorption discussed. Fundamental investigations that probe the thermodynamics and kinetics of the biosorption process are essential for a strong understanding of all biosorption processes. Areas that still need addressing are highlighted, in particular with regard to cadmium biosorption, some models for which are ready to be tested in pilot plants.

An Agar Gel Technique Demonstrates Diffusion Limitations to Cadmium Uptake by Higher Plants

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Toxic effects of trace metals are often related to the amount of metal that is internalized by the organism. Uptake of metals by biota is usually predicted with equilibrium models, which assume that transport of the metal from the solution to the biosurface does not limit uptake. In this study, uptake of cadmium by higher plants is shown to be limited by the transport of the free ions to the root surface under a range of conditions.

Do Exudates Affect Cadmium Speciation and Bioavailability to the Rhizobacterium

Sinorhizobium meliloti?

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Heavy metals such as cadmium can affect soil microbes and consequently perturb important nutrient cycles resulting in deterioration of the soil fertility. Conversely, soil bacteria might influence cadmium cycling, bioavailability and ecotoxicity by producing exudates such as proteins, polysaccharides and siderophores. These substances are shown to form complexes with cadmium, decreasing the free concentration of cadmium in soil solutions.

A Field Investigation of Solubility and Food Chain Accumulation of Biosolid-Cadmium Across Diverse Soil Types

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Cadmium is a potentially toxic metal that is an unwanted contaminant in urban wastewater biosolids, and has the potential to accumulate through the food chain. This study found that the accumulation of cadmium in wheat grain from application of urban biosolids to soils in Australia was less than when cadmium was applied in a water-soluble form. The critical soil cadmium concentration, above which wheat grain would exceed food contaminant limits, could also be simply predicted using soil pH (acidity) and clay content.

Rate of Cd^{2+} Release from Dissolved Fulvic Acid and Natural Dissolved Organic Carbon as a Function of UV_B Dose

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Atmospheric ozone depletion results in an increase of UV_B radiation impinging on the surface waters of aquatic ecosystems. Radiative absorption by dissolved humic substances results in bleaching and photochemical decomposition to smaller molecular weight dissolved components. With respect to the lake biota, this can reduce the effectiveness of a natural absorptive protective UV screen, as well as enrich the surface waters with microbial substrates and previously bound biologically unavailable trace metals. In controlled experiments using low-level Cd-contaminated dissolved fulvic acids and natural lakewater dissolved organic carbon, we examine the relationship between increasing UV dose and cadmium free-ion (Cd^{2+}) concentrations.

Log D_{OW} : Key to Understanding and Regulating Wastewater-Derived Contaminants

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Worldwide, surface water is a source of drinking water and is a recipient of wastewater effluents and pollutants. Many surface water bodies undergo a natural, cyclical, diurnal variation in pH between 7 and 9. Most drinking water and wastewater treatment in the United States is conducted between pH 7 and 8. The pH of water undergoing treatment processes directly impacts the ratio of nonionized to ionized chemical form(s) present, which in turn impacts the success rate of contaminant removal. Many organic wastewater-derived contaminants are very water soluble at pH 7–8 and are inadequately treated.

Mobile Voltammetric Laboratory for Ship-Board and Shore-Based Analyses of Dissolved Copper

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Determining concentrations of dissolved copper in seawater is of interest, because copper (i) affects the health of aquatic biota, and (ii) has the potential to act as a water mass tracer, a marker which can be used to follow the movement of water in oceans. In situ analyses of copper and other trace metals in seawater have become increasingly popular, because they circumvent potential contamination problems associated with sample collection, storage, and transport to off-site analysis locations. This paper describes the assembly of a low-cost, mobile laboratory utilizing adsorptive cathodic stripping voltammetry (AdCSV) for the real-time determination of total dissolved copper in surface waters.