

## Speciation and Distribution of Metallic Pollutants in Various Compartment of Lakes and Coastal Environment

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### Speciation and Distribution of Metallic Pollutants

Migration and bioavailability of metal ion in the aquatic environment depends on both its physical and chemical speciation. In general physical speciation is governed by its complexation with macromolecule like humic and fulvic acid whereas chemical speciation depends on many factors like pH, Eh, ionic strength, etc. The speciation of metals in the aquatic environment (which is composed of both aqueous and solid phases and includes rivers, lakes, estuaries, shelf seas, deep oceans, ice sheets, glaciers, groundwater and ground-ice) are of importance since its biological importance to living organism depends on its physical and chemical state.

Trace metal elements are mainly transported to the marine environment by rivers through estuaries. The magnitude of metal inputs to the marine environment, then, depends on their levels in the river waters and on the physico-chemical processes that take place in the estuaries. In world, the coastline extends to about few lakhs of km of which the mainland accounts for 40-70 % depending on the local geographical pattern. Since many major world cities lie on the coastal plain, it is estimated that more population in the world will move into coastal plains in this century and so the industrialization in these areas will increase. Such developments make these water bodies prone to a wide range of contaminants. Therefore, proper understanding of the spatial and temporal distribution of metallic pollutants in various compartment of aquatic environment is essential.

Metal ions in a water bodies is transported by the water flow (advection processes) and its concentration is altered by the simultaneous influence of turbulent diffusion processes. Metal ion can also interact with suspended sediments and bottom depositions. The metal ions transfer between the water and suspended sediments can be described as an adsorption-desorption process. The transfer between water and the upper layer of the bottom deposition is determined by adsorption-desorption and diffusion processes. The sedimentation of contaminated suspended sediments and the bottom erosion are also important pathways of the "water column-bottom" exchange of metal ions. Once the metal ions comes in the aquatic phase they tries to form complexes with natural inorganic (carbonate, hydroxide, sulfate etc)

and organic (humic substances) ligands depending on the various prevailing physicochemical characteristics. The stability of these complexes varies with the pH and other parameters (Eh & Ionic strength) of the aquatic environment. For example, compounds with hydroxides are common at high pHs. Some metal may get associated with colloids and remains in the soluble fraction. Identification & isolation of these metal associated colloids is one of the challenging tasks as they cannot be removed by conventional filtration processes. Therefore to isolate them one has to use techniques like ultra-filtration, reverse osmosis & coagulation. Various scientists around the globe are working hard to invent new methodology supported by low cost technology to isolate and remove these dissolved contaminants from potable water and other aquatic environments.

Ultra-filtration is commonly used technique to for determination of metal ions in soluble form which is further distributed into different colloidal fractions depending on the adsorption and chelation of trace metals by dissolved ( $\text{DOC} < 0.45 \mu\text{m}$ ) and colloidal organic carbon (500 Dalton [ $0.5 \text{ kD}$ ]  $< \text{DOC} < 0.45 \mu\text{m}$ ). In dissolved state most trace elements are present in different physico-chemical forms varying from low molecular mass (LMM) ions or molecules, via hydrolysis products and polymers to colloids and pseudo-colloids, or incorporated in inorganic or organic particles. The borderline between categories is difficult to establish and transformation among different categories occurs gradually. As natural waters are dynamic systems, the distribution of species exhibits spatial and temporal variations due to ongoing transformation processes. Owing to sorption on available surfaces, complexation with available inorganic as well as organic naturally occurring ligands, polymerisation and aggregation of colloids, LMM species are transformed to High Molecular Mass (HMM) species. While desorption, dissolution, displacement and dispersion processes may mobilise LMM species from surfaces of solids. In order to understand the various process of complexation, different speciation models are developed. These speciation models should not only focus on the distribution of species but also utilise kinetic information on transformation processes influencing the speciation. Information on kinetics and reversibility of transformation processes is, however, scarce in literature.