

# Chemical speciation of metals in estuarine sediments and their accumulation in estuarine benthic organisms

Comprehensive abstract of the thesis is elucidated as follows

**Chapter 1** covers the general introduction about metals with special reference to the estuarine ecosystem. Toxic metal behavior and the importance of metal speciation over total metal concentration are described. This chapter also describes the environmental factors influencing metal speciation and bioavailability in estuarine sediments and how the metal from the sediment interact with the aquatic flora and fauna. This chapter provides the current state of knowledge on the anthropogenic increase of metal input in estuaries, the use of different organisms to understand metal bioaccumulation from sediment, applications of chemical extraction techniques to determine metal bioavailability. The knowledge gaps based on the current state of knowledge are put forward. The objectives of this research work are set in this context demonstrating that metal speciation in estuarine sediment determines bioavailability and bioaccumulation in the associated biota. The review of the anthropogenic increase of metal in estuarine sediments of India was published in Marine Pollution Bulletin Journal (Chakraborty et al., 2014).

**Chapter 2** presents detailed information about the study area, the procedure of sampling, storage of sediment and tissue of biological organisms, laboratory procedure, analytic techniques used in understanding the metal speciation, and the statistical analysis used for the results obtained.

**Chapter 3** presents the speciation of Cu and Ni from the mangrove sediments and its bioaccumulation in the mangrove roots from Divar Island, Mandovi estuary. This chapter presents that Fe/Mn oxyhydroxide and organic phases in the sediments are the major hosting phases for Ni and Cu and control its bioavailability in the mangrove system. Further, this study has proposed a plausible pathway of Cu and Ni uptake by mangrove roots from the mangrove sediments. This work was published in Marine Pollution Bulletin Journal (Chakraborty et al., 2014 and 2015)

**Chapter 4** describes Cd speciation from the estuarine sediments and its bioaccumulation in the edible oyster (*Magallana* sp.). Total Cd concentration in water, suspended particulate matter (SPM) and sediment was determined. This chapter presents the geochemical fractionation study of bulk and finer (< 63  $\mu\text{m}$ ) estuarine sediments to estimate Cd bioavailability (chemically). To understand the Cd bioaccumulation, estimation of Cd concentration in the soft tissues of oysters was carried out. This chapter also describes the relationship between Cd in water, SPM, and bulk sediments with bioaccumulated Cd in oyster (*Magallana* sp.). This chapter concludes that bioaccumulation of Cd in the oyster increases with the increasing association of Cd in water-soluble, carbonate/bicarbonate, and exchangeable forms in the finer particles of the sediments.

**Chapter 5** deals with the Kinetic speciation of Cd in the estuarine sediments and its bioaccumulation in the edible oyster (*Magallana* sp.). This chapter presents the Kinetic speciation study of Cd in finer fraction of (< 63  $\mu\text{m}$ ) estuarine sediments and its relationship with Cd accumulation in soft tissues of the edible oyster. The chapter suggests that sedimentary Cd, especially Cd in the finer fraction (< 63  $\mu\text{m}$ ) of the sediment could be responsible for Cd availability from the environment (as reported in Chapter 4) and may probably enter into the oyster system through its filter-feeding behavior and bioaccumulated in their soft tissues.

**Chapter 6** presents the role of environmental factors (such as pH, salinity, Temperature) in governing the chemical speciation of Cu and Cd and its bioaccumulation. This chapter describes the effect of

overlying water column pH on Cu distribution in different geochemical phases of the sediment. It also describes the influence of salinity on Cd accumulation in oyster tissue.

**Chapter 7** summarizes the results and provides the overall conclusion of the thesis.