

**The influence of surface active substances on metal ions (Cd,Cu,Pb,In and Tl) speciation in NaCl solutions**

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The speciation of metal ions in natural waters is governed by the presence of inorganic and organic ligands as well as particulate matter (BRULAND, 1983). A part of organic matter with surface active properties is very important as it influences the distribution between heavy metal species in the bulk of solution as well as their fractionation at different phase boundaries (COSOVIC, 1990).

Electrochemical methods (differential pulse voltammetry and alternating current voltammetry in phase and out of phase) were used to study adsorption processes at the electrode/solution interface as well as complexation in the solution.

General scheme of the applied methodology is presented in Fig.1. For studying reduction processes the electrode is pretreated at the potential more positive than the standard redox potential by formation of the adsorbed layer of organic molecules. After the absorption period the reduction process of metal ion is measured at the modified electrode surface during the scan in negative direction. For studying oxidation processes the electrode is kept at the potential more negative than standard redox potential while simultaneously adsorption of organic molecules and reduction of metal ions occur. After the accumulation time period the reoxidation of metal is measured during the potential scan in positive direction. However this process takes place at the electrode which is modified by the adsorbed layer of organic molecules.

The comparison is made between the influence of humic acid(HA) and nonionic surfactant Triton-X-100 on the cathodic and/or anodic waves (PLAVSIC and COSOVIC, 1991; PLAVSIC *et al.*, 1991) of heavy metal ions (Cu,Cd,Pb,In and Tl). Triton-X-100 is a typical neutral nonionic surface active substance which absorbs strongly at the mercury electrode and affects charge transfer processes at the electrode/electrolyte interface. HA is at the same time surface active and complexing agent. The complexing capacities of HA for Cu,Cd,Pb,In and Tl were measured in the bulk of solution by direct titration with heavy metal ion (PLAVSIC *et al.*, 1982).

At lower pH values (pH=1.6) the cathodic and anodic waves of metal ions (Cd,Pb,In) decrease with increasing the amount of SAS (both HA and Triton-X-100) and follow the adsorption isotherm of the particular SAS. The same behaviour was also observed for Triton-X-100 at higher pH values (pH=6.4). At higher pH values the predominant reaction of Cd, Pb and In with HA will be complexation reaction, usually enhanced at the electrode surface due to the higher amount of HA present in the interfacial region.

The hydrophobic/hydrophilic effects and dehydration step of aqua complexes of metal ion play an important role in the interfacial region especially for indium ions.

For Cu the predominant reaction with HA will be complexation even at low pH values (pH=1.6) Tl<sup>+</sup>ions are not influenced by the presence of SAS due to a small size and a low tendency for forming complexes .

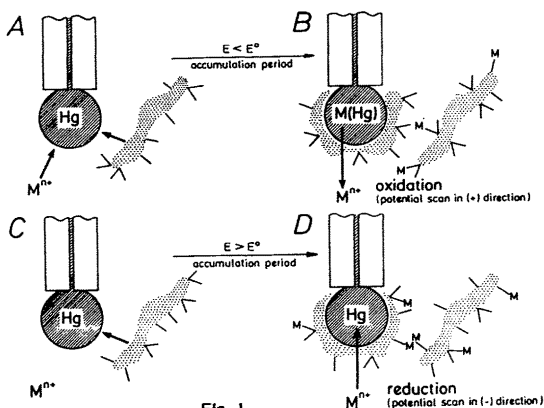


Fig. 1

Our experiments demonstrated that by relatively simple electrochemical method, following the influence of different organic substances on the oxido-reduction processes of different heavy metal ions and adsorption properties of natural and synthetic organic matter some conclusions regarding heavy metal ion speciation (preference for complexation in the bulk of solution, enrichment on the phase boundaries) as well as the nature of the organic matter (adsorbability at the electrode, interaction in the bulk of solution, preference for certain metal ion) can be drawn. The results obtained can be applied to the natural water systems.

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