Eu(III) complexation with humic acid and similar ligands in natural waters

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Humic materials play very important role in the transport and sorption of metal ions in the environment, i.e. in seawater and fresh waters. Namely, as the nuclear energy industry still exsits in a great extent in the environment, fission products and actinide elements, such as europium, americium etc, could be released from the reactor operation, reprocessing plants and reprocessed waste disposal. Furthermore, concentrations of europium (III) in marine and fresh waters are frequently larger than predicted by the solubility products with hydroxide and carbonate concentrations normally present. Naturally occuring organic materials (humic and fulvic acid) are responsible for higher concentrations of these dissolved elements because of the complexation process. The interaction of europium(III) with humic acid (1-3) is very significant in the first place because it has properties which are comparable in a great extent with other characteristic radionuclides, i.e. americium(III) and plutonium(III). The strenght of the Eu(III) complexation with humic acid can be used as an example of the environmental behaviour of the actinides, as well.

Determination of Eu(III)-humate complex, as well as Eu-thenoyltrifluoroacetonate (TTA) and Eu-salicylate complexes by square-wave voltammetry was performed. The complexes are strongly adsorbed at the mercury drop electrode surface.

The main difference between them is the fact that the Eu-humate complex cannot be accumulated at the electrode surface, so it is not suitable for the analysis of lower contents of europium. Complexes of europium with 2-thenoyltrifluoroacetone and salicylic acid accumulate at the electrode surface so that low concentration levels of europium can be detected. With TTA, the concentration level of 5×10^{-9} mol/L of europium at pH = 6.6 was reached. With salicylic acid as a ligand the concentration level 10^{-8} mol/L of europium at pH = 5.3 was obtained. Europium - humate complex was determinated at pH = 5.0 and lowest europium concentration level reached was about 5×10^{-7} mol/L of europium.

It is interesting that the electrochemical process of these complexes proceed by totally different mechanisms what is the characteristic of europium in the various aqueous solutions and in the presence of various ligands.

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