Contribution ID: **995** Type: **Verbal**

Determination of nanogram levels of copper in a variety of matrices using instrumental, preconcentration and radiochemical neutron activation analysis

Thursday, 19 May 2022 08:30 (30 minutes)

Copper at low levels is generally considered an essential element. It can be determined by neutron activation analysis (NAA) via 63Cu(n,γ)64Cu and 65Cu(n,γ)66Cu reactions. The positron-emitting nuclide 64Cu (half-life=12.7 h) is not commonly used because of interferences. The short-lived 66Cu (half-life=5.09 min) can possibly be used in instrumental NAA (INAA). However, it is seldom done in practice due to the Compton background interferences from nuclides such as 28Al, 38Cl, and 24Na. The 66Cu nuclide decays by β-emission and a single non-coincident gamma-ray of 1039.2 keV. The peak efficiency reduction factor (PERF) of this peak was measured as 1.03. INAA in conjunction with anticoincidence counting (INAA-AC) technique was used for analyzing a number of reference materials with varying salt content for copper concentrations as low as 0.06 mg/kg.

Most elements of environmental and toxicological importance in natural waters are typically present at μg/kg or lower levels. A reversed-phase extraction chromatographic (RPEC) preconcentration NAA (RPEC-PNAA) method using a porous inert support, namely Amberlite XAD-4 resin coated with the chelating agent 1-(2-thiazolylazo)-2-naphthol (TAN) was developed in our laboratory for the extraction of copper from aqueous samples including seawater with an absolute detection limit of 0.106 μg.

A radiochemical NAA (RNAA) method was also developed for the determination of very low levels of copper in diets and foods. The method involved irradiation of a sample for 15-20 min followed by rapid dissolution in a mixture of nitric and hydrochloric acids at low heat and coprecipitation of 66Cu with thioacetamide in presence of 10 mg copper carrier. The precipitate was filtered through a polycarbonate membrane, dried, and counted.

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Session Classification: Nuclear Analytical Methods

Track Classification: Nuclear Analytical Methods