RADIOACTIVITY MEASUREMENTS IN NATURAL AND TREATED WATERS

Santos, C.M.; Leonardo, L.; Pecequilo, B.R.S.

Centro de Metrologia das Radiações - IPEN/CNEN-SP

Keywords: gross alpha beta radioactivity; tritium; gas-flow proportional counter; liquid scintillation.

The most widely used measurements of radioactivity levels in natural and treated waters are the gross alpha and beta activities, determined with gas-flow thin-window proportional counters. As the energy loss is strongly deppendent on particle incident energy and absorber density, alpha and beta count rates are affected by the standards energies and chemical composition and thickness of the dissolved solids residues of the samples. Efficiency calibration curves for gross alpha and beta counting were determined for an EG&G-Berthold LB 770-2/5 gas-flow proportional counter. For alpha we used ^{241}Am and natural uranium and for beta, ^{90}Sr/^{90}Y and ^{137}Cs in residues ranging from no thickness to approximately 18 mg/cm^2 thickness, in stainless steel planchets.

Tritium levels are determined by liquid scintillation as follows: the sample is slowly distilled for removing non-volatile radionuclides and usual quenching materials near dryness, assuring complete transfer of tritiated water. A subsample of the distillate is mixed (1:15 ratio) with a scintillation solution Insta-Gel XF in a glass vial and counted on a Packard Tri-Carb 2100 scintillation spectrometer.

Tritium levels in groundwater samples from the Environmental Monitoring Program at IPEN, from 2000 to 2003, are in the range of 20 Bq·L^{-1} to 91 Bq·L^{-1}. The effective committed dose for general public considering the highest tritium level is 1,3 m Sv·y^{-1}, which is below the ICRP dose limit of 1m Sv·y^{-1}. Tritium concentration of radioactive liquid effluents samples from the IEA-R1 research reactor storage tank showed values from 3,6x10^3 Bq·L^{-1} to 6,2x10^3 Bq·$^{-1}$L, approximately 1000 times below the Brazilian daily discharge limit of 3,7x10^6 Bq·L^{-1}.

USE OF SEQUENTIAL EXTRACTION TO DETERMINE THE SPECIATION OF Ra-226, Pb-210, RARE EARTH AND TRACE ELEMENTS IN PHOSPHOGYPSUM

[1]Santos, A.J.G.; [1]Mazzilli, B.P.; [2]Fávaro, D.I.T.

[1]Centro de Metrologia das Radiações - IPEN/CNEN-SP, [2]Centro do Reator de Pesquisas - IPEN/CNEN-SP

Keywords: sequential extraction; speciation; natural radionuclides; rare earth elements; phosphogypsum.

Phosphogypsum is a waste produced by the phosphate fertiliser industry. It is formed by precipitation during wet sulphuric acid processing of phosphate rocks. Although phosphogypsum is mainly calcium sulphate dihydrate, it contains elevated levels of impurities, which originate from the source phosphate rock used in the phosphoric acid production. Among these impurities, radionuclides from U-238 and Th-232 decay series, particularly Ra-226 and Pb-210, are of most concern due to their radiotoxicity.

The Brazilian phosphate fertiliser industry is responsible for the production of approximately 23.5 million tons of phosphogypsum per year. The bioavailability of radionuclides (Ra-226 and Pb-210), rare earths and trace elements to the surrounding aquatic system was evaluated by the application of sequential leaching to the phosphogypsum samples from two main Brazilian phosphoric acid producers.

The sequential extraction results show that most of the radium and lead are located in water-insoluble (non-CaSO4) fractions, and that only 13% to 18% of these radionuclides are distributed in the most labile fraction.