

DETECTION CAPABILITY FOR DETERMINATION OF SR-89 AND SR-90 BY LIQUID SCINTILLATION COUNTING

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We developed a new method for simultaneous determination of Sr-89 and Sr-90 in environmental samples. The samples were digested and Sr was separated from Y and other radionuclides by a two-stage procedure using the DGA resin and the Sr resin. Each sample was promptly counted once for 100 min on the Hidex 600 SL liquid scintillation counter (LSC), followed by a gamma spectrometric measurement of Sr-85 added to measure chemical recovery of Sr. The LSC counter was calibrated in 3 counting windows emphasizing the Sr-90, Sr-89, and Y-90 peaks, while bypassing the Sr-85 peak. Sr-85 calibration was needed to subtract its background in the 3 windows. Both Sr-85 and Sr-89 were calibrated for in a standard way. However, Sr-90 and Y-90 calibration was performed by following an ingrowth of Y-90 in a freshly prepared Sr-90 fraction for 1 month. The calibration coefficients were determined from a chi-square fit to the ingrowth data. The method was tested on 18 water samples spiked at levels from several to several hundred of Bq of Sr-89 and Sr-90, with either pure radionuclides or with approximate activity ratios of 1:1, 2:1, 5:1, 10:1, and vice versa. In addition, 8 method blanks (MB) were measured. The data were analyzed numerically (rather than analytically) by solving a system of linear equations for Sr-89 and Sr-90 activities as analytes and Y-90 activity as a participating component. The total uncertainties of the results were calculated numerically according to the established methods using variances and covariances. The average bias from the known activities was -0.3% (range from -3.6 to 3.1%) for Sr-90 and -1.5% (range from -10.1 to 5.1%) for Sr-89. The Eta-scores were within -1.0 and 1.0 at 95% confidence level. The detection capabilities of this method were determined using the Altshuler, Pasternack and Currie formalism, by means of the decision threshold LC and the detection limit referred to as the minimum detectable activity (MDA). All relevant uncertainties were propagated into the LC and MDA. Under background conditions, the average LC and MDA values were 49 and 102 mBq for Sr-89, as well as 69 and 142 mBq for Sr-90, respectively. This corresponds to, for example, MDAs of 2.8 pCi/L (Sr-89) and 3.8 pCi/L (Sr-90) for 1-L water sample, and to 2.0 and 2.8 Bq/kg for 50 g of food sample, respectively. For samples spiked with either pure Sr-89 or Sr-90, false positives were observed for the opposite radionuclide exceeding the LC values. This was attributed to the interference by the spiked activity. A method was developed to calculate the LC and MDA in the presence of interference. The analysis time for a group of samples was 2 days for samples of 100 g or less and 3 days for larger samples. In summary, we developed an accurate LSC method for the determination of Sr-89 and Sr-90 encompassing wide range of activities, which has a potential application in contamination monitoring of food and environmental samples.

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