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Alpha radiometric determination of plutonium and uranium isotopes after separation of the radionuclides by cation exchange and liquid extraction

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The radioactivity concentration of uranium and plutonium isotopes (Pu-236 and U-232) in water samples has been determined by means of alpha spectroscopy after chemical separation of the radionuclides by cation exchange and liquid-liquid extraction using the Chelex-100 resin and 30%TBP/dodecan. Method calibration using Pu-236/U-232 standard solutions results in a detector efficiency of 19% and in a cation exchange separation efficiency which varies between 60% and 90%, and 50% and 70%, for uranium and plutonium, respectively, depending on the radionuclide concentration in the sample. Application of the method to test solutions of constant radionuclide concentration and variable composition (0.1, 0.5 and 1 M NaCl; 0.1 and 0.5 M Ca(NO₃)₂; 0.1 and 1 mM FeCl₃; 10 and 100 ppm SiO₂; 10 and 100 ppm humic acid) shows generally that the cation exchange efficiency is not significantly affected by the presence of major components, except for increased Fe(III) concentrations in solution (> 0.1 mM). The liquid-liquid extraction efficiency is almost similar for both radioelements and varies between 50% and 80%, depending on the radionuclide concentration in the sample. Taking into account that the electrodeposition of the radionuclides under study is quantitative, the total method efficiency is calculated to vary between 30-70% and between 25-55%, for the uranium and plutonium isotopes, respectively. The detection limit of the alpha spectrometric system has been found to be 0.2 mBq/l, suggesting that the method could be successfully applied for the radiometric analysis of uranium and plutonium isotopes in natural waters

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