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Selective liquid-liquid extraction of Sr-85 with modified calixarenes

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Sr-90 is a long-lived radionuclide ($T(1/2) = 28.6$ a), produced as a by-product in nuclear power plants. Due to its chemical similarity to calcium, it follows the food chain from environment (e.g. aquatic systems and soil) to fauna and human in case of release in the biosphere. Strontium can be, as well as calcium, incorporated in bones. Stable isotopes of strontium might not be harmful, but radioactive strontium can lead to bone disorders and diseases, including leukaemia[1].

Calixarenes and their functionalised derivatives are research subjects in the development of extracting agents, transporters, stationary phases[2] or bio-sensors. We used modified calixarenes, including derivatives having carbonyl binding sites, for the extraction of strontium[3] by means of a liquid-liquid extraction in a chloroform / water system. As a simulated contamination solution with Sr-90, the aqueous strontium phase was traced using the short-lived radionuclide Sr-85 ($T(1/2) = 64.9$ d), which was produced and purified at the in-house 18 MeV-cyclotron[4].

Under alkaline conditions, strontium extraction yields of $>(90\pm 4)\%$ were obtained. Furthermore, the impact of inorganic and organic impurities, competing ions like sodium, calcium, acetate or tartaric acid, to the extraction performance was studied. The used carboxy-modified calixarenes are highly potent and selective extracting agents towards strontium, under conditions near to nature (e.g. synthetic groundwater).

[1] Wallova, G., N. Kandler, and G. Wallner, Monitoring of radionuclides in soil and bone samples from Austria. *Journal of Environmental Radioactivity*, 2012. 107(0): p. 44-50.

[2] Wendel, V., Neuartige Wirt-Gast-Komplexe basierend auf Cycloheptatrienbausteinen, Mathematisch-Naturwissenschaftliche Fakultät I 1998, Humboldt-Universität zu Berlin: Berlin.

[3] Casnati, A., et al., New Efficient Calixarene Amide Ionophores for the Selective Removal of Strontium Ion from Nuclear Waste: Synthesis, Complexation, and Extraction Properties. *J. Am. Chem. Soc.*, 2001. 123: p. 12182-12190.

[4] Mansel, A., et al., Production of Sr-85 at a 18 MeV-cyclotron and purification for geochemical investigations, 2012. (submitted)

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