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Production of 51Cr by proton irradiation of natV and purification by precipitation and ion exchange chromatography

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European demand for chromium has grown dramatically, leading to the need for a detailed understanding of recycling of steel sludges and separation methods. To simulate these processes, we will use the radiotracer technique. 51Cr (T1/2 = 27.7 d) was choosen as a radionuclide. The isotope can be produced by the nuclear reaction natV(p,n)51Cr at a cyclotron. We used our recently installed cyclotron Cyclone® 18/9 (IBA) for the irradiation of natV (99.75% 51V). The vanadium foil was put in an aluminium holder with a diameter of 10 mm and a depth of 100 µm. The target was covered by a 100 µm thick aluminium foil. The irradiation was done at a beam of 16 MeV protons and a current of 10 µA for 4 hours. For the separation of 51Cr we established a multistage treatment. After cooling for 20 hours, the vanadium foil was dissolved with 2 ml conc. nitric acid. After addition of 20 mg iron(III) chloride, the hydroxide was subjected to a threefold cycle of precipitation with ammonia and dissolution with nitric acid. Vanadium(V) is soluble under these conditions. The separation of the radionuclide 51Cr and iron(III) was performed by ion exchange chromatography with AG 1-X8 (BIORAD) in conc. HCl. The 51Cr solution was eluted on the resin and the resin was washed six times with 2 ml conc. hydrochloric acid to remove the iron(III). The combined 51Cr solutions were evaporated to dryness and the residue was dissolved in 0.01 M sulfuric acid. The detection of 51Cr was done by gamma-counting (320 keV; 9.91%). The radiochemical yield was 66% at a production rate of 0.575 MBq/µAh.

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