Sorption of Rare Earth Elements from Environmental Waters Using Organically Modified Silica Gel Before ICP-MS Determination

Semira Ünal, Ahmet E. Eroğlu, Talal Shahwan, and Ali Çağrı
İzmir Institute of Technology, Faculty of Science, Chemistry Department, P.O. 35430, İzmir, Turkey, semiraunal@iyte.edu.tr

Silica gel modified with various organic compounds containing mercapto and amine functional groups was proposed as adsorbent for rare earth elements (REEs) from environmental waters before ICP-MS determination. The organic compounds used were (3-aminopropyl) trimethoxysilane (APTMS), (3-mercaptopropyl) trimethoxy silane (MPTMS), 2-aminobenzothiazole, 2-aminophenol, 2-aminothiophenol, and L-glutamic acid dimethyl ester. The characterization of the new sorbents was performed with SEM/EDX and elemental analysis. It was shown that REEs can be adsorbed only by APTMS- and MPTMS-modified silica gels quantitatively in a broad pH range (pH>3). At high REEs concentrations APTMS-modified silica gel (silica-amino) worked better than unmodified silica gel. Up to 10.0 mg/L, silica-amino have adsorbed higher than 80% of the REEs while silica gel could adsorb only 30% of them. Among the sorbents investigated silica-amino was chosen for subsequent experiments. Desorption from APTMS-modified and unmodified silica gels was realized with 1.0 M HNO₃. Spike recovery tests were performed in various water types including ultra pure water, tap water, sea water, and geothermal water and the results were found to change between 81-110%.