Application of Extraction Chromatography Resins as a Sample Preparation Technique for Radiochromatographic Analyses

J. E. Roane[1], T. A. DeVol[1], J. D. Leyba[2], and R. A. Fjeld[1]

[1]Dept. of Environmental Engineering and Science, Clemson University, Clemson, SC 29634-0919
[2]Savannah River Technology Center, Westinghouse Savannah River Co., Aiken, SC 29808

The presented work investigates the application of extraction chromatography resins as a sample preparative technique to reduce the effects of the sample matrix constituents on the analysis of environmental samples by radiochromatography. The quality of the radiochromatographic data is generally inversely related to the complexity of the sample matrix; the more complex the sample matrix, the greater the effect of the matrix constituents on the separation and quantification of the radioactive analytes. In this study the sample matrices, given in order of increasing matrix complexity, included a radionuclide-spiked groundwater, a sample from a high activity drain tank, and radionuclide-spiked soils.

Preparative techniques were performed on the samples and depended on the complexity of the matrix. These techniques included: (1) simple filtration and pH adjustments for the spiked groundwater, (2) no treatment as well as extraction chromatography for the high activity drain tank sample, (3) microwave-aided acid digestion and/or acid leaching with extraction chromatography for the spiked soil samples. Extraction chromatography involved the application of Sr-Spec and TRU-Spec resins (Eichrom Industries, Inc.) to concentrate the strontium and actinides, respectively, and reduce the mass loading of the non-radioactive species. Three different soil types, based on their iron content, were utilized in the study. Microwave-aided acid digestion was performed on the three types of radionuclide spiked soil, while microwave-aided acid leaching was performed on the intermediate iron content soil.

Following sample preparation, radiochromatography was performed on the sample. Radiochromatography is an analytical technique that can rapidly separate and quantify radioactive analytes. In this technique, cationic radionuclides (as well as non-radioactive cations) in an aqueous solution are sorbed onto a cation exchange preconcentration column. With the proper selection and sequencing of chemical eluents, the radioactive ions are moved onto a mixed bed ion exchange separation column where they are separated based on charge density (approximately by element). Following elution from the separation column, the radioactivity is detected and quantified with an on-line flow-cell scintillation detector. The resultant peak areas are used to calculate the activity of the analyte with identification of the peak inferred through the peak retention time. The results of applying extraction chromatography as a sample preparation technique prior to radiochromatographic separation will be presented through activity (mass) balances and statistical analyses of the chromatographic data.