



Contribution ID: 35

Type: Verbal

Extraction of radionuclides with solutions of complexing agents in supercritical fluids and compressed gases

Monday, 19 April 2010 10:45 (15 minutes)

One of the main advantages of extraction with supercritical fluids (SCF) or liquid gases (LG) is a possibility of the reagent-free regeneration of "solvent", which sharply decreases the secondary waste volume. As a result, in last 20 years the researcher in many countries focus their attention on the supercritical fluid extraction (SFE) of the trace amounts of radioactive and heavy metals for treatment to remove and decontamination of various solid objects (including soils) and on SFE of actinide macroamounts for reprocessing of the spent nuclear fuel of the nuclear power plants (SNF NPP).

In this work we analyze the similarities and differences between the liquid-liquid extraction of radionuclides and extraction with SCF and LG and the prospects of extraction using supercritical and liquid gases in radiochemistry..

In last 20 years the data on SFE of a series of metals were published in more than 100 papers. The detailed data was presented on SFE of U, Th, rare-earth elements (REE), Co, Cu, Mn, Pu, Np, and Am. The SFE of U, Th, and REE P3 Σ with tri-n-butyl phosphate (TBP) and its mixture with β diketones were also extensively studied. Rather detailed data were presented on SFE of transuranium elements and fission products using carbon dioxide solutions of TBP, β diketones and their mixtures and even on recovery of these elements from non-irradiated nuclear fuel and from SNF NPP. SFE of Cs and Sr with solutions of organic acids and polyethers was also well studied.

The detailed data are published of the extraction of U, REE, Cu, Pb, Zn, Cd, Cr, and As using carbon dioxide solutions of various acids such as di-2-ethylhexyl phosphoric, bis(2,4,4-trimethylphenyl) phosphoric (cyanex-272), bis(2,4,4-trimethylphenyl)monothio phosphoric (cyanex-302), bis(2,4,4-trimethylphenyl)dithio phosphoric (cyanex-301), and di-2-ethylhexylthio phosphoric acids.

Our analysis showed only slight differences between the extraction of macro- and microamounts of metal cations with solutions of complexing agents in liquid and supercritical CO₂ and liquid-liquid extraction. At the same time it should be noted that:

- ☑ low viscosity and high diffusion rate allows performance of extraction in CO₂ without mixing of the phases;
- ☑ CO₂ can affect pH of the liquid phase being in equilibrium with it;
- ☑ main difference between the extraction of metal cations with solutions in liquid and supercritical CO₂ and liquid-liquid extraction are observed for microamounts of metals.

Moreover, it should be mentioned that the technologies of SNF reprocessing and procedures of deactivation in supercritical and compressed CO₂ and Freons are the most promising for radiochemistry. The advantages of these processes are sharp decrease in the volume of secondary liquid radioactive wastes; absence of organic solvents and toxic compounds, and rather small operation temperature (25-80°C). It should be noted that the use of Freons instead of CO₂ allows to decrease the working pressure to 1-4 MPa.

Primary author: Dr SHADRIN, Andrey (Khlopin Radium Institute RPA)

Co-authors: Dr MURZIN, Andrey (Khlopin Radium Institute RPA); Mr SHAFIKOV, Denis (Khlopin Radium Institute RPA); Mr KAMACHEV, Vladislav (Khlopin Radium Institute RPA)

Presenter: Dr ALYAPYSHEV, Mikhail (Khlopin Radium Institute RPA)

Session Classification: Chemistry of Nuclear Fuel Cycle, Radiochemical Problems in Nuclear Waste Management 1

Track Classification: Chemistry of Nuclear Fuel Cycle, Radiochemical Problems in Nuclear Waste Management