

# Micelle mediated extraction of americium and europium by calix[4]arene phosphine oxides from nitric acid media

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## Abstract

© 2016, Akadémiai Kiadó, Budapest, Hungary.  $^{152}\text{Eu}$  and  $^{241}\text{Am}$  recovery from  $\text{HNO}_3$  by conventional and micelle mediated extraction are studied. It is stated that radionuclides distribution ratios  $D$  (KD) in micelle mediated extraction are significantly higher than those of conventional extraction, with  $^{241}\text{Am}$  is slightly less extracted than  $^{152}\text{Eu}$ . Distribution ratios dependence on medium acidity is similar for both processes, with extraction maximum at  $C(\text{HNO}_3) = 0.2\text{--}1 \text{ mol L}^{-1}$ . Microscopic research and dynamic light scattering prove micellar nature of calixarene solutions. Nano-scale of particles, which accumulate radionuclides, is confirmed by ultramicrofiltration. This method is also applied for studies of radionuclides re-extraction and electrochemical deposition.

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## Keywords

Americium, Europium, Micelle mediated extraction, Micelle shape and size, Phosphorylated calix[4]arenes, Ultramicrofiltration

## References

- [1] Mittal K (ed) (1977) Micellization, solubilization and microemulsions. Plenum, New York
- [2] Paleologos E, Giokas D, Karayannis M (2005) Micelle-mediated separation and cloud-point extraction. *Trends Anal Chem* 24(5):426–436
- [3] Watanabe H (1982) In: Mittal K, Fendler E (eds) Solution behavior of surfactants. Plenum Press, New York
- [4] Pelizzetti E, Pramauro E (1985) Analytical applications of organized molecular assemblies. *Anal Chim Acta* 169:1–29
- [5] Paleologos E, Stalikas C, Tzouwara-Karayanni S, Karayannis M (2001) Selective speciation of trace chromium through micelle-mediated preconcentration, coupled with micellar flow injection analysis-spectrofluorimetry. *Anal Chim Acta* 436:49–57
- [6] Silva M, Fernandes L, Olsina R, Stacchiola D (1997) Cloud point extraction, preconcentration and spectrophotometric determination of erbium(III)-2(3,5-dichloro-2-pyridylazo)-5-dimethylaminophenol. *Anal Chim Acta* 342:229–238
- [7] Ortega C, Cerutti S, Olsina R, Silva M, Martinez L (2003) On-line complexation/cloud point preconcentration for the sensitive determination of dysprosium in urine by flow injection inductively coupled plasma-optical emission spectrometry. *Anal Bioanal Chem* 375:270–274
- [8] Vodolazkaya N, Mhchedlov-Petrosyan N, Bogdanova L et al (2012) In: Ryabchenko V (ed) From molecules to functional architecture. Supramolecular interactions. East Publisher House, Donetsk

- [9] Zakharova L, Kudryashova Yu, Selivanova N, Voronin M, Ibragimova A et al (2010) Novel membrane mimetic systems based on amphiphilic oxyethylated calix[4]arene: aggregative and liquid crystalline behavior. *J Membr Sci* 364:90-101
- [10] Kudryashova Yu, Valeeva F, Zakharova L, Solovieva S et al (2012) New organized systems based on amphiphilic oxyethylated Calix[4]arene. *Colloidal J* 74:67-77
- [11] Mustafina A, Zakharova L, Elistratova J, Kudryashova Yu, Solovieva S et al (2010) Solution behavior of mixed systems based on novel amphiphilic cyclophanes and Triton X100: aggregation, cloud point phenomenon and cloud point extraction of lanthanide ions. *J Colloid Interface Sci* 346:405-413
- [12] Mustafina A, Elistratova J, Burilov A, Knyazeva I et al (2006) Cloud point extraction of lanthanide (III) ions via use of Triton X-100 without and with water-soluble calixarenes as added chelating agents. *Talanta* 68:863-868
- [13] Smirnov I, Karavan M, Babain V, Kvasnitskiy I et al (2007) Effect of alkyl substituents on extraction properties and solubility of calix[4]arene dialkylphosphine oxides. *Radiochim Acta* 95:97-102
- [14] Atamas L, Klimchuk O, Rudzevich V, Pirozhenko V et al (2003) New organophosphorus calix[4]arene ionophores for trivalent lanthanide and actinide cations. *J Supramol Chem* 2(4-5):421-427
- [15] Klimchuk O, Atamas L, Miroshnichenko S, Kalchenko V et al (2004) New wide rim phosphomethylated calix[4]arenes in extraction of americium and europium. *J Incl Phenom Macrocycl Chem* 49:47-56
- [16] Klimchuk O (2004) Design, synthesis and properties of phosphorylated ionophoric calix[4] arenes, Abstract of PhD Thesis, Kyev
- [17] Novikov A, Ryleeva V, Abramova A, Pribylova G, Smirnov I (2014) Electrodeposition of americium on the stainless steel support for the purpose of radiochemical assay. *J Radioanal Nucl Chem* 302:543-544
- [18] Karavan M, Smirnov I, Miroshnichenko S, Kal'chenko V (2008) Water-soluble Calix[4]arene Dialkylphosphine Oxides in the process of cloud point extraction. In: *Proceedings of XV International conference on phosphorous compounds ICCPC-XV, Saint-Petersburg*
- [19] Karavan M (2009) Phosphorylated calix[n]arenes as perspective extractants for actinides and some fission products from nitric acid medium, Abstract of PhD Thesis, Saint-Petersburg
- [20] Smirnov I (2009) Extraction of actinides and fission products by multifunctional and macrocyclic compounds: general patterns in the processing of HLW. Thesis for the degree of Doctor of Science, Saint-Petersburg
- [21] Karavan M (2009) Phosphorylated calixarenes for the recognition of f-elements, PhD Thesis, University of Strasbourg