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REVEALING THE DEPENDENCIES OF PARTITIONING AMERICIUM-241 AND URANIUM USING SORPTION TECHNOLOGY BASED ON SOLID-PHASE EXTRACTANT TODGA

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INTRODUCTION

Objective To reveal the dependences of the separation of americium-241 and uranium using sorption technology based on the solid-phase extractant TODGA.

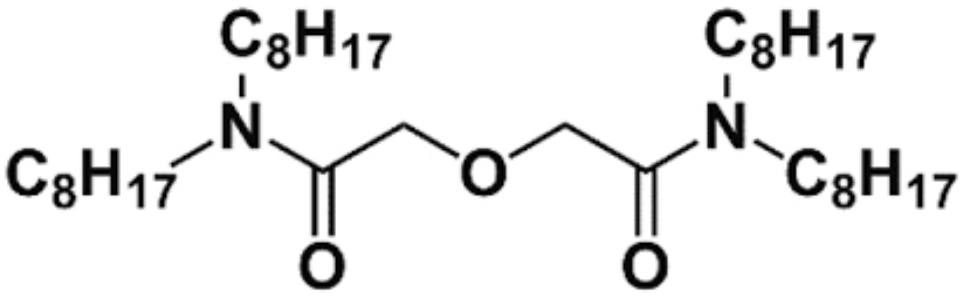

FIG. 1. Structure of N, N, N ', N' – tetraoctyldiglycolamide (TODGA)

Table 1. Characteristics of the solid-phase extractants based on TODGA samples under study

Sample	Functional	Porosity, %	Specific grain area, m^2/g	Average grain diameter, mm
1 2 3	cation exchanger cation exchanger neutral	33,8 57,7 54,3	87,0 11,8 83,2	1,0 1,3 0,7

STATEMENT OF THE RESEARCH PROBLEM

$$C_{Me-sample} = V_{solution}(C_{iniMe} - C_{resMe}) / V_{sample} \quad (1)$$

$$K_d = C_{Me-sample} / C_{Me-solution} \quad (2)$$

where $C_{Me\text{-}sample}$ – radionuclide concentration in the sample, mg/l; $V_{solution}$ – solution volume, ml; C_{iniMe} – initial concentration of radionuclide in solution, mg/l; C_{resMe} – residual concentration of radionuclide in solution, mg/l; V_{sample} – sample volume, ml; $C_{Me\text{-}solution}$ – radionuclide concentration in solution, mg/l.

$$F(t) = k_f \cdot t^{\frac{1}{2}} + C \quad (3)$$

$$k_f = 3D / r_{samples} \Delta r K_d \quad (4)$$

where k_f – diffusion film rate constant, mmol·g^{-1}·min$^{1/2}$; C – parameter related to the thickness of the boundary layer, mmol/g; D – effective film diffusion coefficient, cm^2/s; Δr –effective thickness of the diffusion boundary layer, μm; $r_{samples}$ – sample radius, mm.

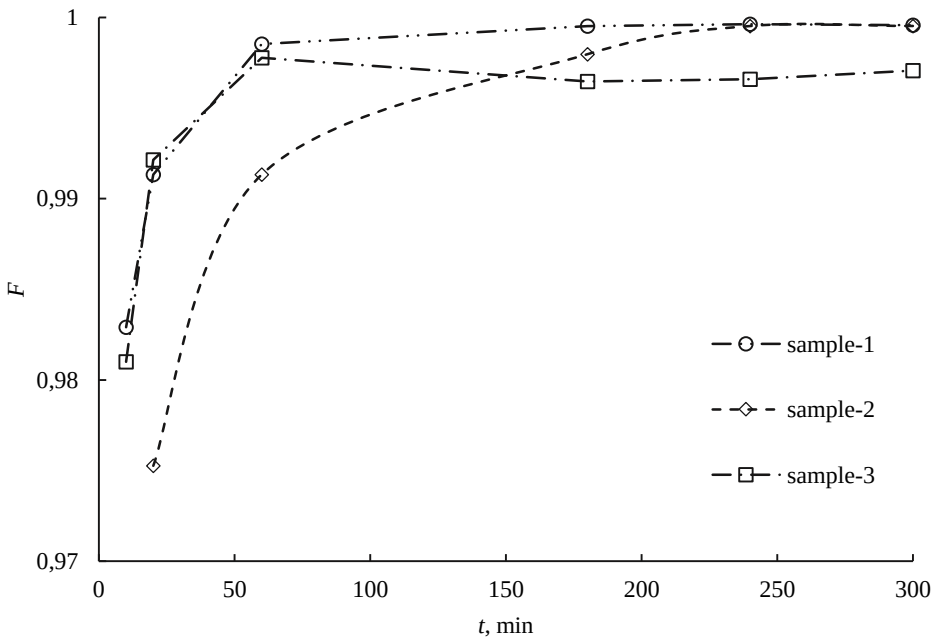

FIG. 2. Dependence fractional attainment of equilibrium the extractant container with americium-241 with all samples on time

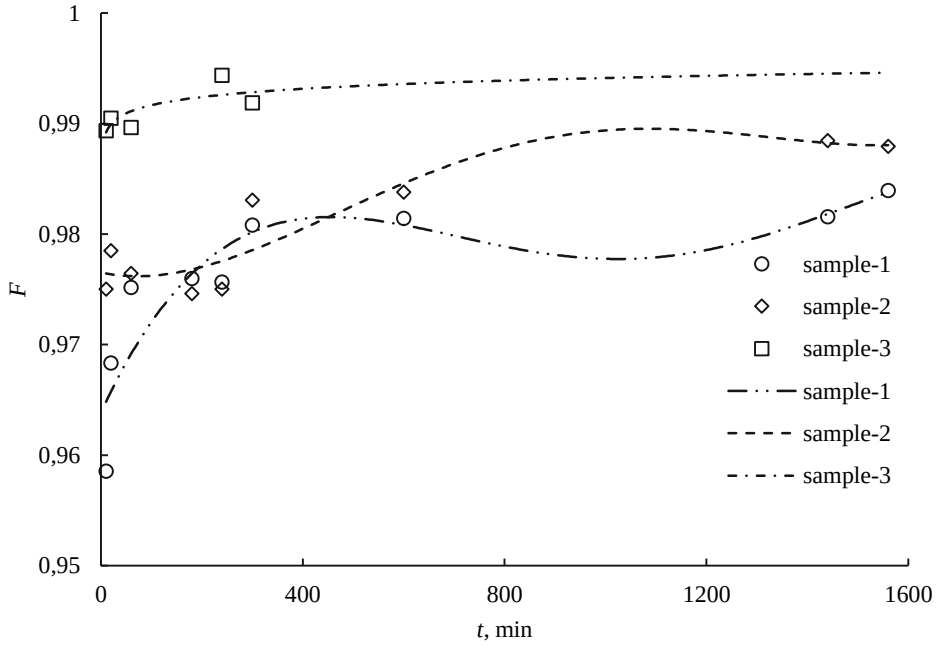

FIG. 3. Dependence fractional attainment of equilibrium the extractant container with uranium with all samples on time

THE DISCUSSION OF THE RESULTS

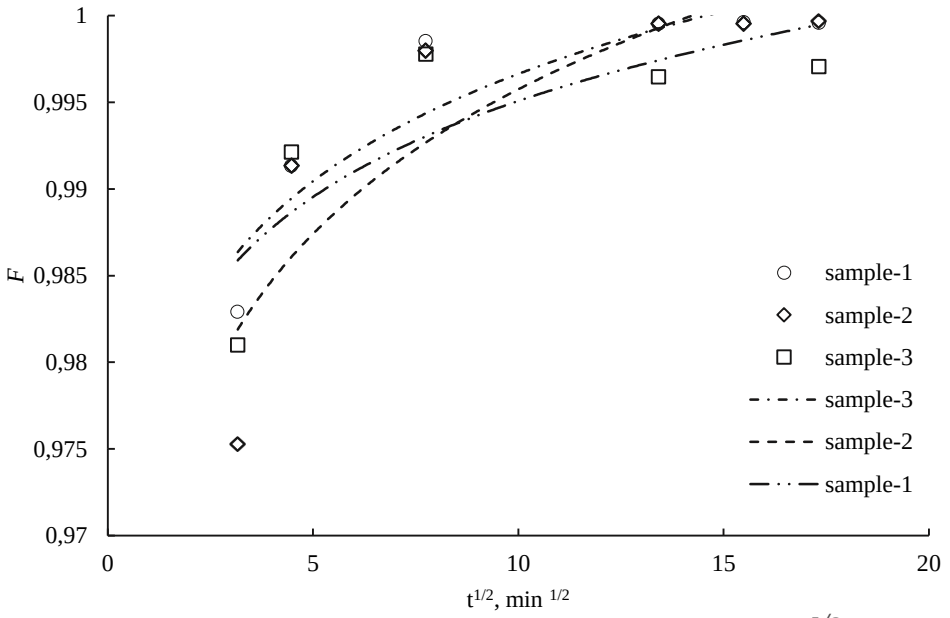

FIG. 4. Dependence in coordinates $F - t^{1/2}$ for americium-241 for all samples

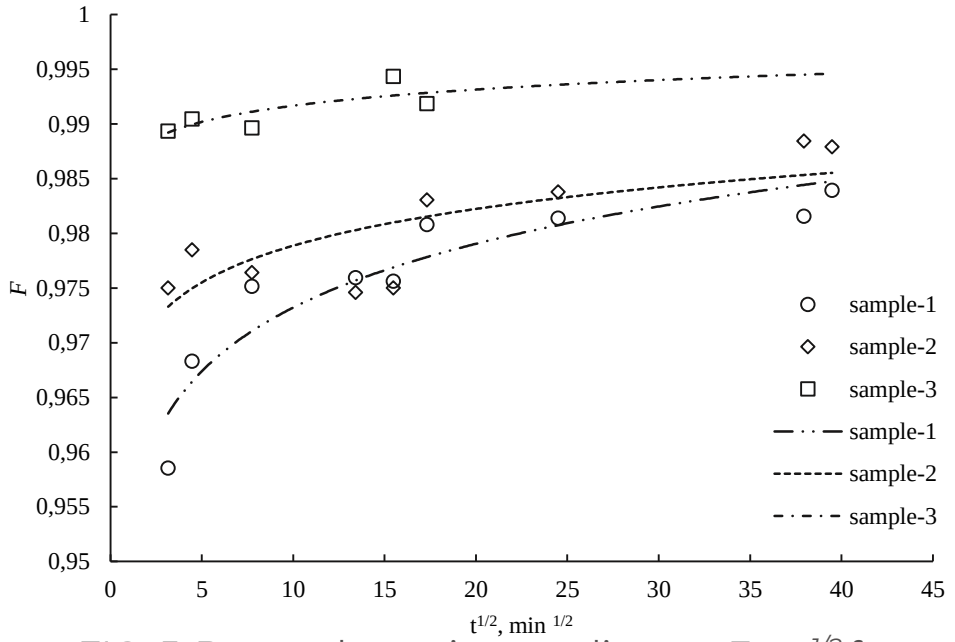

FIG. 5. Dependence in coordinates $F - t^{1/2}$ for uranium for all samples

Table 2. Values of kinetic characteristics for americium-241 and uranium

Sample	Distribution coefficient of americium-241	Distribution coefficient of uranium	Diffusion film rate constant of americium-241, mmol·g^{-1}·min$^{1/2}$	Diffusion film rate constant of uranium, mmol·g^{-1}·min$^{1/2}$	Effective film diffusion coefficient of americium-241, n·10^{-5} cm^2/s	Effective film diffusion coefficient of uranium, n·10^{-6} cm^2/s
1	2658	62	0,009	0,008	4	0,8
2	3045	87	0,012	0,005	9	1
3	440	177	0,008	0,002	0,5	0,5

CONCLUSION

- The mechanism of diffusion kinetics has been established.
- The film diffusion constants have been found and the effective film diffusion coefficients of americium-241 and uranium during their sorption have been determined for three prototypes of solid-phase extractants TODGA.
- The distribution coefficients of americium-241 and uranium in all samples have been determined. From the analysis of the obtained results, an increased sorption rate of americium-241 compared to uranium for sample №2 has been revealed, which coincides with the distribution coefficients.
- The effective use of a functional cation exchanger has been confirmed.
- The dependence of the kinetic parameters on the physical characteristics of the samples has been established.

The results of these studies will be used to continue work on the determination of desorption parameters on a modified solid-phase extractant TODGA sample №2 for the separation of americium-241/uranium.