

**Uptake of technetium by bottom sediment of fresh water lake  
and role of microorganisms in this process.**

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Technetium-99 - is one of the long-lived fission products of some radionuclides (time of half-life --  $2,1 \cdot 10^5$  years). The content of technetium in the spent fuel of (PWR or) thermal reactors could reach the value of  $1 \text{ kg} \cdot \text{T}^{-1}$  and in that of FBR up to the  $3 \text{ kg} \cdot \text{T}^{-1}$  [1]. In the reprocessing of the fuel, technetium due to its complicated physical-chemical properties (for example, volatility and solubility in water and organic solution) enters in all types of radioactive wastes and environment.  $^{99}\text{Tc}$  was found in water of Irish Sea, where the radioactive wastes of English reprocessing plants were put down on the sea bottom in 60th years [2]. Diffusion of technetium-99 from Sellafield to banks of Scandinavian peninsula took 4-5 years [3]. The trace concentration of  $^{99}\text{Tc}$  was found in ground water under depository in Hanford (USA) [4]; in water of French river Rhona lower atomic center Marcule [5]. The behaviour of  $^{99}\text{Tc}$  in environment was described in papers [6,7] too. In Russian scientific literature there is information about pollution by radioactive wastes of the lake Karachai and river Techa near plant "Majak" [8] and river Enisey near reprocessing plant Krasnojarsk [9].

There is information about distribution of Pu-239 and Cm-244 between lake water and bottom sediments and considerable concentration of actinides in the last sediments. But published data about biological and physical-chemical mechanisms of uptake actinides by bottom sediment are not complete [10].

The aim of our work is the study of behaviour of technetium and some actinides (Pu-239 and Cm-244) in the water and sediment of typical fresh water lake White Kosino of Middle Russian Plain and the influence of microorganisms on the behaviour of these radioactive elements.

The sorption of technetium was studied on natural and sterilized (by irradiation and 2% formalin solution) sediments from lake White Kosino during 4 months in laboratory conditions (natural light, room temperature and without stirring). Sorption of technetium by sterilized sediment is negligible. During the same time in natural conditions (non sterilized sediment) technetium uptake from liquid to solid phase is almost complete - 98%. The kinetic of technetium sorption is given on Fig.1.

The main processes in White lake - sulfatereduction and methanogenesis. The several experiments were made with sulfatereducing bacteria. Following data were received: at initial concentration 40 mg/l of technetium(VII) after 8-10 days radioactivity was decreased on 30-50% and dark brown sediment fell-out. Identification of this sediment by phase analysis was not successful, because sediment was X-ray amorfous. The elemental composition of this sediment was studied by X-ray microanalysis. The results are given on Fig.2. As generally known, sulfatereducing bacteria reduce sulfate to  $\text{H}_2\text{S}$ , which can react with  $\text{TcO}_4^-$  making sulfides of technetium. And we suppose that sulfatereducing bacteria can reduce  $\text{TcO}_4^-$  to  $\text{TcS}_2$  analogically reduction  $\text{SO}_4^{2-}$  to  $\text{H}_2\text{S}$ .

The sorption of some actinides - Pu-239 and Cm-244 by natural sediment was investigated in the same conditions as technetium. In this conditions the