



Contribution ID: 26

Type: Poster

Coprecipitation of Radionuclide Microquantities on Chitosans of Different Molecular Masses in Solutions

Wednesday, 19 September 2012 18:00 (1h 50m)

The current approaches to spent nuclear fuel treatment lead to the occurrence of radionuclides in repositories and ponds for the storage of fuel elements. In addition, radionuclides, including the above-mentioned ones, are components of low-activity liquid waste. Despite the efforts taken to localize radioactive compounds, they penetrate into the environment, including the World Ocean. The usage of chitosans and their derivatives as flocculants in sewage water purification from heavy metals, dyes, and surfactants is reported in [1, 2]. The advantages of ashless organic coprecipitators over inorganic ones are described in [3]. The authors showed that the degree of Pu extraction from 0.01 M solutions of HNO₃ on high-molecular chitosan (HMC) with MM = 150105 g/mol and low-molecular chitosan (LMC) with molecular masses (MM) = 50103 g/mol is 95% to 99%. Simultaneously, it was established that the coprecipitation degree of ⁶⁰Co and ⁵⁴Mn radionuclides ranged from 78% to 85%, and that of ⁹⁰Sr and ¹³⁷Cs was 25-30%, irrespective of the MM of the chitosans and the solution compositions. The data on the behavior of other radionuclides during flocculation on chitosans is unavailable in the literature.

Based on the above considerations, the aim of this study was to study the behavior of radionuclides during coprecipitation on chitosans from solutions of complex chemical compositions. The possibility of ²³³U, ²³⁹Pu, ²⁴¹Am, ¹⁵²Eu, ⁹⁰Sr, ⁹⁰Y, and ⁶⁰Co coprecipitation on chitosans of different MM was studied.

At first, the solubility of the obtained chitosans in different media was studied. It was shown that HMC and LMC were insoluble in distilled water and dissolved well at pH < 3. The solubility of chitosans in those solutions ranged from 8 g/l to 10 g/l and 10 g/l to 15 g/l for HMC and LMC, respectively. Increasing the solution pH to 6 for LMC and 8 for HMC resulted in the formation of a bulk thick precipitate. In both cases, the residual chitosan concentration was 0.45 g/l. In sea water at pH = 8.5, the solubility of HMC and LMC decreased to 0.045 g/l.

It was found that the efficiency of the sorption of the ²³³U, ²⁴¹Am, ¹⁵²Eu, and ⁶⁰Co radionuclides on crystallized HMC and LMC from salt solutions is low, with the distribution coefficients K_d being not higher than 100 ml/g after the time of contact between the solid and liquid phases of 1 h and at V/m = 100 ml/g. Since the studied chitosans displayed a low sorptive capacity, our further research was focused on the flocculation coprecipitation of radionuclides.

As follows from the data on the ²³³U, ²³⁹Pu, ²⁴¹Am, ¹⁵²Eu, ⁹⁰Sr, ⁹⁰Y, and ⁶⁰Co coprecipitation on HMC and LMC in solution, in both cases degree of coprecipitation of all radionuclides studied, except ⁶⁰Co and ⁹⁰Sr, reached virtually peak values at a chitosan concentration of 1 g/l. For HMC, it was 80% for ¹⁵²Eu and ⁹⁰Y, 99% for ²³³U and ²⁴¹Am, and 85% for ²³⁹Pu. In contrast to An, ¹⁵²Eu, and ⁹⁰Y, the α for ⁶⁰Co increased monotonically with increasing the HMC concentration in solution and at [HMC] = 5 g/l, reached 40%. For ⁹⁰Sr, α was not higher than 3% over the entire chitosan concentration range. For LMC α for An, ¹⁵²Eu, and ⁹⁰Y varied insignificantly ranging from 92% to 99%. For ⁶⁰Co and ⁹⁰Sr, α increased to 40% in the chitosan concentration range 0-1 g/l. Increasing the [LMC] in solution further on had hardly any impact on α for ⁹⁰Sr, by increasing it monotonically for ⁶⁰Co. The obtained α values were 40% and 60% for ⁹⁰Sr and ⁶⁰Co, respectively, at [LMC] = 5 g/l. A comparison of the results showed that the coprecipitation of all the elements studied was more effective on LMC than HMC.

To conclude, using chitosans for concentrating radionuclides from salt solutions could find practical use during not only ecological monitoring of natural waters, but also the reprocessing of low-level liquid waste.

The research was carried out using financial support by the Russian Fund for Fundamental Research (Grant N 11-03-00106).

References

1. Qiang Yu, Shubo Deng, Gang Yu. *Water Research*. 42(12) 3089-3097 (2008)
2. Li Wang, Aiqin Wang. *Bioresource Technology*. 99(5) 1403-1408 (2008)
3. Kosyakov V.N., Veleshko I.E., Yakovlev N.G. et al. *Radiochemistry (Russia)*. 45(4) 366-369 (2003)

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Session Classification: Poster Session

Track Classification: Radioactive elements in the environment, radiation archeometry and Health Physics