SEARCH FOR CERAMIC MATERIAL FOR IMMOBILIZATION OF RADIOACTIVE WASTES

Grigoryev A.S.[1,2], Chubreev D.O.[1]
Scientific adviser: Antonenko M.V.[1], candidate of technical sciences, Myshkin V.F.[2], doctor of physical and mathematical sciences, professor
FSUE «Mining and Chemical Combine», 662972, Zheleznogorsk, Lenin St., 53
Tomsk Polytechnic University, 634050, Tomsk, Lenin Avenue, 30
E-mail: atomlink@mcc.krasnoyarsk.su

Spent fuel rods of industrial uranium-graphite reactors (IUGR) of FSUE «MCC» were stored in Reactor plant (RP) cooling pools. To date a large number of radioactive silt sediments have been formed in the cooling pools. This silts is of a natural origin and of alluvial character and contain beta and gamma activity including ^{137}Cs, ^{241}Am, ^{152}Eu, ^{154}Eu. At present it is envisaged to extract the silts from the cooling pools with its subsequent solidification and its transfer to National Operator for Radioactive Waste Management [1].

The report considers measures to minimize the amount of RW generated during the decommission of the cooling pools. It is proposed to put the silt sediments in a ceramic matrix, which further is planned to place in the clay belt of the reactor.

In the report the results of studying the properties of kaolin clay, bentonite clay, red clay and loam that are located in the quarries near Zheleznogorsk city are presented. The main components of these clays are SiO_2 (50–64%), $A1_2O_3$ (12–20%), components that are contained in smaller quantities are Fe_2O_3, TiO_2, CaO, MgO, K_2O, Na_2O, H_2O. Also, the composition of the silt sediments of the cooling pools was determined and the radiation resistance of ceramic materials was analyzed.

In accordance with State Standard 21216-2014 "Raw clay. Test methods" the following parameters was determined: sand content in a sample weighing 100 g is 14-80 g; the plasticity number is 9-13; air shrinkage is 8,9-9,24% and fire shrinkage is 8,92-10,08% [2]. Photos of the samples after the research on fire shrinkage are shown in Figure 1.

The study of the water-resistant properties of the samples revealed that the calcined clays possess weak anti-filtration properties. In this regard, as a protective water-repellent coating for the clay after calcination $Na_2O(SiO_2)_n$ was applied [3]. By the results of conducted experimental tests of the coated with a layer of $Na_2O(SiO_2)_n$ samples was determined that red clay possesses the minimum absorption of water (7.5%).

a)  b)  c) 

Figure 1 - Samples after sintering: a) kaolin; b) loam; c) red clay.

It is known that the radiation resistance of structural materials depends on their isotopic composition and cross sections of the interactions of these isotopes with ionizing radiation [4]. It should also be expected that the destruction of the clay materials during an interaction with ionizing radiation is connected with their isotopic composition.

Analysis of the γ-radiation interaction with the silt deposits reveals that the radionuclides from the silt deposits have an insignificant influence on the structure of the clay samples. Therefore, it can be considered that both the investigated clay samples and their mixtures are suitable for use as a matrix for immobilization of the MCC radioactive silt deposits. Within the framework of this study additional experimental studies to predict long-term stability and to determine a leaching rate of ^{137}Cs are planned.

LIST OF REFERENCES

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