The main technologies for producing oxide compositions for dispersion nuclear fuel are: thermal decomposition, reduction of oxides, electrolytic production from molten salts, sol-gel process. Common disadvantages of these technologies are: multi-staging, high cost of processing raw materials, uneven distribution of phases in the product, the need to use a large number of chemicals.

At the same time, the technology for the synthesis of oxide compositions in air plasma has the following advantages: one-staging, homogeneous phase distribution with a given stoichiometric composition, the ability to actively influence the particle size and morphology [2,3].

It should be noted that the processing of nitric acid solutions in plasma is quite expensive. To reduce energy consumption, an organic component is added to the composition of the solutions, which, oxidizing in the air plasma, adds additional energy, allowing to increase the consumption of the processed solution and, thus, increase the yield of the target product.

The work was carried out thermodynamic modeling of the process of plasma-chemical synthesis of complex oxide compositions from water-organic nitrate solutions (WONS), consisting of fissile material and matrix material. Uranium and thorium oxides were considered as fissile inclusions, magnesium oxide was used as the matrix material, acetone was used as an organic additive.

As a result of the simulation, the optimal WONS compositions based on uranyl, thorium and magnesium nitrates, as well as acetone, were calculated. The optimal modes of WONS plasma treatment were determined as well. The results of the studies can be used to calculate the plasma chemical synthesis of complex oxide compositions for dispersion nuclear fuel.

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PLASMA IMMOBILIZATION OF SILTS IN STORAGE POOLS WITH LOW RADIOACTIVE WASTE

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During exploitation of equipment at nuclear fuel cycle (NFC) plants a lot of liquid radioactive wastes (LRW) were accumulated and located at the bottom in storage pools. They consist of Fe (3–17 %), Si (2.8–8.5 %), Ca (0.2–3.2 %), Mg (1–2.8 %), Na (0.7–1.9 %), P (0.1–0.9 %), etc. [1].

Different recycling methods such as sorption, electrochemical, chemical are known [2]. To stabilize and convert silts into sustained forms preventing migration of radionuclides from wastes different methods involving

high-temperature processing of ceramic and glass matrixes are used [3]. The common disadvantages of such methods are multistage and high recycling cost.

As it is shown in [4] plasma utilization of wastes in the form of optimal water organic inflammable compositions (WOC) having adiabatic combustion temperature of about 1200 °C provides their effective and environmentally safe utilization.

The second stage contains evaluation of the feasibility for plasma immobilization of solid products obtained after the utilization process. The immobilization process at the metal chlorides which are resistant to radiation exposure means that the main condensed products after plasma immobilization are localized in NaCl (a) and KCl (b) melts. Condensed product is a result of model silt plasma utilization process.

All experiments were conducted with the help of laboratory plasma bench. Plasma bench included the high-frequency generator, high-frequency torch plasmatron and also other auxiliary equipment and control devices. The samples with different content were prepared and consisted of sodium chloride, simple and complex oxide powders obtained after plasma utilization of silts. These 100 gram samples were placed into quartz glass pot and then located under air plasma flow generated by high-frequency jet plasmatron. During the experiments a temperature of heated surface of sample was measured with a portable infrared pyrometer.

At the surface temperature of NaCl lower than 750 °C, plasma immobilization process of the samples with solid dispersed products proceeds with low intensity. Increasing air plasma stream capacity from 12 to 20 kW increases surface temperature up to 850–900 °C. That is why intensity of immobilization process increases.

The analysis of the obtained results shows that in 5 minutes after the start of experiment more than 80 % of all initial sample weight has been evaporating. In 10 minutes sample weight decreases to 14.6 g (losing 85.4 %), in 15 minutes – to 9.8 g (losing 90.2 %), in 20 minutes – to 4.7 g (losing 95.3 %). It shows that the plasma immobilization could be successfully applied to safety managing the silts in storage pools sharply decreasing their initial volume.

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ПОДГОТОВКА ФРАГМЕНТОВ ОБОЛОЧЕЧНОГО ТОПЛИВА К ГИДРОМЕТАЛЛУРГИЧЕСКОЙ ПЕРЕРАБОТКЕ

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Один из известных вариантов подготовки топлива заключается в переводе диоксида урана в значительно более реакционноспособный октаоксид триурана в атмосфере кислорода при температуре