RESULTS AND PROSPECTS OF USING COMBINED-ACTION PREPARATIONS IN NUCLEAR POWER ENGINEERING AND MEDICINE

A. I. Ksenofontov[1], E. I. Kurbatova, D. A. Petrov[1, 2]

[1]National Research Nuclear University «MEPhI», Moscow, Russia

[2]Leningrad Nuclear Power Plant, Sosnovy Bor, Russia

The paper discusses the creation and research of combined-action preparations relevant to the decommissioning of water bodies used in the operation of nuclear installations, including holding pools, SNF reloading wells, as well as temporary wet-type storage facilities containing significant volumes of water.

Their peculiarity is the fact that, in addition to radioactive substances, the water contains impurities of heavy metals (including iron, nickel, zirconium) formed as a result of degradation of the fuel shell material, as well as microorganism's characteristic of sedentary waters.

This combination of types of pollutants requires decontamination and comprehensive purification of these water bodies for subsequent treatment operations.

This paper presents the results of a study of combined-action preparations that are effective not only against radionuclides, but also heavy metals and bacteria., combined-action compositions (CAC).

The development was based on the creation of CAC based on protein structures in a composition with various high-molecular compounds or inorganic salts of heavy metals.

Natural proteins are multifunctional compounds that provide catalytic activity and direction of chemical reactions, as well as transport of cations and electrical polarization of macromolecules. Dissolving in water, protein structures form salts with many cations - multiply charged complex compounds.

Finally, when applied to aqueous solutions, they provide a concentration of positive charge, which significantly increases the effective range. This is often accompanied by increased sorption activity.

In addition, by affecting bacterial cells with an excessive charge, such structures destroy their nucleus, which leads to their death.

For laboratory studies of the decontamination ability of the compositions, model aqueous solutions activated with strontium-90 and caesium-137 were used. The same compositions were used for precipitation of heavy metal impurities (iron, nickel, zirconium) in aqueous solutions.

When conducting bacteriostatic studies, strains of E-coli bacteria. They were applied to special agars, which were treated with various compositions. In the course of the study, special techniques were developed, including for radiometric monitoring of caesium-137 and strontium-90 in model solutions.

The results of a study of the activity of model solutions containing strontium-90 after treatment with various CAC formulations showed a decrease in their activity by 1–1.5 orders of magnitude.

During bacteriostatic studies, it was noted that bacterial growth suppression zones were observed on the plates where the cells of bacterial suspensions treated with the studied CAC solutions were seeded, while the suppression area was about 20–50%,

In the case of precipitation of heavy metals, for example, at threshold iron concentrations of 0.05–2.2 mg/dm^3 in a solution with pH = 7, a decrease in its content by 1.2–1.5 times was observed with the introduction of CAC.

Analyzing the studied properties of CAC, including its high activity against radionuclides, approaches for the creation and research of compositions activated with strontium-89 as models of radiopharmaceutical preparations are considered.