Analysis of the state of glass blocks, obtained during the processing of liquid radioactive waste

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Significant amount of electricity production in the CIS countries is provided mainly by nuclear power plants (NPPs). Their operation is associated with the formation of a significant amount of radioactive waste, among which one should distinguish liquid radioactive waste (LRW).

The most important problem of handling LRW is very high costs in the technologies of their processing and storage. In Ukraine, the cost of processing and storing of 1 m3 of LRW is 5-10 thousand US dollars.

The main method of LRW utilization is their evaporation, as a result of which a significant amount of residual residues (RR) is formed. During differentiating the RR, a large amount of readily soluble, highly active crystallophase is formed, which requires the use of special techniques (cementing, bituminization, vitrification) and equipment for transformation into a form suitable for long-term storage in special storage facilities.

Now there is an objective necessity introduction of new methods for neutralizing and utilizing LRW in order to eliminate or reduce the risk of pollution of the environment during their final disposal.

The method of vitrification of radioactive waste provides inclusion of radionuclides in the glass matrix. Glass, being a non-stoichiometric substance, is capable for absorbing radionuclides in the form of both molecular particle and condensed particles, which is because off its structure. Technologically, this process consists of introducing into the suitably prepared charge some amount of dry RR. The mixture is averaged and heated to form a liquid phase. The product obtained, has high chemical and radiation resistance, is isotropic, non-porous. The disadvantage of this method is non uniform distribution of radionuclides in the stloematrix. Earlier, we (Pat. 77123 Ukraine) proposed a method for obtaining of glass phase formed as a result of the coagulation of polysilicic acids and iron compounds. The glass phase thus obtained is characterized by more uniform distribution of radionuclides. Thus, vitrification is considered to be the most suitable method for solidifying LRW.

The main disadvantage of the glass is its thermodynamic instability, which manifests itself in the crystallization of glass ("devitrification") under the influence of time and is greatly accelerated by the action of high temperature and ionization radiation. These processes are accompanied by accelerated release of incorporated radionuclides into the dispersive medium. Consideration of the patterns of removal of individual components from aluminosilicates showed that the rate of release when interacting with aqueous solutions is not constant and varies with time. Experimental studies devoted to release of radionuclides from glass blocks buried in geological formations have also shown that the latter are not stable, and radionuclide leaching processes change with time. At the present time, there is no one coherent theory that would sufficiently fully and reliably explain the experimentally obtained facts.

The aim of the work is to investigate the processes of destruction of glass blocks containing radionuclides, to reveal the regularities of these processes and to create a general theory of "release" of individual components from glass.