METAL CHLORIDES REMOVAL FROM THE SOLIDS' SURFACE BY FLUID EXTRACTION

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At present time, the combined pyro-hydrometallurgical technology is being developed within the framework of "PRORYV" project [1]. Pyrochemical operations placed at the head of the technological process allow reducing the cooling time of spent nuclear fuel (SNF), which should be reprocessed, by using as a medium resistant to radiation salt melts (chlorides) instead of aqueous solutions [2]. Despite several advantages of SNF processing in salt melts over hydrometallurgical processes, as a result of pyrochemical operations, a number of nonspecific for classical water technologies types of radioactive waste (RW) are formed. Usually its handling required the new technology development. One of them is structural materials of pyrochemical processing equipment contaminated with residual salt melt containing fission products and nuclear materials.

The main goal of this work is to remove chloride salts from the surface of pyrochemical SNF processing equipment by fluid extraction to reduce the cost of its final insulation.

In the course of the work, the possibility of alkali metal and actinide (U, Pu) chlorides removal by fluid extraction from the surfaces of structural materials (stainless steel, heat-resistant steel, Ni, Mo, Ta, ceramics (MgO, Al_2O_3), pyrographite) was tested. Extraction was carried out with fluid (CO_2, 1,1,1,2-tetrafluoroethane (freon 134a)) containing solvent and complexon.

After a single treatment of non-porous structural materials, such as metal, besides Ni, about 90% of lithium and potassium chlorides were removed from the surface. By doing so, the content of chloride salts on the surface of structural material can be reduced by about 10 times. Surface treatment of porous structural materials allowed to remove 67-80 % of chloride salts and to reduce the content of alkali metal chlorides only by 3-4 times.

About 80% and more than 90% of actinide chlorides was removed from molten MgO ceramics and stainless steel using liquefied freon 134a, contained solvent and complexon. In the case of all other structural materials only about 70 % of actinide chlorides were removed from the surface. Extra ~ 2% of actinide chlorides can be removed during second surface treatment under the same conditions.

As a result of this work, the principal possibility to remove alkali metal and actinide chlorides from the surfaces of different type of structural materials of pyrochemical SNF processing equipment by fluid extraction is shown.

[1] Shadrin A.Y., Dvoeglazov K.N., Maslennikov A.G., at all. PH PROCESS AS A TECHNOLOGY FOR REPROCESSING MIXED URANIUM–PLUTONIUM FUEL FROM BREST-OD-300 REACTOR. Radiochemistry. 2016. T. 58. № 3. C. 271-279.

[2] Shadrin A.Y, Dvoeglazov K.N., Ustinov O.A. Radichemistry. 2016. Vol. 58. № 3. P.234.