Oxidative dissolution of triuranium octaoxide in hydroxide-peroxide media

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**Background**

The main direction of spent nuclear fuel (SNF) reprocessing in carbonate media (including CARBEX process) is related to its dissolution in carbonate or carbonate-alkaline solutions and is considered as an alternative to hydro-chemical reprocessing in various options of the PUREX process.

An oxidizing agent is required to dissolution UO2 and U3O8 in carbonate and carbonate-alkaline media. The applying of H2O2 in dissolution process allows the rapidly and quantitatively dissolution of UO2 and U3O8 in aqueous solutions of alkali metal or ammonium carbonates. Addition of the peroxide ion to the U(VI)-containing carbonate solution results in highly soluble mixed peroxo-carbonate complexes. Soluble mixed peroxo-hydroxide complexes are formed in aqueous alkaline solutions.

**Aim:** Study of the kinetic of U3O8 powder oxidative dissociation in NaOH solutions and determine the conditions for complete dissolution of U3O8 in alkaline media containing hydrogen peroxide.

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**Materials and Methods**

**Results and discussion**

The oxidative dissolution of U3O8 powders obtained at 480°C, 600°C, 800°C, 1000 °C, and 1200°C in aqueous NaOH solutions in the presence of H2O2, in the temperature range of 25-75°C. An increase in the temperature and the specific surface area of the U3O8 powder leads to an increase in the dissolution rate. Fractional yield of U(VI) is necessary for complete oxidation of U(V) and dissolution of U3O8 in NaOH solutions. This is due to rapid decomposition (increased alkali and temperature) and a decrease in the concentration of oxidant and complexing agent (H2O2) in an alkaline solution. Maintaining the required concentration of H2O2 in an alkaline solution during oxidative dissolution of U3O8 powder is a key condition for achieving high process rate, completeness of dissolution of the oxide and stabilization of uranium(VI) in an alkaline solution.

**Conclusion**

The possibility of complete dissolution of U3O8 (480°C) and U3O8 (600°C) powder samples in 1.0M NaOH – 0.1M H2O2 solutions at 75°C and H2O2 fractional feeding due to the formation of soluble mixed peroxo-hydroxide complexes of uranium(VI) is shown. It has been found that stopping the H2O2 feed leads to the decomposition of soluble peroxo-hydroxide complexes of uranium(VI) and the quantitative distribution of uranium(VI) from the alkaline solution to the precipitate.

Obtained data makes it possible to develop approaches to the processes of selective leaching of uranium from voloxidized spent nuclear fuel and its hydrolitic reagent-free precipitation from alkaline solutions in the form of a preliminary concentrate purified from the bulk of highly radioactive fission products. Such an approach may be one alternative to replacing the first solvent extraction cycle of uranium(VI) from carbonate and alkaline solutions after oxidative dissolution of spent nuclear fuel in the CARBEX process.

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**References**


**Acknowledgments**

The work was carried out with the financial support of the Russian Science Foundation. Grant number 20-63-46006.