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The development and testing of the new flowsheets for the plutonium purification cycle of the Purex process

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Abstract

In order to improve the extraction flowsheet of RT-1 Plant two versions of plutonium purification unit flowsheet were developed: a flowsheet with stabilization of Pu(IV)-Np(IV) valence pair and Pu, Np co-recovery, and a flowsheet with stabilization of Pu(IV)-Np(V) valence pair and Pu recovery. The task related to stabilization of the valence pair of the target components in the required state was solved with the use of reactants already applied at RT-1 Plant, namely, hydrogen peroxide, hydrazine nitrate and catalyst (Fe). Both flowsheets were adapted for the plant purification facility with minimum modifications of the equipment, and passed the full scale industrial testing. As a result of this work, reduction in volume and salt content of the raffinate was achieved.

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1. Introduction

Spent nuclear fuel is currently reprocessed in Russia only at the Radiochemical Plant RT-1 (FSUE Mayak PA). The extraction flowsheet of the PUREX process applied at RT-1 Plant is based on several extraction cycles. The

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head-end extraction cycle provides extraction of uranium, plutonium, neptunium and technetium (solvent - 30% TBP), removal of fission products (FP's) to the raffinate and separation of valuable components.

In order to achieve higher degree of purification, uranium is treated at the second (uranium purification) cycle, while plutonium, neptunium and technetium are transferred to a separate flow and are also delivered to the dedicated purification unit that consists of two extraction cycles for extraction, purification and concentration of Np and Pu respectively (Fig. 1).

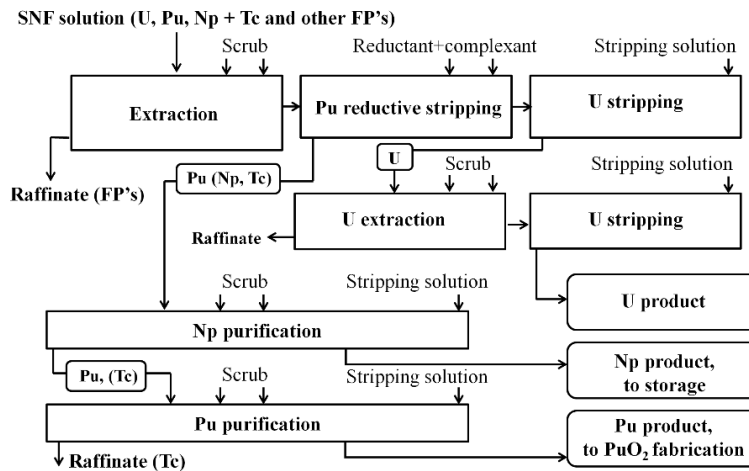


Fig. 1. Schematic diagram of the PUREX-process flowsheet applied at RT-1 Plant.

The original Np and Pu purification process is based on creating Pu(III) – Np(IV) valence pair. This process provides the capability to produce concentrated solutions of Pu and Np purified from each other with Tc removal to the raffinate (Fig. 2)¹. After purification the Pu product is subjected to oxalate precipitation and the produced plutonium oxalate is calcined to dioxide. The Np solution is transferred to a storage facility and it is currently not in demand.

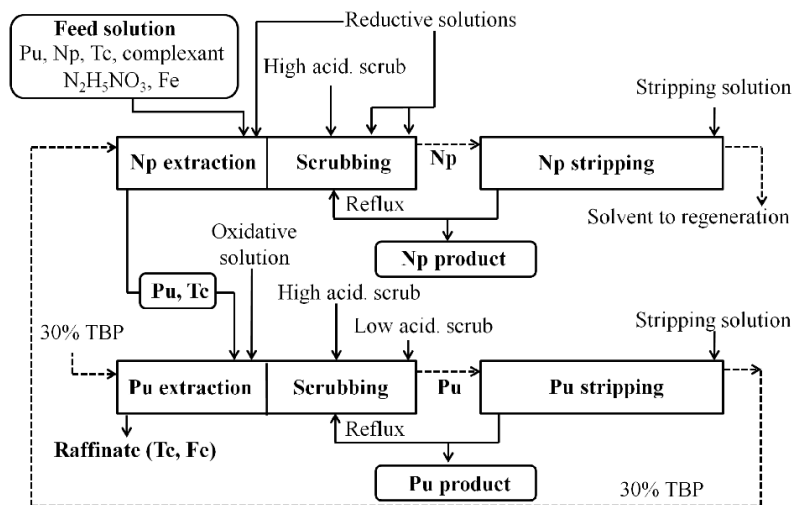


Fig. 2. The background flowsheet of the Pu-Np purification unit at RT-1 Plant.

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