1-8 Development of Uranium Recovery System by Crystallization Technologies

–R&D Status on Uranium Crystallization System for Future FBR Recycle System–

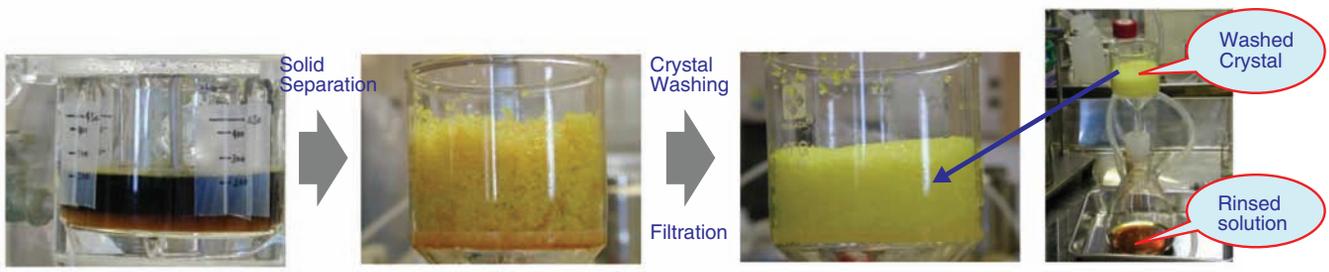

Fig.1-24 Steps in uranium crystallization from uranium and ruthenium nitrate solution
The solution in the vessel is cooled to lower temperature as e.g. 0°C. The crystal and mother solution are separated by suction filtration by a glass filter, the crystal is washed to remove mother solution remained.

Fig.1-25 Development of Engineerring Scale Crystallizer
Crystallizer tank (about 300mm(ID) × 900mm(L), hold-up volume is about 5 liters) has a cooling jacket made of transparent plastic to allow internal observation. The crystal size is about 700 to 800 μm.

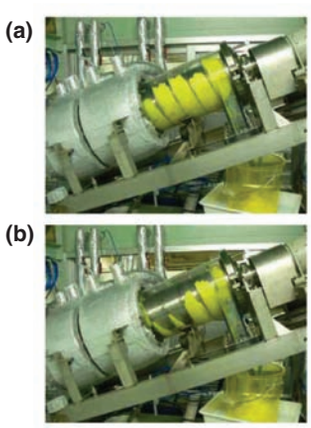

Fig.1-26 Appearance of non-steady state simulation test
(a) Crystal blockade is intentionally caused by reducing the rotation speed.
(b) The crystal blockage is removed by manually.

The crystallization is considered one of the key technologies for uranium recovery from the spent fuel in the future reprocessing plant, because it promises much desired safety and economical efficiency.

The crystallization is a separation technology based on differences in solubility, executed by changing temperature and concentration, with no organic reagent needed, so that the separation system can be simple (Fig.1-24) .

Since 1990s, JAEA has been carrying out small scale hot experiments at the Chemical Processing Facility (CPF), and development of an engineering-scale system is being carried out.

In the hot experiments, the uranium recovery rate, the decontamination factors of plutonium, and fission products (FPs) have been confirmed, and the crystal purification technology have been investigated.

In research for practical application, we selected a rotary driven type crystallizer which has the advantages of criticality safety, high throughput, and remote maintenance, etc. (Fig.1-25).

The uranium crystal is generated in the cooled solution in the crystallizer, and the crystal is isolated from residual solution (mother solution) by the cylinder rotation and is discharged from the device.

In the system development of the engineering scale system, we fabricated an engineering scale crystallizer system, and have been investigating the properties of steady and non-steady state operations. In these investigations, the operation conditions for stable crystallization, the crystal accumulation and blockage phenomena during crystal discharge, and the outlet of mother solution are being confirmed. The crystal accumulation can be monitored by a cylinder torque meter, and the event can be overcome by the stoppage of feed solution and stepwise increment of the screw speed (Fig.1-26). Development of the instrumentation and control system also is progressing.

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Reference

Ohyama, K., Nomura, K. et al., Development of Uranium Crystallization System in "NEXT" Reprocessing Process, Proceedings of International Conference on Advanced Nuclear Fuel Cycles and Systems, Boise, USA, 2007, p.1461-1466, in CD-ROM.