

7-5 Advancing the Separation Process for Spent Nuclear Fuel Reprocessing — Development of a Sludge-Cleaning Method in a Centrifugal Contactor —

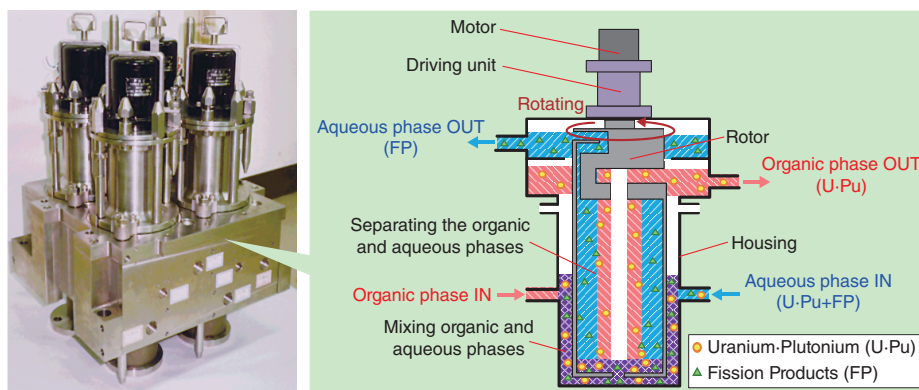


Fig.7-14 Schematic of a centrifugal contactor

A centrifugal contactor comprises a motor, driving unit, rotor, and housing. Aqueous-phase and organic-phase are mixed in the annular area (between the rotor and the housing), and then the mixed phase is separated in the rotor.

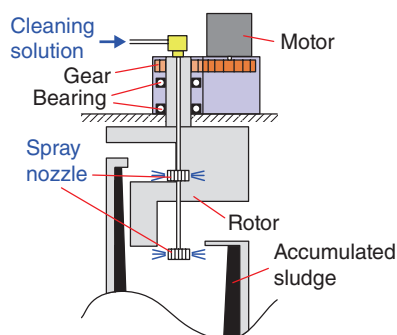


Fig.7-15 Addition of the spray nozzle

We introduced the spray nozzle to the rotor to more efficiently clean the sludge accumulated there.

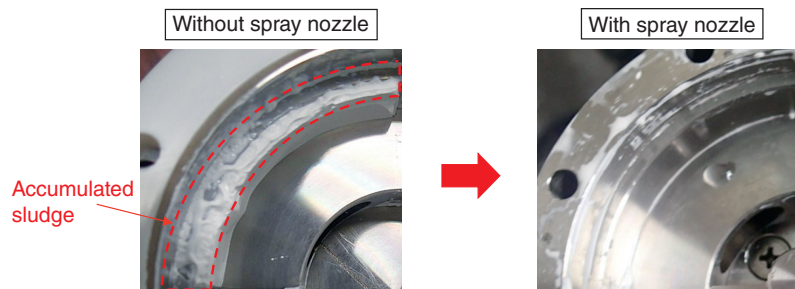


Fig.7-16 Effect of spray nozzle upon cleaning performance (upper rotor)

The sludge accumulated in the upper rotor could not be cleaned without the spray nozzle (left); in contrary, it could be significantly cleaned by introducing a spray nozzle (right).

We have been developing a centrifugal contactor for the solvent extraction process in spent nuclear fuel reprocessing (Fig.7-14).

A centrifugal contactor allows mixing of aqueous and organic phases in the annular area and separates them in a rotor using its strong centrifugal force. This characteristic reduces the residence time of the mixed solution compared to other apparatuses, e.g., mixer settlers, or pulsed columns, thereby preventing solvent degradation.

The centrifugal contactor has been used in the purification stage of reprocessing plants; however, it has not been used in the extraction stage for uranium and plutonium due to the sludge that is contained as fine particles or insoluble residue in the feed solution.

It is difficult to remove sludge perfectly from the process solution; therefore, we experimentally evaluated the sludge accumulation behavior in the centrifugal contactor and its influence on phase separation and extraction performance.

The result showed that the sludge was accumulated only in the rotor and decreased the separation performance.

As it is necessary to keep the centrifugal contactor clean for stable operation, we tried to introduce a spray nozzle for efficient cleaning. We embodied the structure of the spray nozzle in the centrifugal contactor by surveying the relation between its structure and the cleaning performance (Fig.7-15). This centrifugal contactor supplies the cleaning solution from the top of the rotor, which decreases the risk of radioactive-solution leakage and makes maintenance easier.

This new centrifugal contactor could perfectly clean the accumulated sludge with 20% of the cleaning solution and time needed by conventional centrifugal contactors (Fig.7-16).

Through this study, we could establish an efficient cleaning method for sludge accumulated in the centrifugal contactor.

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Reference

Sakamoto, A. et al., Effect of Sludge Behavior on Performance of Centrifugal Contactor, *Procedia Chemistry*, vol.21, 2016, p.495-502.