KNF-
FUEL-02

# Uranium Purification

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**Uranium purification process is a chemical process which separates pure uranium from the uranium containing impurities. Uranium mixture dissolves in nitric acid to form crude UNH solution. When this solution contacts with TBP(Tri-N-Butyl Phosphate), uranium is selectively extracted by TBP from the solution. This way, the pure uranium is obtained.**

## Description

### ● Purpose

- Extract pure uranium from uranium containing impurities

### ● Necessity

- The core process through front-ends and back-ends of the nuclear fuel cycle
- Indispensable to the uranium recovery process to recover uranium scraps
- Applicable to uranium recovery process to extract uranium from radioactive wastes
- Applicable to non-uranium metal refining

### ● Principle

- **Extraction** : TBP in the organic phase selectively extracts uranium from crude UN solution

  $UO_2^{2+}(aq) + 2NO_3^-(aq) + 2(C_4H_9)_3PO_4(org)$
  $\rightarrow UO_2(NO_3)_2 \cdot 2(C_4H_9)_3PO_4(org)$

- **Stripping** : Water or diluted nitric acid extracts uranium from the organic phase containing UN

  $UO_2(NO_3)_2 \cdot 2(C_4H_9)_3PO_4(org)$
  $\rightarrow UO_2^{2+}(aq) + 2NO_3^-(aq) + 2(C_4H_9)_3PO_4(org)$

- **Solvent regeneration** : Decomposition products of TBP are removed by reacting with Na ions in alkali solution and forming water-soluble compounds

  $(C_4H_9)_2HPO_4(org) + Na^+(aq) \rightarrow (C_4H_9)_2NaPO_4(aq) + H^+(aq)$
  $(C_4H_9)H_2PO_4(org) + 2Na^+(aq) \rightarrow (C_4H_9)Na_2PO_4(aq) + 2H^+(aq)$

### ● Process configuration

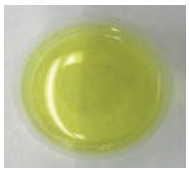
- Uranium purification process consists of 3 sub-processes : Dissolution, solvent extraction, solvent regeneration
  - Dissolution : Dissolving uranium mixture in nitric acid to form crude UN solution
  - Solvent extraction : Extracting uranium from crude UN solution to produce pure UN solution
  - Solvent regeneration : Regenerating and recycling spent solvent from solvent extraction

< $UO_x$ mixture >

Nitric acid → Dissolution

< Crude UN solution >

TBP solvent →
Nitric acid
Demi-water →
Solvent extraction
→ Spent solvent
→ Raffinate



< Pure UN solution >

## Distinctiveness

### ● Characteristics

- Proven advanced process and performance compared to existing ones by developing the main process equipment independently
- Process performance

| Impurity | Rejection (%) | Impurity | Rejection (%) |
|---|---|---|---|
| Al | 97.9 | Fe | 95.7 |
| B | 90.9 | Ni | 99.5 |
| Bi | 99.7 | Pb | 97.0 |
| Ca | 95.3 | Th | 97.8 |
| Cu | 98.3 | Zn | 96.4 |

- Impurity content in pure UN : within 3% of the allowable limit [DC virgin powder : 7%]
- More stable : by unique interface control technology with less controls and simplified logic
- More effective : by unique pulse generation method with smaller equipment requiring less power
- More flexible : by unique modularized extraction column

### ● Benefits

- Cost reduction in purchasing new uranium by utilizing/recycling uranium scrap
- Transfer plant technology

## Experience

- Commercial plant EPC completed : Max. capacity 40 ton.U/yr

## Deliverables

- **Product : $UO_2$ powder**
  (with AUH reconversion process)
- **Overseas uranium purification plant EPC**
- **Technical services**
  - Uranium purification
  - Uranium recovery from wastes containing uranium
  - Uranium purification process design and engineering
  - Similar process development, design and engineering

## Technology Readiness Level (TRL)

Actual system proven through operation

## Business Model

Technology Transfer
**Licensing**
Joint Search
**Service Execution**
Others