Sorption of $^{237}$Np by UO$_2$ under Repository Conditions

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Presented at the  
International High-Level Radioactive Waste Management Conference  
Las Vegas, Nevada  
April 30–May 4, 2006
The Contribution of $^{237}$Np to Total Site Boundary Calculations


OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY
Neptunium Sorption from Aqueous Solutions onto Uranium Dioxide

![Graph showing sorption of neptunium isotopes over time](image-url)
Np(IV) Sorption onto DUO₂ vs pH
Relatively Thin Layers of UO₂ Become Impermeable to Water

*Data courtesy of T.V. Kazakovskaya (VNIIEF, Russia) and E.V. Zaharova (IPC, Russia)
Some Key, General Conclusions of Russian/American Sorption onto UO$_2$ Research

- UO$_2$ sorbs Np(V) and Np(IV). Equilibrium is reached rapidly. UO$_2$ pretreatment temperature affects the amount sorbed. Increase of temperature to 95°C increases the amount sorbed. Np(V) sorption is irreversible.

- TC(IV) sorbs onto UO$_2$

- Filtration of water flow through UO$_2$ is almost complete in a short period of time.
Experiment Data Implications

- UO₂ may be an effective chemical barrier to key radionuclide release

- Spent nuclear fuel burn-up is ~<5%. The remaining 95% UO₂ may retain key radioisotopes

- Radionuclide retention might be enhanced by using depleted uranium (DU) oxides in a Richard’s Barrier (i.e., as backfill), using DUO₂ steel cermets as a material of construction for waste packages, filling the void space within the waste canister with DUO₂, using DUO₂ as ballast in the invert
Potential DU Dioxide Applications in a Geologic Repository

- Component of Backfill
- Cermet Waste Package (DUO$_2$-steel cermet)
- Waste Package Fill Material
- Ballast in Invert

Repository Tunnel Components
- Steel Lined Tunnel
- Titanium Drip Shield
- Spent Nuclear Fuel
- Backfill
- Waste Package
- Invert