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The Chemistry of Protactinium. VIII. Synergistic Effect of Di-isobutyl Carbinol on the Pa(V)-TTA-Benzene Solvent Extraction System

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Abstract

For the purpose of understanding the behavior of protactinium in a perchloric acid solution toward TTA-benzene extraction, the effect of di-isobutyl carbinol (DIBC) on the extraction was studied. A marked synergism was observed. As a result of a detailed investigation of such things as the effects of the TTA concentration, of the DIBC concentration, and of the acidity, the unified mechanism of TTA-benzene and TTA-DIBC-benzene extraction is considered to be a series of successive reactions, (1) through (4), with an increase in the DIBC concentration:

\[ \text{PaO}_m(\text{OH})_n^{2-m-n} + 4\text{HT} = \text{Pa}(\text{OH})_2\text{T}_3(\text{HT}) + (m+n-2)\text{H}_2\text{O} + (5-2m-n)\text{H}^+ \]

\[ \text{Pa}(\text{OH})_2\text{T}_3(\text{HT}) \rightarrow \text{PaOT}_3(\text{HT}) \quad \text{(slow, irreversible)} \]

\[ \text{PaO}_m(\text{OH})_n^{2-m-n} + 4\text{HT} + \text{B} = \text{Pa}(\text{OH})_2\text{T}_3(\text{HT})\text{B} + (m+n-2)\text{H}_2\text{O} + (5-2m-n)\text{H}^+ \]

\[ \text{Pa}(\text{OH})_2\text{T}_3(\text{HT})\text{B} \rightarrow \text{PaOT}_3(\text{HT})\text{B} \quad \text{(slow, irreversible)} \]

\[ \text{PaO}_m(\text{OH})_n^{2-m-n} + 3\text{HT} + \text{B} = \text{Pa}(\text{OH})_2\text{T}_3\text{B} + (m+n-2)\text{H}_2\text{O} + (5-2m-n)\text{H}^+ \]

\[ \text{Pa}(\text{OH})_2\text{T}_3\text{B} \rightarrow \text{PaOT}_3\text{B} \quad \text{(slow, irreversible)} \]

The slow, irreversible reaction in each step indicates the irreversible formation of unstrippable species in the organic phase with aging. The absorption spectral measurements gave results consistent with this conclusion.