# *Note on the Solvent Extraction of Some Metals by Tri-n-octyl Phosphine Oxide*

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Tri-*n*-octyl phosphine oxide (TOPO) is one of the alkyl phosphine oxides and has been employed as a solvent extraction reagent for many elements[1,2]. The detailed investigation of the extraction behavior with this reagent has been carried out for a few metals[2]. This paper presents the extraction behavior of zirconium, hafnium, niobium and tantalum in the system of TOPO-cyclohexane and hydrochloric or nitric acid.

TOPO was dissolved in cyclohexane without further purification. The distribution ratio, $K_d$, was determined radiochemically using the radionuclides Zr-95, Hf-181, Nb-95 and Ta-182. Activities in the aliquots of the two phases were measured with a gamma-ray scintillation counter. The aqueous solution containing a radionuclide such as the metallic ions was shaken vigorously with an organic solution for thirty minutes in a thermostat kept at $25\pm0.5$°C.

Figure 1 shows the variation of the $K_d$ values of zirconium and hafnium in the range of $1\times10^{-3}$ to $1\times10^{-2}$ M TOPO concentration in the organic phase, keeping the acidity of the aqueous phase constant. The plots of log $K_d$ vs. logarithmic TOPO concentration

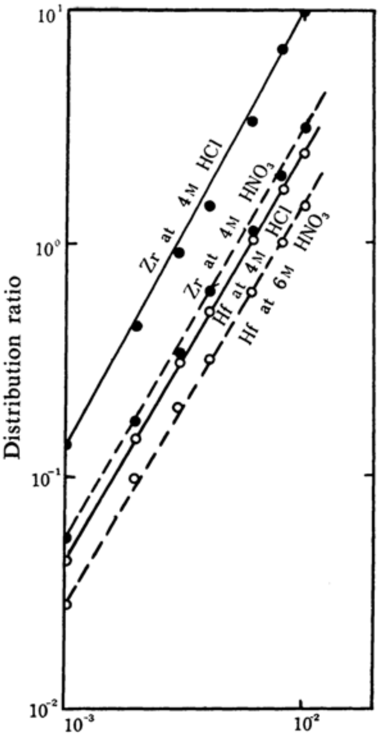

Fig. 1. Power dependence of distribution ratio on TOPO concentration.

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[1] J. C. White, U. S. AEC Rep., TID-7555, "Analytical Chemistry in Nuclear Reactor Technology", (1957), p. 240.

[2] J. C. White, "Symposium on Solvent Extraction in the Analysis of Metals", American Society for Testing Materials, Philadelphia (1958), p. 27.

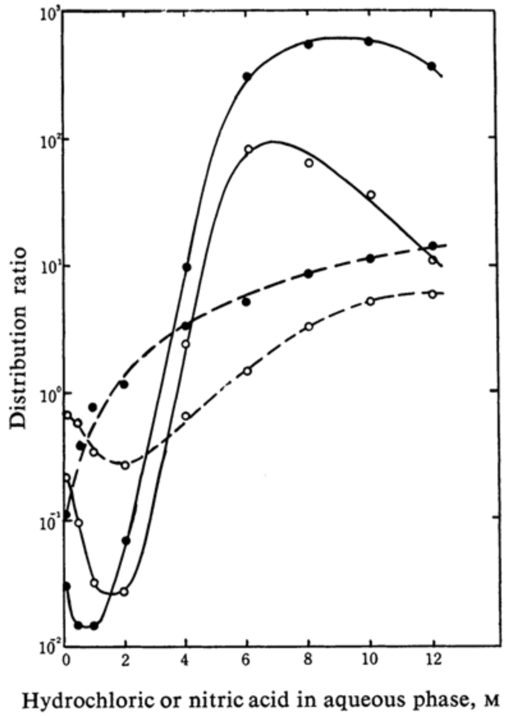

Fig. 2. Distribution ratio of zirconium and hafnium.

——: Hydrochloric acid ----: Nitric acid
●: Zirconium ○: Hafnium

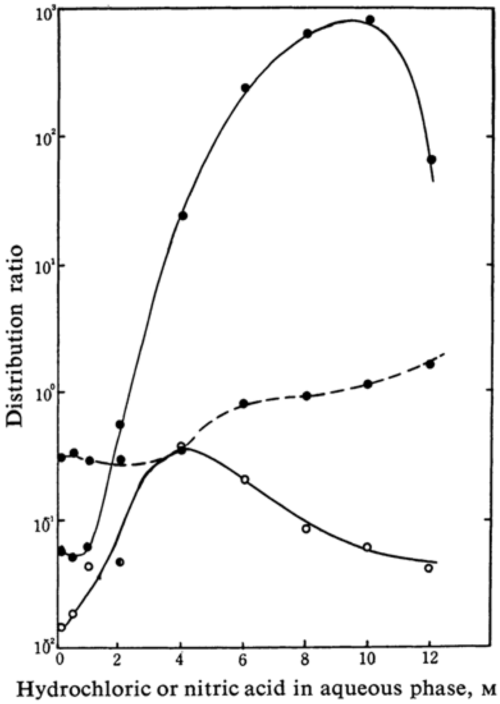

Fig. 3. Distribution ratio of niobium and tantalum.

——: Hydrochloric acid ----: Nitric acid
●: Niobium ○: Tantalum

show a constant slope of about 2 in all cases. The second power dependence of the $K_d$ values on the TOPO concentration suggests an extracted species that has a value of two for the moles of TOPO per mole of zirconium or hafnium.

Figures 2 and 3 show the $K_d$ values of zirconium, hafnium, niobium and tantalum in the range of hydrochloric or nitric acid concentration from 0.1 to 12 M, keeping the TOPO concentration $1\times10^{-2}$ M except in the case of tantalum in nitric acid. The $K_d$ values for tantalum in nitric acid could not be determined exactly, because the activities extracted into the organic phase were very low. As shown in these figures, the $K_d$ values greatly depend on the kind of acid and on its concentration. Zirconium can be separated from hafnium in the high acidity region, and also from niobium in nitric acid. A mutual separation of niobium and tantalum can be carried out more completely than that of zirconium and hafnium in hydrochloric acid.

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