Kurze Mitteilungen

Extraction of Gallium(III) from Hydrochloric Acid Solutions with an Indigenous Solvent Fusel Oil Phosphate or Ethyl Acetate

Extraktion von Gallium(III) aus salzsaurer Lösung mit Hilfe eines Fuselöl-Phosphates oder Äthylacetat

Extraktion von Gallium(III) mit Fuselöl-Phosphat, Äthylacetat; salzsaure Lösung

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We have utilised fusel oil phosphate (FOP), an indigenous solvent similar to TBP for the extraction of gallium(III) from its hydrochloric acid solutions, and compared it with ethyl acetate. The FOP was prepared by phosphorylation of the fusel oil, a by-product of the alcohol industry. The distribution coefficient in both the cases is maximum at 6.0 N HCl concentration and the empirical formula of the extracted metal species is invariably $HGaCl_4$, which is disolvated when FOP is used. Various factors affecting the extraction namely metal concentration, salting out agents, and nature of diluent have been worked out and the separation of the metal ion from its admixture with Al(III), In(III), and Tl(III) has been successfully achieved.

The data collected in the following table for the extraction of group III B metals into ethyl acetate indicate that the percentage extraction depends significantly on the initial acid concentration.

Table 1. Percentage extraction of group III B metals into ethyl acetate

Metal ions	% extraction at HCl concentration (N)						References
	1.0	2.0	3.0	4.0	5.0	6.0	
Al(III)	—	—	—	—	—	—	[1]
Ga(III)	—	—	30.9	90.1	95.4	98.3	this work
In(III)	—	—	—	1.4	2.4	3.7	[3]
Tl(III)	72.3	78.0	85.6	92.7	94.2	97.8	[2]

The fact that Al(III) is not extracted at all at 6.0 N HCl concentration could be used for a complete separation of Ga(III) from Al(III) by three batch by batch extractions. At 3.0 N HCl solutions In(III) is not extracted while Ga(III) extracts by 30.9% and hence a ten times batch by batch extraction was used to completely separate the two metals. For the separation of Tl(III) from Ga(III), use was made of the fact that the former extracts to 72.3% even at 1.0 N HCl concentration where the latter is not extracted at all. Four batch by batch extractions with ethyl acetate completely separated Tl(III) from Ga(III) solutions, the HCl concentration was then raised to 6.0 N and Ga(III) extracted.

A similar separation of Ga(III) from Al(III), In(III), and Tl(III) has been possible using FOP as the extracting solvent.

It is concluded that FOP is a better solvent than ethyl acetate as it is involatile, resistant to acidic hydrolysis and more efficient for the extraction of Ga(III) from its HCl solutions. It has been observed that Ga(III) is not extracted from its $HClO_4$ solutions and thus the possibility of direct solvation of the metal which is apparently saturated in tetrahedral surrounding by Cl^-, is ruled out. It seems that the proton of $HGaCl_4$ is solvated, the solvation number being 2.0 for FOP extraction but inconsistent for ethyl acetate.

References

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