The Extraction of Potassium with α-Hexyl in Nitrobenzene

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In the previous papers,[1,2] the extraction of potassium with dipicrylamine (Hexyl) and its derivatives was studied. Previously Tôei synthesized α-Hexyl[3] as a precipitant of potassium and this reagent was found to be an extractant of potassium from an aqeuous solution. Several ions interfere with the extraction and sodium ion gives the most serious effect. The repeated extraction, however, makes possible to extract potassium from a solution which contains a large amount of sodium ion.

Experimental

Reagents. α-Hexyl (picryl-2,4-dinitronaphthylamine) nitrobenzene solution (2.000×10^{-2} M) was prepared by dissolving 8.886 g of the reagent in nitrobenzene. Kalibor and Zephiramine (Dojinodo & Co. Ltd.) were used to prepare 0.02 M sodium tetraphenylborate and 0.01M tetradecyldimethylbenzylammonium chloride solutions, respectively. These reagents were standardized against the potassium chloride solution (1.000×10^{-2} M). A 0.02 per cent aqueous solution of Clayton Yellow was used as an indicator.

Extraction and Determination of Potassium. The procedure of extraction and stripping of potassium was almost the same as in the previous work[1] and the determination of potassium extracted was carried out by the titrimetry[4] which had been reported. Therefore, only a brief description about these procedures will be given here.

A potassium solution (25 m*l*, 0.01 M) in the presence of a certain amount of sodium hydroxide was shaken with the same volume of the nitrobenzene solution in a separatory funnel. After the extraction, 10 m*l* of the nitrobenzene phase was pipetted out and was shaken with 10 m*l* of 0.05 N hydrochloric acid. To 5 m*l* of this aqueous solution, equal volume of the sodium tetraphenylborate solution and a small amount of solid calcium hydroxide were added, and the preicpitate formed was filtered. Five milliliter of the filtrate was titrated with Zephiramine using Clayton Yellow as an indicator. The amount of potassium extracted was expressed in per cent throughout the experiments.

Results and Discussion

The Effect of Alkalis. The amount of alkali is found to have a large effect on the extraction of

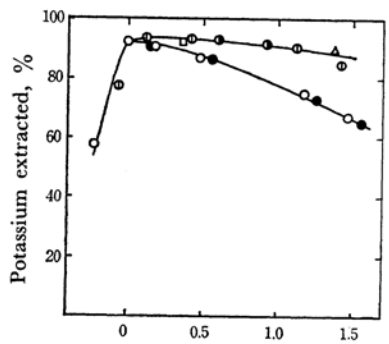

Fig. 1. The effect of alkalis.

RH/K=1; RH and MOH are expressed in normality and K in molarity.

NaOH	○	Na_2CO_3	●
LiOH	◐	Li_2CO_3	◑
$Ca(OH)_2$	□	$Ba(OH)_2$	△

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1) T. Iwachido and K. Tôei, This Bulletin, **37**, 1276 (1964).
2) H. Ueda, T. Iwachido and K. Tôei, *Nippon Kagaku Zassi (J. Chem. Soc. Japan, Pure Chem. Sect.)* **86**, 865 (1965).
3) K. Tôei, *ibid.*, **76**, 106 (1955).
4) T. Iwachido, *Talanta*, **13**, 341 (1966).

potassium, as is shown in Fig. 1. In the absence of an alkali the most part of potassium (97%) is remained unextracted. The amount of potassium extracted increases with the amount of the alkalis added and decreases gradually through a maximum. The maximum extraction (about 93%) is attainable when the reagent (RH) is just neutralized by these alkalis (MOH). Under the same condition, dipicrylamine and its derivatives also give almost the same value at the maximum extraction. Among the alkalis examined, sodium hydroxide and sodium carbonate have a most obvious interference.

The Effect of Diverse Ions. The effect of various salts on the extraction of potassium is shown in Table 1. The excess of sodium ion reduces the extractabilities as is expected from Fig. 1. The decrease of coloration of the aqueous phase is also observable at that time. A small differences among the extractabilities implies that the anions have no effect on the extraction. Consequently, a comparatively large interference of sodium salts and a small one of lithium and alkaline earth metal salts may be ascribed to the cations involved.

Table 1. The effect of various salts on the extraction of potassium
(RH/KOH=1, M/K=35)

Salt	Potassium extracted %	Salt	Potassium extracted %
None	92.5	$NaNO_3$	62.1
$NaC_2H_3O_2$	62.6	NaCN	62.3
NaCl	68.0	NaBr	61.9
NaI	62.9	NaF	62.6
Na_2SO_4	61.9	Na_2HPO_4	61.9
$MgSO_4$	86.5	$CaCl_2$	88.5
$MgCl_2$	87.9		

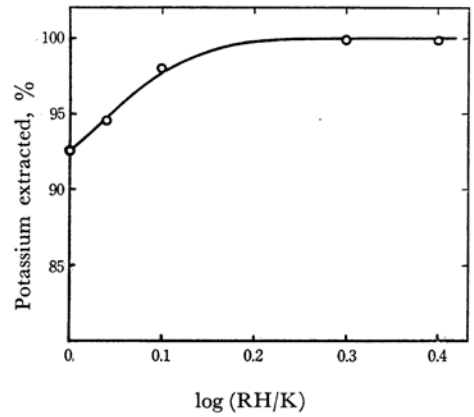

Fig. 2. The effect of the amount of the reagent.
NaOH/RH=1

The Effect of the Amount of the Reagent. Figure 2 shows that the amount of potassium extracted increases with the amount of the reagent used, and about twice amount of the reagent is enough to complete the extraction, if sodium ion is not present in excess. The repeated double extraction with the reagent (RH/K=2.5) is found to be sufficient to attain a complete extraction, even when 37.5 times of sodium ion is present in the sample solution.