STUDY OF THE EXTRACTION PROPERTIES OF β–$\beta$$'$-DICHLORODIETHYL ETHER (CHLOREX)

Chemistry

1965

SovietRxiv

Abstract

Full Text

UDC 542.61

Chemistry

P. I. ARTYUKHIN, E. N. GILBERT, B. I. PESHCHVITSKII, V. A. PRONIN, Corresponding Member of the Academy of Sciences of the USSR A. V. NIKOLAEV

STUDY OF THE EXTRACTION PROPERTIES OF β–β'-DICHLORODIETHYL ETHER (CHLOREX)

Recently, a large number of papers have been published on the study of the extraction properties of a wide variety of extractants, the number of which increases exponentially with each year, while their structures become ever more exotic. As a result, many extractants, because of their limited availability, cannot be used by chemists working on the problem of separating elements. Meanwhile, in the arsenal of organic chemistry there are many simple reagents produced industrially whose extraction properties have either not been studied at all or have been studied only very weakly. It is quite possible that among them there may be substances that selectively extract individual elements.

It seemed of interest to us to carry out a study of the extraction properties of β –β'-dichlorodiethyl ether (chlorex), which should behave somewhat differently from ordinary diethyl ether because of the presence of two chlorine atoms in the molecule. In the literature there is information only on the extraction by chlorex of iron in the trivalent state (^1); data on the extraction of other elements are absent. We studied the extraction by chlorex of twelve elements (Fe(III), In(III), Cr(III); Sn(IV), Mn(II), Co(II), Zn(II), Cu(II), Ag(I), Sb(V), As(V), Te(IV)) from hydrochloric-acid solutions with the aim of finding conditions for their separation.

The work was carried out using radioactive indicators. Before the experiment, solutions of the elements with indicators were subjected to identical treatment: they were boiled with aqua regia, then evaporated twice with hydrochloric acid. The initial concentration of the elements in all experiments was approximately 1-10 μg/ml. The commercial chlorex preparation was distilled, and the fraction boiling at 176–178° was collected.

The experiment was carried out as follows. To two milliliters of a hydrochloric acid solution of known concentration, containing the corresponding radioactively labeled element, an equal volume of chlorex was added; the mixture was then shaken for 10 min.* Preliminary experiments showed that this time was quite sufficient for equilibrium to be reached. After phase separation, the activity of the aqueous and organic phases was measured and the distribution coefficient (K_p) was calculated.

The results obtained are presented in Fig. 1, from which it is evident that chlorex extracts Sb(V) and Fe(III) very well, Sn(IV), Te(IV), and In(III) weakly, and practically does not extract Zn(II), Cu(II), Co(II), Mn(II), Cr(III), As(V), and Ag(I). Moreover, the region of maximum extraction of antimony and iron, in comparison with diethyl ether ([2-]4), is shifted toward higher hydrochloric acid concentration. This phenomenon may be explained by a decrease in the polarity of the ether molecule upon introduction of two chlorine atoms. In the presence of high concentrations of iron and antimony (50 g/l), the distribution coefficients of microamounts of other elements decrease by a factor of 5 or more (see Table 1). The high selectivity of the extraction of Fe(III) and Sb(V) in comparison with other elements can be used—

* All experiments were carried out at room temperature (20$±$2°).

use it for analytical purposes for concentrating impurity elements (separation of the main substance), or, conversely, for isolating microquantities of iron and antimony from other substances.

Fig. 1. Dependence of lg K_p on the initial concentration of hydrochloric acid. 1—Sb(V), 2—In(III), 3—Mn(II), 4—As(V), 5—Fe(III), 6—Sn(IV), 7—Co(II), 8—Te(IV), 9—Zn(II), 10—Ag(I), 11—Cu(II), 12—Cr(III)

The study of the distribution of other elements between Chlorex and hydrochloric-acid solutions, as well as the use of other media and concentrations of the distributed elements, will make it possible in the future to outline more clearly the extraction properties of Chlorex. The examples already given show that in some cases Chlorex can successfully replace diethyl ether. Another fact in favor of Chlorex is that it is only slightly volatile and is explosion-safe. Its high specific gravity (1.222) permits multiple extraction without removal of the aqueous phase from the extraction vessel.

Table 1

Distribution coefficients of elements during extraction with Chlorex from 11.4 n HCl in the presence of large amounts of iron and antimony

Element	Sb(V)	Fe(III)	Sn(IV)	Te(IV)	In(III)	Co(II)	Cr(III)	Zn(II)
In the presence of 50 g/l Fe(III)	112	—	$2.5 \cdot 10^{-1}$	$8.6 \cdot 10^{-2}$	$2.7 \cdot 10^{-2}$	—	$5.3 \cdot 10^{-4}$	$2.2 \cdot 10^{-3}$

Element	Sb(V)	Fe(III)	Sn(IV)	Te(IV)	In(III)	Co(II)	Cr(III)	Zn(II)
In the presence of 50 g/l Sb(V)	114	55.5	$2.5 \cdot 10^{-1}$	$9.5 \cdot 10^{-2}$	$3.4 \cdot 10^{-2}$	$3.4 \cdot 10^{-2}$	$2.9 \cdot 10^{-4}$	$1.2 \cdot 10^{-3}$

Institute of Inorganic Chemistry
Siberian Branch of the Academy of Sciences of the USSR

Received
10 IV 1965

CITED LITERATURE

1. J. Axelrod, E. H. Swift, *J. Am. Chem. Soc.*, **62**, 33 (1940).
2. F. Mylius, C. Hüttner, *Ber.*, **44**, 1315 (1911).
3. D. E. Chalkley, R. J. P. Williams, *J. Chem. Soc.*, 1955, 1920.
4. V. I. Kuznetsov, *ZhOKh*, **17**, 175 (1947).

Note: Figure translations are in progress. See original paper for figures.