

Phase equilibrium in extraction systems for separation of boron isotopes

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Abstract

At temperature 293-298 K, the phase equilibrium in the extraction systems "aqueous boric acid – organic phase" was studied for the separation of stable isotopes of boron ¹⁰B and ¹¹B. The key of the study is the formation of boron-containing compounds in the organic phase capable of isotopic exchange reactions with boric acid in water, which implies the possibility of using extraction systems as an alternative to existing gas-liquid systems for the separation of boron isotopes. The initial solutions were prepared by the gravimetric method, the used range of initial concentrations of boric acid in aqueous solution was (0.05-0.75) M, the organic and aqueous phases were mixed at a volume ratio 1:1, the equilibrium concentration of boron in the aqueous phase was determined by spectrophotometry, and the equilibrium concentrations of boron in the organic phase were calculated using the material balance. Primary, secondary and tertiary aliphatic amines were used as the main source of organic substances. Based on the obtained isotherms of boric acid extraction and the values of extraction coefficients, the most effective extraction of boric acid from aqueous solutions is observed when using as the organic phase a solution of a tertiary amine in an aromatic solvent in combination with the addition of hydroxycarboxylic acid to the initial aqueous phase. The values of extraction coefficients when using primary amine do not exceed 1, when using secondary and tertiary amine can significantly exceed 1, while using a tertiary amine and a relatively dilute initial aqueous solution of boric acid, the value of the extraction coefficient can be equal to 100-120. For the studied extraction systems, the formation of a viscous mass was detected by the interaction of primary, secondary and tertiary amine with an aqueous solution of boric acid in the absence of an organic solvent.

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