Materials of the Conferences

HEAT OSCILLATING EXTRACTION OF RARE EARTH ELEMENTS

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Using classical extraction for separation of chemically similarly elements requires the necessity of construction of cumbrous many-extractors cascades. As a result of this interest to search new alternative extraction methods just becomes greater. Work on development and improvement of separation methods based on nonstationary oscillating extraction has been carried on already more than ten years. Various factors deflecting system from stationary state are used: chemical, electrochemical, temperature and other.

Behavior of extraction system in nonstationary conditions using heat oscillating was investigated. Distribution of rare earth elements between two phases in one extractor and their separation between two extractors under these conditions was studied. Different condition of heat oscillating extraction: different oscillating period and different temperature peaks above normal state (25°C) was used. Optimal conditions for separation of elements with similar chemical properties were found.

Following system with simultaneous presence of two metals was investigated: H_2O – $Nd(NO)_3$ – $Pr(NO)_3$ – tributyl phosphate – kerosene. Determination of metal concentrations was realized using CCD-based spectrophotometers on-line. Modified experimental setup described in [1] was used. The concentration profiles of rare earth in time in aqueous phases and in organic phase showed the dependence of metal's concentration ratio on time. This fact can be used to separate similar elements using heat oscillatory extraction.

The Literature:

1. A. Kopyrin, A. A. Baulin, and M. A. Afonin, Oscillatory Extraction System with a Liquid Membrane for Separating REEs, Radiochemistry, Vol. 47, No. 4, 2005, pp. 387-391. Translated from Radiokhimiya, Vol. 47, No. 4, 2005, pp. 355-358.

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METHODOLOGICAL ASPECTS OF THE STUDY OF THE TEMPERATURE-KINETICS PARAMETERS OF THE F-ELEMENTS' EXTRACTION

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The methodic of the study of non-stationary f-elements' extraction was elaborated. The main methodic aspects of obtaining of the temperature-kinetics parameters were marked out.

The extraction rate constants from the independent experiment with one extractor (Lewis cell) on rare earth elements' (REE) mass transfer kinetics study were received. Two extraction systems were investigated, №1: 6M $NaNO_3$ – $Nd(NO_3)_3$ – $Pr(NO_3)_3$ – three-n-butylphosphate (TBP) – kerosene and №2: $[Nd(NO_3)_3{\cdot}3TBP]$ – $[Pr(NO_3)_3{\cdot}3TBP]$ – kerosene – 0.1M HNO_3.

Received data was set in the developed mathematical model of extraction kinetics. Calculated kinetics curves match well with experimental ones.

The series of experiments with extraction of REE under conditions of periodical thermal oscillations with low mass transfer in both extraction systems were worked out. The influence of periodical oscillations of the temperature on extraction and stripping processes in the extraction systems is studied. Mathematical model of the non-stationary membrane extraction is enhanced including the dependence of extraction rate constants on temperature. The values of activation energy for direct and reverse reactions of extraction and stripping reactions of Pr and Nd were calculated from experimental temporal dependencies of metal concentration and temperature by solving reverse kinetics problem using proposed mathematical model.

On the basis of the extraction rate constants and activation energies the optimization of the extraction process of separation of rare earth elements by liquid membrane under the influence of periodical oscillation of the temperature is carried out. The optimal conditions of separation by liquid membrane were found: frequency and amplitude of thermal oscillations, effective boundary area and liquid membrane flow rate.

The series of experiments with influence of periodical oscillations of the temperature on the extraction system using bulk liquid membrane between two extractors were carried out. The following extraction system was investigated: 6M $NaNO_3$ – $Nd(NO_3)_3$ – $Pr(NO_3)_3$ – TBP – kerosene – 0.1M HNO_3 with 0.5M TBP in kerosene as bulk liquid membrane. The mathematical model describes experimental data adequately.

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