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Tracer-scale Mo and W extraction in the Cyanex 600/nitric acid system

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The work deals with a complex topic of liquid-liquid extraction of Mo and W from the Sg point of view, which puts emphasis on extraction rate and efficiency. The topic can be divided into three main areas of focus: exploring the possibility of employing industrial grade extraction agent Cyanex 600 for extraction of group 6 elements from nitric acid solutions, suggesting the extraction mechanism of both Mo and W in the Cyanex 600/HNO₃ system, and describing the system's behaviour in sub-minute continuous extraction process using microfluidic techniques.

The Cyanex 600/HNO₃ system characterization revealed similarity with extraction mechanism of organophosphorus acids. The mechanism of Mo extraction with Cyanex 600 was established and apparent extraction constants of three pH-dependent extraction sub-processes were calculated. Although it was not proved with absolute certainty that the mechanisms for W and Mo are the same, results for W extraction were determined identically. In addition, the data analysis provided value of apparent dimerization constant of Cyanex 600 in kerosene. Based on its value, and the mechanism itself, it was revealed that main component of Cyanex 600 might not be Cyanex 272 as anticipated, but rather its dithio-derivate Cyanex 301.

Microfluidic system for fast extraction was successfully employed, and yielded aqueous-to-organic overall volumetric mass transfer coefficients that quantify kinetic performance of the system under given conditions. The region between 0.1 and 0.01M HNO₃ was identified as the most promising for potential Sg application for its fastest kinetics and extraction efficiency for both Mo and W. Furthermore, two microfluidic mixing techniques were compared: extraction in a capillary (inner diameter of 250 μm) and in a micromixer chip. Both were shown to have almost identical kinetic performance.

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