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Thermodynamic modeling of the rare elements behavior during the dissolution of heat-resistant nickel alloys waste in mineral acids

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Abstract

This work is aimed at studying the possibility of heat-resistant alloys waste processing, in particular, to determine the distribution of elements of a heat-resistant nickel alloy in solutions of mineral acids. The aim of the work was to predict the behavior of alloy components using the method of thermodynamic analysis. The research results can serve as a scientific basis for the development of promising technologies for the processing of metal wastes of heat-resistant alloys, allowing the extraction and separation of valuable rare and non-ferrous metals. Thermodynamic modeling of the interaction for the heat-resistant nickel alloy containing refractory rare metals with hydrochloric, sulfuric and nitric acids was carried out within a temperature range of 20-100 °C and concentration from 50 to 150 g/dm^3 under a pressure of 1 atm. According to the results of calculations, it was revealed that nickel transfers into sludge, both in the form of a metal and in the form of a Ni_4W compound. A temperature growth of more than 60 °C and an acid concentration from 50 to 150 g/dm^3 do not affect predominant distribution of tantalum and niobium pentoxides into the slurry and contributes to the transition to a solution of non-ferrous metals. The obtained data of thermodynamic modeling were confirmed in experiments on the anodic dissolution of the alloy in sulfate solutions. According to the results of X-ray phase analysis of sludge, it was found that the highest intensity of the diffractogram peaks corresponded to a solid solution of tungsten in nickel. The oxide phases of tantalum were also detected. In the electrolyte solution transferred, mainly Re, Co, Cr. Thus, it was shown the possibility of using the method of thermodynamic modeling to predict the behavior of elements in the processing of waste heat-resistant nickel alloys.

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