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THE LATEST COBALT AND NICKEL RECOVERY METHODS FROM MINERAL RAW

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The monograph considers innovative methods for extracting cobalt, nickel and related metals from cobalt-nickel-containing raw materials in Kazakhstan. Based on the establishment of regularities in the processes of interaction of cobalt minerals with various solvent reagents using the developed non-traditional thermodynamic method, which makes it is possible to determine the solvent reagents necessary for the opening of cobalt-containing compounds. Within the framework of this method, based on two international discoveries by Kh.K. Ospanov, a value is introduced, called the "average atomic energy of formation" ($-\Delta_f\overline{G}°$), which allows using the estimated forecast for assessing the ability of the body to a serious disease (minerals), and, therefore, as it approaches to the dissolution of poisoning, including for the mineral's cobalt and nickel in relation to an important or other dissolving reagent. In addition, a "calculated removal of a new chemical" ($\Delta_r G^0/n$) Within the framework of this method, based on two international discoveries by Kh.K. Ospanov, a value is introduced, called "average atomic energy of formation" ($-\Delta_f\overline{G}°$), which allows for predicting the difference in the reactivity of solids (minerals), and, accordingly, the sequence of dissolution of substances, including for the minerals cobalt and nickel with one or another dissolving reagent. In addition, the "calculated value of the reduced new chemical affinity" (-) is introduced, which makes it possible to predict the efficiency of the use of reagents and their dissolving abilities.

Based on the use of these two proposed values, the authors proposed a model of reactivity, which was used in the study of solvents of cobalt and nickel minerals under the conditions of their interaction during the processing of cobalt-containing raw materials. It is theoretically predicted and experimentally proved that – in the general case can be a theoretical basis that allows you to select the reagents necessary for the dissolution of several minerals by the hydrometallurgical method, including cobalt-nickel-containing minerals. Based on the results of this study, it is possible to develop an innovative technology that, depending on the chemical composition of cobalt-containing ores, can reduce the cost of their processing.

The monograph is intended for students, undergraduates, PhD students, research technologists (metallurgists), and scientists involved in the problems of thermodynamics and chemical kinetics at the solid-liquid interface.

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INTRODUCTION

Preface

At present, the most fundamental task in the field of physical chemistry is the construction of a theory of the reactivity of minerals (solid substances) and the creation of general principles for predicting the rate of competing reactions using an unconventional thermodynamic approach.

The problems of the physicochemical foundations of hydrochemical processes (hydrometallurgy, ore dressing, chemical technology, geochemical processes, chemical enrichment) occurring at the solid-liquid interface are essentially based on the laws of chemical thermodynamics and kinetics. However, the thermodynamics and kinetics of chemical reactions occurring under conditions far from equilibrium have several specific features, and traditional approaches within the framework of homogeneous processes are insufficient.

It should be noted the possibility of using these physicochemical characteristics, such as solubility (L), solubility product (SP), standard redox potentials (E^0), oxidation potential (E_r^0-pH) of a solution, for calculating ionic equilibria in analytical chemistry, geochemistry, in chemical technology. They are used when discussing data on the dissolution of salts and assessing the stability of certain forms of compounds [1–20]. However, the possibility of using these physicochemical characteristics to assess differences in the reactivity of solids under the conditions of a hydrochemical process occurring at the solid-liquid interface is limited. Of all the physicochemical parameters, solubility is the most important for evaluating the difference in reactivity. However, the determination of the solubility of natural minerals is associated with certain difficulties.

First, it is necessary to select pure monomineral fractions, which is not an easy task. Secondly, the study should be carried out in an environment where there is practically no complex formation, oxidation, hydrolysis, etc.

In the presence of an oxidizing agent and a complexing agent, conventional solubility methods may give incorrect results, as in this case, the solubility of sulfides is affected by complex formation and redox processes. Molar thermodynamic functions and classical chemical affinity have such a limitation. The use of molar thermodynamic characteristics does not allow predicting the difference in the reactivity of minerals, since the structural units of minerals include different numbers of unequal atoms and different types of bonds. Therefore, a comparison of the Gibbs energy of formation within the

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Method of selective extraction of nickel minerals from dolomite ores in the presence of cobalt minerals

(73) Қазақстан Республикасы Білім және Ғылым министрлігінің «Әл-Фараби атындағы Қазақ Ұлттық Университеті» шаруашылық жүргізу құқығындағы республикалық мемлекеттік кәсіпорнының «Ғылыми-технологиялық парк» шаруашылық жүргізу құқығындағы еншілес мемлекеттік кәсіпорны (KZ), Қазақстан Республикасы Білім және ғылым министрлігінің «әл-Фараби атындағы Қазақ ұлттық университеті» шаруашылық жүргізу құқығындағы республикалық мемлекеттік кәсіпорны (KZ)
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