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Thermodynamics Processes of Nitric Acid Leaching of Multicomponent Middlings

Denis Rogozhnikov

Ural Federal University, Mira st. 19, 620002
Ekaterinburg, Russia

Abstract

Phase and elemental composition of materials were studied with X-ray diffraction and electron microscopy investigations.
Thermodynamics analysis of nitric acid leaching processes with Pourbaix diagram was performed.

Keywords: Thermodynamics processes, nitric acid, Pourbaix diagram, multicomponent middlings

1 Introduction

The aim of this work is the thermodynamic evaluation of reactions occurring during nitric acid leaching of sulfide middlings, for the most complete translation of copper, zinc and sulfur in solution wuth Pourbaix diagram.

2 Experimental

Analyzed middlings is an intractable division of the selective flotation multicomponent sulphurous materials of deposits «Maykain B», Kazakhstan. The chemical composition of middling is presented in Table 1.

Table 1. The chemical composition of middling «Maykain B», % mass.

Cu	Zn	S	Fe	Pb	Au, g/t	Ag, g/t	Ca	Mg
6,37	9,21	46,30	33,57	1,18	11,50	81,30	1,72	0,24

The X-ray diffraction analysis showed that sphalerite, pyrite, chalcopyrite and galena are the most common minerals represented in the middlings.

Figure 1 presents the results of a study of the array of sulfide middlings grains using a transmission electron microscope JEM 2100 with an attachment for microanalysis Oxford Inca. The main elements of the array of middlings grains are %: 21, 29 S, 29, 65 Fe, 16, 53 Zn, 12, 19 Cu. Comparison of data with the results of X-ray analysis confirmed the presence of ZnS, $CuFeS_2$, FeS_2.

Element	Weight %	Atomic %
O K	6.03	15.46
Si K	0.50	0.74
S K	32.75	41.93
Ca K	1.12	1.15
Fe K	29.65	21.80
Cu K	12.19	7.87
Zn K	16.53	10.38
As L	1.23	0.67
Totals	100.00	100.00

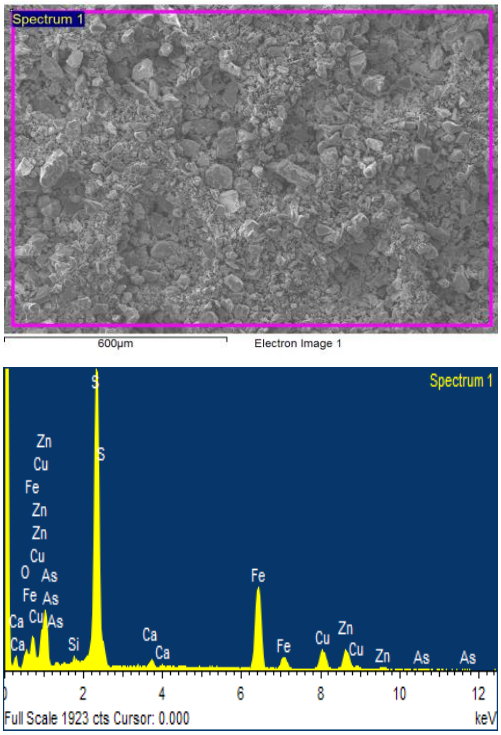

Figure 1. The results of a study of the array of sulfide middlings grains

3 Results and discussion

To determine the most probable conditions of formation of the desired leaching products of sulfide middlings in nitric acid, the mutual influence of the components produced pulp on the performance of the process, conducted the thermodynamic behavior assessment of middlings in nitric acid with a computer program «HSC Chemistry6» for construction of Pourbaix diagrams E – pH.

Joint diagram of copper, zinc and iron in the nitric acid existence during oxidation of sulphides (figure 2) allows to predict the behavior of all the main components of the studied complex polymetallic middling, choose modes of the process of oxidation of sulfides in order to maximize the full transfer of raw material components in a convenient form for further processing.

Diagram analysis showed that the full transfer of sulfide copper-zinc components of raw materials in the sulphate form required initial high oxidation potentials of E > 0.9 V. It is important that the copper and zinc are completely converted into cationic form.

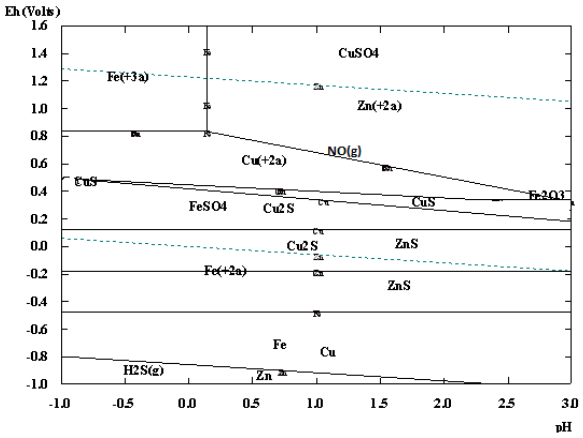

Figure 2. Joint diagram of copper, zinc and iron in the nitric acid existence during oxidation of sulphides

4 Conclusions

1. According to the results of X-ray and electron microscopic analysis mineralogical composition of multicomponent sulfide middlings was determined: major minerals are sphalerite, pyrite, chalcopyrite and galena.

2. Carried out with the Pourbaix diagrams thermodynamic analysis showed that the maximum transfer of sulfide middlings components in sulphate form required initial high oxidation potentials of E > 0.9V. Thus, copper and zinc completely pass in cationic form, the metal sulphide reacting with nitric acid leads to its disintegration and the formation of nitrous gases.

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