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Investigation of Cobalt Solubilities from Pyrite Cinder in Sulphuric Acid Solution

Mustafa AKDAĞ

Abstract

Cobalt is an important metal which is being used in advanced technologies such as alloying and electronic industry; as well as in painting and ceramics. This paper attempts to research the possible ways of transferring possibilities of cobalt from calcine which is obtained as a waste from roasting pyrite concentrates.

Keywords: *pyrite cinder, cobalt,sulphuric acid, calcine*

Mustafa Akdağ *is a professor at Industrial Engineering Faculty of Qafqaz University, Azerbaijan*

1. Introduction

Cobalt is an important metal which is being used in advanced technologies such as alloying and electronic industry as well as in painting and ceramics. This paper attempts to research the possible ways of transferring possibilities of cobalt from calcine which is obtained as a waste from roasting pyrite concentrates from Etibank Ergani Copper Mines (1).

Studies carried out on two different wastes:

1. Industrial waste from sulphuric acid production plant

2. Pyrite cinder obtained by a laboratory scale fluidized-bed roaster from pyrite concentrate.

2. Experimental

2.1 Materials and Methods

Table 1. Chemical and screen characters of industrial waste

Chemical Composition	%	Screen Aperture, mm	%
Cobalt	0,42	+0,425	0,1
Copper	0,88	-0,106+0,076	14,4
Iron	51,5	-0,076+0,053	38,0
Sulphur	1,2	-0,053	47,5

On the industrial waste (Table 1) only the parameters of cobalt solubilities in sulphuric acid solutions is investigated.

In the second part of the studies the samples of pyrite concentrate (Table 2) at first roasted in a laboratory scale fluidized-bed roaster.

Table 2. Chemical and screen characters of pyrite concentrate

Chemical Composition, %				Screen aperture, mm	%
Cobalt	Copper	Iron	Sulphur	+0,150	10
0,32	0,66	38,7	39		
				-0,106	75

2.2 **Results I** (On the industrial waste)

Influence of particle size on the cobalt solubilities

Experimental conditions:
Acid concentration: 0,30 M
Stirring rate: 900 rpm
Temperature: 85 0C
Solid rate: %5

Extraction yields of cobalt, %

Screen Aperture (mm)	Extraction duration, h				
	0,5	1,0	2,0	3,0	4,0
Original	4	9	18	20	23
-0.053	16	19	22	24	26

Influence of solid ratio on the cobalt solubilities

Experimental conditions:
Stirring rate: 900 rpm
Temperature: 85 0C
Extraction duration: 4 h
Particle size: original

Extraction yields of cobalt,%

Solid ratio, %	H_2SO_4 concentration, M	
	0,30	Additional solid ratio
5	23	23
10	11	27
30	1	35

Influence of Temperature on the Cobalt Solubilities

Experimental conditions:
Acid concentration: 0,30 M
Stirring rate: 900 rpm
Solid ratio: %5
Particle size: original

Extraction yields of cobalt, %

Temperature °C	Extraction duration, h				
	0,5	1,0	2,0	3,0	4,0
50	0,2	0,5	1,3	1,5	2,0
85	4,0	9	18	20	23
103	11	15,5	20	21,5	25,5

Influence of H_2S0_4 concentration on the cobalt solubilities

Experiment conditions:
Stirring rate: 900 rpm
Temperature: 85C
Solid rate: %5
Particle size: original

Extraction yields of cobalt, %

H_2SO_4 Concentration, M	Extraction duration, h				
	0,5	1,0	2,0	3,0	4,0
0.05	Extraction very low				
0.15	0,5	1,0	1,1	1,3	1,5
0.30	4	9	18	20	23
0.60	13	17,5	26	30	31,5

2.3 **Results II** (On the pyrite cinder-laboratorial product)

In literature it was decided that roasting conditions, especially temperature and duration have great effect on the chemical components (2-4). Due to this, different temperatures and roasting durations were applied to concentrates in a small scale fluidized-bed reactor and then products leached in the sulphuric acid solutions under optimal conditions.

Influence of roasting temperature on the cobalt solubilities

Roasting conditions:
Roasting Duration: 2h
Roasting Air : 0.93L/m
Quantity of Conc: 50g

Extraction yields of cobalt,%

Extraction Medium	Roasting Temperature, °C				
Medium	480-500	580-600	680-700	780-800	850-870
in water (l h)	60	28	2,5	-	-
in sulphuric acid solution (2h)	72	70	50	26	22,5

Acid concentration: 0,3M, Temperature: 85°C, Stirring rate: 550 rpm, Solid rate: %5, Particle Size: original

Influence of roasting duration on the cobalt solubilities

Roasting conditions:
Roasting temperature: 680-700°C
Roasting air: 0,93 L/m
Quantity of concentrate: 50g

Extraction yields of cobalt,%

Extraction Medium	Roasting duration, h				
	0,5	1,0	2,0	4,0	6,0
in water (lh)	29	5	2,5	1,0	-
in sulphuric acid solution (2h)	56	53	50	30	26,4

Acid concentration: 0,3 M, Temperature: 85°C, Stirring rate: 550 rpm, Solid rate: %5, Particle size: original

3. Conclusion

It is concluded that particle size, leaching temperature and sulphuric acid concentration have affected solubilities of cobalt from the industrial waste. But only even in ideal conditions 35% cobalt yield is obtained. It is noticed that the most important reason of this result comes from conditions of roasting for sulphuric acid production. In order to implement, pyrite concentrate roasted in laboratorial conditions and then products were let to leaching experiments. In fact, extraction yields of cobalt were doubled in comparing with first experimental results. It is cleared that the reason of low outcome of cobalt extraction into solution is due to high roasting temperatures and long period of roasting which have great effect on the transformation of cobalt into insoluble compounds(5,6).

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