

# The Investigation of High-Temperature Autoclave Leaching of Copper-Zinc Flotation Concentrate

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## **Abstract**

Autoclave leaching of «Maykain B» flotation concentrate, Kazakhstan, was performed. The results of study showed that copper recovery was 96,83-98,21% at the residual content in the cake 0,28-0,81%, zinc recovery was 98,83-99,52% at the residual content in the cake 0,13-0,48%.

**Keywords:** Autoclave leaching, flotation concentrate, recovery of copper and zinc

## **1 Introduction**

The aim of this work is the determination of the parameters of autoclave leaching of «Maykain B» flotation concentrate, at which the maximum extraction of copper and zinc in the solution can be achieved [1, 2].

In our previous studies a nitric acid leaching middlings of «Maykain B» were conducted [3-5].

## **2 Experimental**

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

**Table 1. The chemical composition of flotation concentrate «Maykain B», % mass.**

Cu	Zn	S	Fe	Pb	Au, g/t	Ag, g/t	Ca	Mg
7,09	10,42	44,00	34,06	0,48	1,11	11,50	81,30	1,84

Concentrate leaching was conducted in the titanium autoclave of 1,0 dm<sup>3</sup> volume, using the following parameters:

1. Weighed mass 50 g.
2. The leach solutions – sulfuric acid solution 5 g/dm<sup>3</sup> and saturated solution of in-situ leaching (SSISL) of OAO «UGM», Polevskoy, leaching solution volume 500 cm<sup>3</sup>.
3. The temperature leaching from 190 – 205<sup>0</sup>C.
4. The leaching time 2 – 2,5 hours.
5. The oxygen partial pressure 4 bar.

Leaching was performed at a constant stirring of the pulp, the oxygen feeding started after reaching the temperature 185<sup>0</sup>C. After oxygen, the autoclave was cooled to avoid overheating by the exothermic reaction.

At the end of the leaching autoclave was cooled, filtered pulp on a vacuum filter, the filter cake was washed with 2 portions of water 200 cm<sup>3</sup>. The solutions obtained were analyzed. The cake was dried, weighed and analyzed as well. Output of cake was 12g or 24% from the initial amount. Chemical composition of SSISL shown in Table 2.

**Table 2. Chemical composition of saturated solution of in-situ leaching SSISL**

Sample	pH	Eh	Concentration, g/dm <sup>3</sup>					
			H <sub>2</sub> SO <sub>4</sub>	Al	As	Ca	Cd	Co
SSISL	1,62	454	1,96	0,850	0,004	0,445	0,001	0,013
Sample	pH	Eh	Concentration, g/dm <sup>3</sup>					
			Cu	Fe	Mg	Mn	Ni	Zn
SSISL	1,62	454	0,563	2,016	0,893	1,124	0,015	0,141

### 3 Results and discussion

Leaching results are presented in Table 3.

**Table 3. The results of autoclave leaching of «Maykain B» flotation concentrate**

№ test	Solid/liquid	Leach solution, g/dm <sup>3</sup>	T, °C	t, hours	The composition of the productive solution, g/dm <sup>3</sup>							
					Cu	Zn	Fe	As	Pb	Au, mg/dm <sup>3</sup>	Ag, mg/dm <sup>3</sup>	H <sub>2</sub> SO <sub>4</sub>
1	1:10	sulfuric acid solution	195	2,5	6,91	9,72	24,78	0,23	0,00	0,00	0,00	44,1
2	1:10	sulfuric acid solution	190	2,5	6,73	9,72	19,04	0,18	0,00	0,00	0,00	42,6
3	1:10	SSISL	200	2,5	8,37	10,58	14,38	0,14	0,00	0,00	0,00	71,6
4	1:10	SSISL	190	2,0	7,96	9,78	16,86	0,17	0,00	0,00	0,00	68,3
H <sub>2</sub> SO <sub>4</sub> formation, kg/kg concentrate	Cake form-n, %	The composition of the cake, %									Recovery, %	
		Cu	Zn	Fe	As	Pb	Au, g/t	Ag, g/t	S	Cu	Zn	
0,39	29,00	0,57	0,46	33,5	0,095	3,70	38,33	270	21,2	97,59	98,61	
0,38	31,86	0,40	0,24	36,7	0,089	3,48	36,10	254	14,6	98,21	99,23	
0,68	53,58	0,28	0,13	41,6	0,08	2,07	21,46	151	19,0	98,04	99,31	
0,65	30,00	0,81	0,16	43,7	0,12	3,70	38,33	270	11,1	96,83	99,52	

The results of study showed that copper recovery was 96,83-98,21% and the residual content of copper in the cake 0,28-0,81%, zinc recovery was 98,83-99,52% and the residual content of zinc in the cake 0,13-0,48%.

Cake yield increased from 29 to 53,58% when used as a leach solution SSISL, and decreased the concentration of iron in solution after leaching with 24,78 g/dm<sup>3</sup> to 14,38 g/dm<sup>3</sup>.

### 4 Conclusions

1. Autoclave leaching of «Maykain B» flotation concentrate, Kazakhstan, using a leaching sulfuric acid solution 5 g/dm<sup>3</sup> and saturated solution of in-situ leaching (SSISL) of OAO «UGM», Polevskoy, at a temperature 190-200°C were performed.

2. When used as a leach solution SSISL concentration of iron in solution decreased from 24,78 g / dm<sup>3</sup> to 14,38 g / dm<sup>3</sup>. Extraction of copper and zinc remains almost at the same level.

3. During autoclave leaching 96,83-98,21% copper recovery was achieved with residual content of copper in the cake 0,28-0,81% and the recovery of zinc - 98,83-99,52% with residual content of zinc in the cake 0,13-0,48%.

4. Leach process forms sulfuric acid. In the leaching solution of a weak acid 0,38-0,39 kg H<sub>2</sub>SO<sub>4</sub>/kg concentrate is formed during leaching by SSISL 0,65-0,68 kg H<sub>2</sub>SO<sub>4</sub>/kg concentrate.

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