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STUDYING THE PROCESS OF DEPOSITION OF ANTIMONY WITH CALCIUM CARBONATE

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Abstract. Industrial production of copper solutions, in addition to the basic components (Cu, Ni), contain undesirable impurities which include arsenic and antimony. The process of withdrawal of antimony in copper electrolyte with calcium carbonate, which is present in nature as known minerals and in many cases is a waste product. The use of calcium carbonate to clean technology solutions allows you to bring the content of antimony to the optimum content.

Keywords: copper production, electrolyte, antimony, calcium carbonate, copper, calcium antimonate

The main volumes of balance reserves of copper are concentrated in Karaganda and East Kazakhstan oblasts of Kazakhstan.

Industrial production of copper solutions, in addition to the basic components (Cu, Ni), contain undesirable impurities which include arsenic and antimony. For qualitative and complete recovery of copper and nickel from solutions, the prior deposition of these impurities is required.

It is well known (Absat & Tusipbaev, 2012; Zhambekov & Absat, 2003) that the method of purification of an electrolyte copper from arsenic with insoluble calcium carbonate is economically advantageous in case of low acidity of the electrolyte (25-60 g/l sulfuric acid). However, in the factory the concentration of sulfuric acid in the copper electrolyte is not less than 100 g/l, which predetermines its preliminary neutralization processing methods known in the technological solutions of the copper production, in connection with the use of calcium carbonate to precipitate the antimony and bismuth from a copper electrolyte has great theoretical and practical interest.

To study the deposition of antimony calcium carbonate, we carried out research on the probability-determinination planning of experiment on four levels. The factors taken: Ca: Sb (Bi) (x_1) (0.5:1; 1:1; 1.5:1; 2:1); Temperature, °C(x_2) (25,40,55,70); sulfuric acid concentration in g / L (X_3) (80,100,120,140); duration of experiment, min. (X_4) (15, 30, 45, 60) and multiplier of dosing precipitator (x_5) (1,2,3,4).

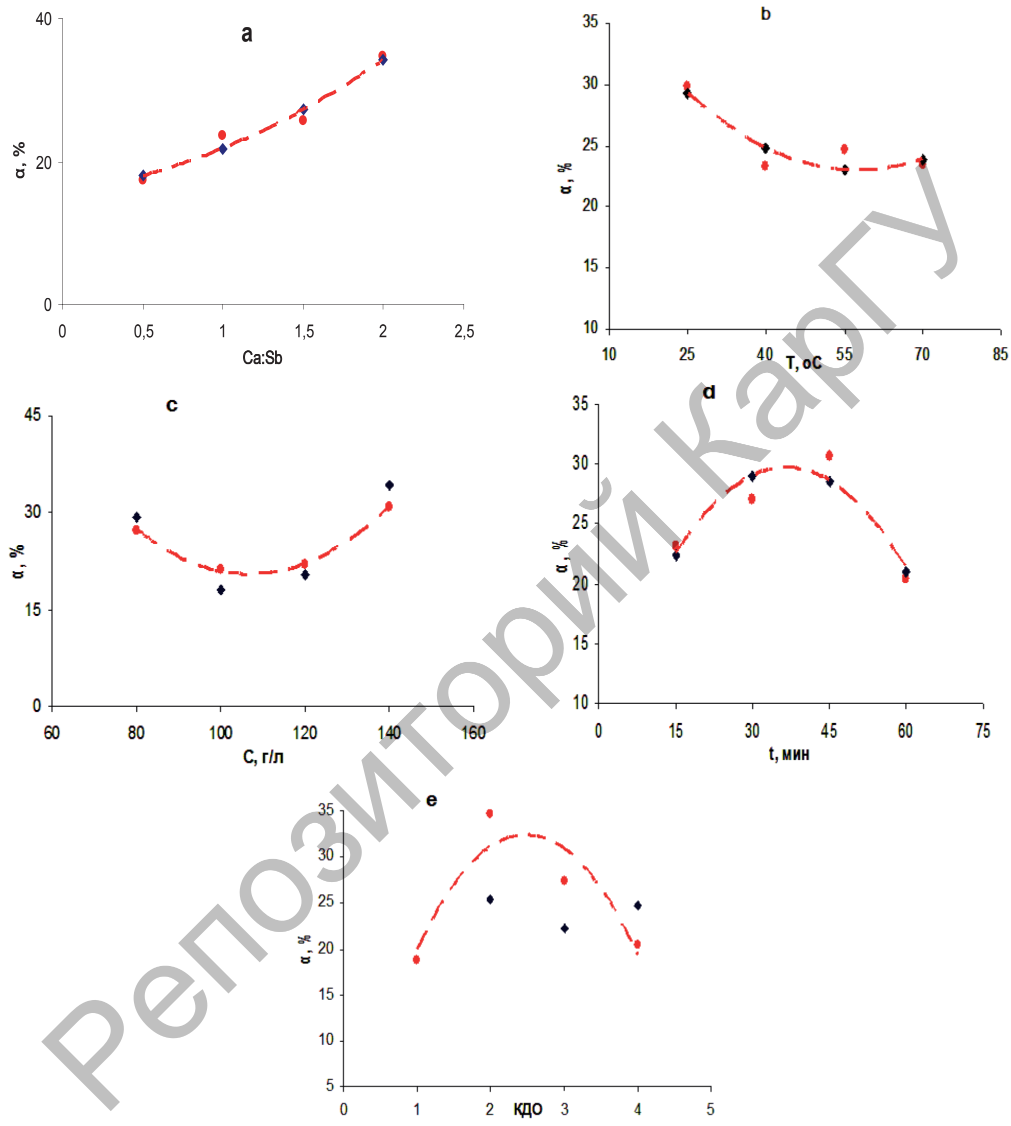
The experimental conditions and results for the deposition of antimony (α) shown in Table 1.

Table 1. Plan matrix and the results of the five-factor experiment at four levels of antimony

	Proportion of Ca:Sb (x_1)	(x_2)	(x_3)	(x_4)	(x_5)	$\alpha_э$, Sb %	$\alpha_т$, Sb %
1	0,5:1	25	80	15	1	15,06	20,21
2	1:1	40	100	30	1	12,53	20,75
3	1,5:1	55	120	45	1	20,18	25,06
4	2:1	70	140	60	1	27,05	33,54
5	0,5	40	120	60	2	16,47	13,16
6	1:1	25	140	45	2	48,27	35,68
7	1,5:1	70	80	30	2	36,65	32,27
8	2:1	55	100	15	2	7,02	23,27
9	0,5:1	55	140	30	3	26,31	23,44
10	1:1	70	120	15	3	26,15	16,38
11	1,5:1	25	100	60	3	23,31	22,17
12	2:1	40	80	45	3	41,97	41,40
13	0,5:1	70	100	45	4	11,93	16,21
14	1:1	55	80	60	4	14,93	18,07
15	1,5:1	40	140	15	4	22,13	29,53
16	2:1	25	120	30	4	32,79	40,73

As a result of our data sample we received the following: dependence on the degree of partial deposition of antimony on these factors, and the calculated theoretical values of the degree of deposition of antimony, which are shown in Fig. 1

For each degree of partial deposition of antimony dependencies on various factors chosen algebraic description of their correlation coefficients and significance were calculated (Table 2).



● - experimental values of antimony
♦ - theoretical values of antimony

Fig. 1 (a, b, c, d, e) - Private antimony deposition depending on various factors

Table 2. Correlation coefficients (R) and their significance (t_R) for private dependency degree of deposition of antimony with calcium carbonate

Function	R	t_R	Importance
$Y_1 = 3{,}11x_1^2 + 2{,}999x_1 + 15{,}712$	0,97	55,66	important
$Y_2 = 0{,}006x^2 – 0{,}6903x + 42{,}83$	0,84	9,06	important
$Y_3 = 0{,}0094x_3^2 - 2{,}0035x_3 + 127{,}48$	0,99	0,71	important
$Y_4 = -0{,}0157x_4^2 + 1{,}1471\ x_4 + 8{,}755$	0,88	6,61	important
$Y_5 =3{,}0056\ x_5^2 – 18{,}519x_5 + 50{,}697$	<0,66	<2	not

Statistical description of the partial dependence is presented by equation of Protodyakonov. For the deposition of antimony with calcium carbonate:

$$Y_n = (3{,}11x_1^2 + 2{,}999x_1 + 15{,}712) \cdot (0{,}006x^2 - 0{,}6903x + 42{,}83)\ (0{,}0094x_3^2 - 2{,}0035x_3 + 132{,}94) \cdot (-0{,}0157x_5^2 + 1{,}1471x_5 + 8{,}755\ ) \cdot 25{,}3^{-3}$$

The correlation coefficient of the equation for antimony R = 0,67, and its importance t_R = 4,14, error equation σ = 7,76%.

In addition to the significance of the correlation coefficients, importance of private functions was calculated by confidence interval, and the reproducibility of the experiment was calculated according to Cochran's Q test.

According to the values of the correlation coefficient and the confidence interval, it can be concluded that both the significance tests are in complete agreement.

Based on the analysis results of the study, the optimal conditions for the deposition of highly acid solutions of antimony copper were determined, in which antimony mostly fully precipitates: Ca ratio: Sb - 2:1, the temperature to 25°C, the content of sulfuric acid in the copper electrolyte - 80g/l, the duration of the process from 45 minutes to 60 minutes. The presence of solid precipitation of calcium antimonate confirmed by x-ray analysis.

Thus, for the first time, the process of output of antimony copper electrolyte by calcium carbonate was studied, whereas calcium carbonate meets in the minerals in nature and known in many cases as a waste product. The possibility of using calcium carbonate to clean technology solutions in order to bring the content of antimony to the optimum concentration, which subsequent stages of processing solutions in copper production brings a high quality of copper- and nickel-containing products.

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