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Research of the Valuable Components` Extraction Possibility from Technological Solutions Copper Production by Method of Ionic Flotation

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ABSTRACT: For the purpose of the collector`s choice at ionic flotation the dependence of ions` copper`s extraction and molybdenum in "skin" from pH solution and duration of flotation for the following collectors was investigated: amilovyxanthogenate, ethyl xanthogenate, isopropyl xanthogenate and diethyldithiocarbamate of sodium. As appears from the provided data, rather low extraction of ions is received with amilovyxanthogenate. All collectors form dry "skin" at high extraction of copper`s ions.

KEY WORDS:extracts, valuable components, solution, copper, ion flotation, metals, wastewater, reagent.

Researchers have shown a possibility of use of the collector of diethyldithiocarbamate of sodium at ionic flotation of metals. It is established that extraction of copper, molybdenum, iron and zinc comes from solution in a certain interval of values pH. The first floats copper (at pH = 5-5,5), then iron and molybdenum (at pH = 3-3,5). In a copper product (concentrate) 98,6-99,5% on the mass of copper are taken and content her in a product is 69,8-72%, at the same time extraction of molybdenum and gland makes 1-2% on weight and 4-7% on weight, respectively. In a molybdenic product 68-70% on the mass of iron are taken, 85-89% on the mass of molybdenum and 0,5-1,5% on the mass of copper and contents them in a product make 20,0-25,0; 50,5-52,0; 1,0-2,0% on weight, respectively. The received copper product after drying can be overworked in the converter, molybdenic it is possible to use as additive for receiving high-quality steel.

I. INTRODUCTION

Process of extraction of valuable components of technological solutions in many fields of chemistry and metallurgy is connected with use of new effective processes of division of components of solutions. Flotation of ions and molecules – a perspective method of extraction of substances from solutions is of undoubted interest. The achievements of the last years connected with extraction of surface-active ions considerably have expanded possibilities of this method.
Process of flotation is based that the particles of water dispersions having rather hydrophobic surface are capable to stick to vials of gas. At mutual movement of bubbles and dispersion similar particles concentrate on surfaces of bubbles, and particles which don't have the specified ability remain in volume of dispersion. Separating one way or another bubbles, it is possible to achieve division of particles on the basis of differences in their ability to concentrate on surfaces of bubbles.

Distinctions, necessary for division of particles, can be artificially created or increased by means of special reagents: collectors (collectors) and regulators (modifiers) operating with a certain degree of selectivity. The stability of bubbles necessary for conducting process of flotation is provided with reagents - foaming agents.
In the course of ionic flotation in solution there can be ions (molecules) of the extracted metal both in an untied state - kolligenda, and as a part of chemical compound with the superficially active agents (SAA) - the sublat forming a deposit. Surfactant, the forming connection with kolligendy, is called the collector.

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II. HARDWARE REGISTRATIONS.

Despite a constructive variety of the equipment offered so far, the vast majority of installations keeps within the schematic diagram represented in fig. 1. The last includes the systems of supply of gas 1, an initial product 2 and solution of the collector 3, the dividing device 4 and also systems top 5 and the lower 6 products.
The system of submission of gas changes depending on installation assignment. Generally it includes: a source of the raised or reduced pressure (a bulb or the line of oblate gas, the personal blower, the compressor, etc.); mechanical cleaning of gas from dust, oil droplets, etc.; chemical cleaning from impurity of unwanted gases; regulation and measurement of the expenditure, temperature and humidity of gas.

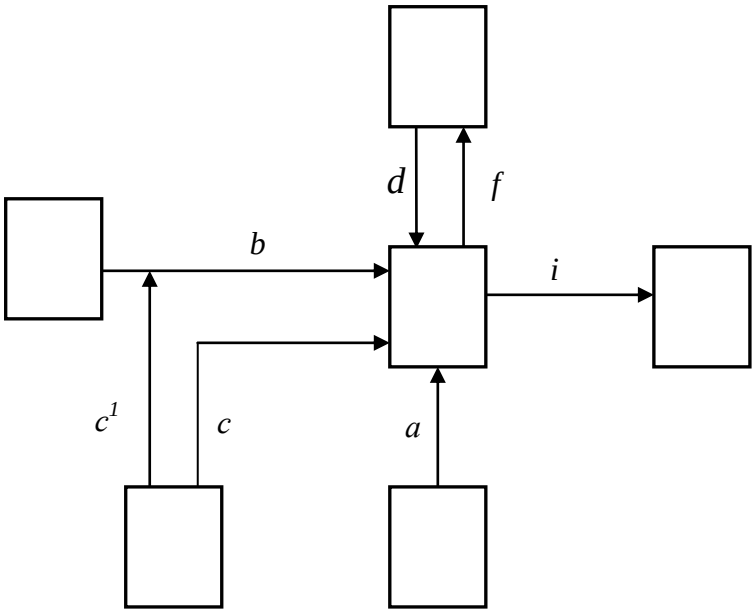

Fig. 1. The generalized schematic diagram of installation: a – gas; b – initial product; c and c^1 – solution of the collector; d and f – the upper product; i – lower product.

All these operations can be realized by the known methods.
The system of submission of the initial product is necessary only in case of the continuous process. As a rule, it includes capacity for the initial product the small pump and a rotameter [1].

The collector is usually entered into the initial product in advance. However sometimes he moves independent [1] – directly in the separating device or to the line of submission of the initial product. It is necessary to mark that in vitro the continuous and strictly constant dispensing of the concentrated spirit solution of the collector calls the considerable difficulties as expenditures of this solution are very small. Davis and Sebba [2] used for this purpose the micropump, and Kuzkin and Golman [1] – the linear dispenser.

It is necessary to mark that normal floatation machines of mechanical type are a little suitable for flotation of ions. The intensive agitation of liquid and the related energetic expenses necessary in mineral flotation for maintenance the coarse-dispersion of particles in suspension, are absolutely excessive in this case. Moreover, in bubble fractionation intensive agitation promotes solution homogenization, in foamy flotation can lead to drop-out of particles of a skin in solution volume, and in a flotoekstraktion – to emulsifying of an organic phase. Normal floatation machines of mechanical type are not suitable for a foam separation also because their cameras do not create conditions for drainage and dephlegmation of rather steady foams. Proceeding from above explained, we recommend the drawing of installation for extraction of valuable components from liquid waste of metallurgical production by method of the ionic flotation (fig. 2).

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It is necessary to emphasize that already now at a right choice roentgen the mode ionic flotation allows in several minutes at losses surfactant at the level of several milligrams in liter to take 90-99% on the mass of the metal which is contained in solution with initial concentration tens – hundreds of milligrams in liter and to receive a foamy product humidity of 10-20% on weight. Meanwhile industrial mastering of the ionic flotation and the related detailed researches of process only begin so, apparently, there are considerable reserves of increase in efficiency.

III. RESULTS AND DISCUSSIONS

For extraction of metals process of ionic flotation proceeding from the following advantages is chosen from sulfate solutions:
1) has high efficiency (time of flotation is several hundreds of seconds);
2) effectively at low concentration of metal in solution (from milligram shares to hundreds of milligrams in liter);
3) loss of organic reagent at the correct mode chosen as reagent, doesn't exceed several milligrams in liter;
4) differs in a lower of capital investments;
Besides, the necessary equipment is available on Joint-stock company Almalyk is mountain iron and steel works.
In most cases for flotation of ions and molecules, gas is necessary only as an inert phase for formation of an interphase surface liquid – gas. Therefore in laboratory researches nitrogen or air which yield almost equivalent results is most often used. Also cases of use of argon and other noble gases are known. Commercially follows, to be guided by air though in case of need it is possible to organize regeneration and turnover of gas, apparently. In our case air is used.
The technological sulfate solution forming by production of copper has pH =5-5,5 and contains (g l - 1): copper – 10-12,5; molybdenum – 1,5-2,5; gland – 5-5,5. In solution copper is in the CuSO4 form, iron in the form of $FeSO_4$.For the purpose of the choice of the collector the dependence of extraction of ions of copper in "skin" from pH solution (fig. 3) and duration of flotation (fig. 4) for the following collectors was investigated: amyl xanthogenate, ethyl xanthogenate, isopropyl xanthogenate and diethyldithiocarbamate of sodium. As appears from the provided data, rather low extraction of ions is received with amyl xanthogenate. All collectors form dry "skin" at high extraction of ions of copper.

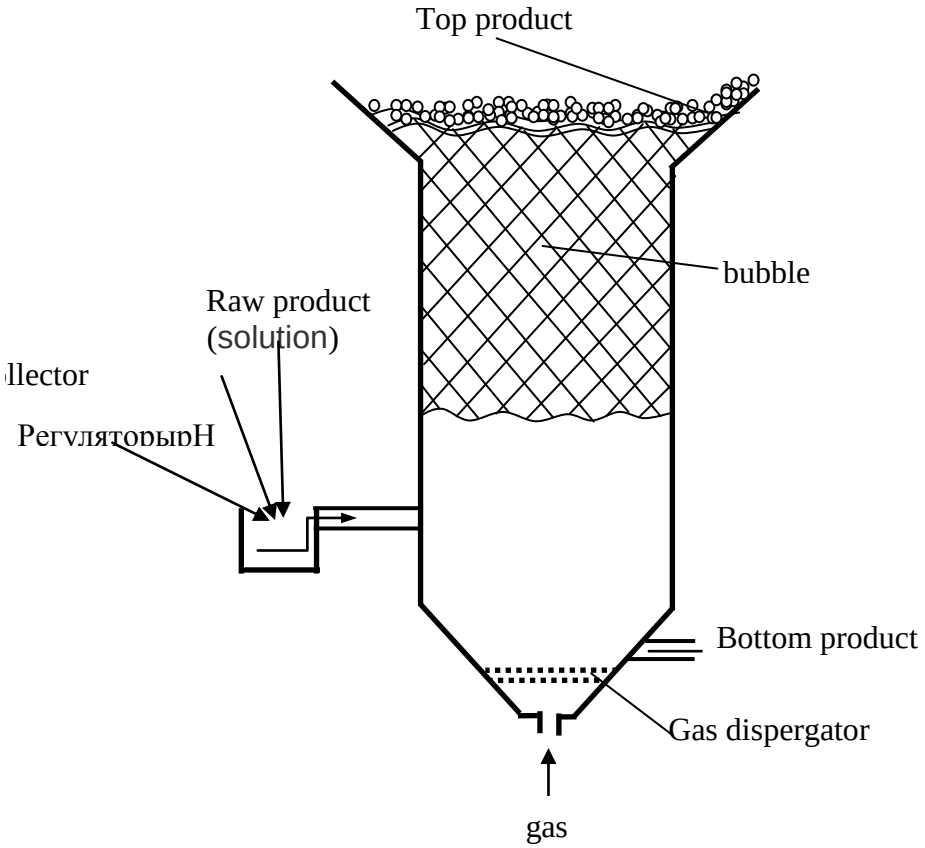

Fig. 2.The recommended drawing of installation.

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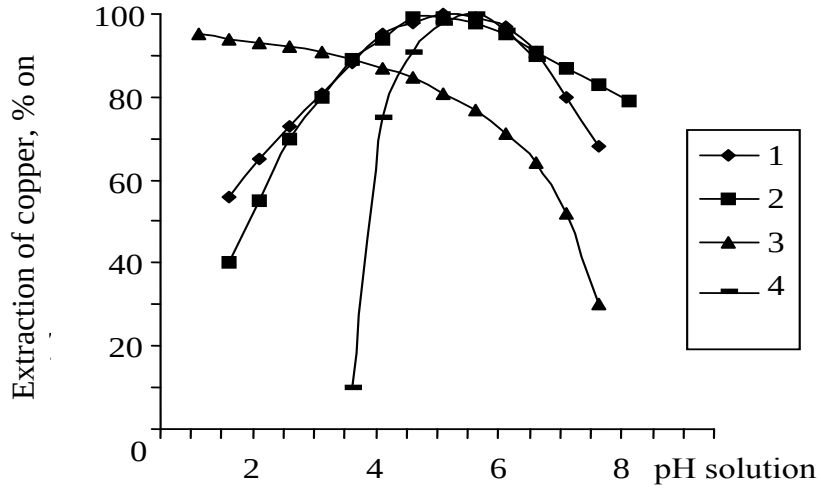

Fig. 1. Dependence of extraction of ions of copper from sulfate solution from pH environment, xanthogenates: 1-ethyl; 2-isopropyl; 3-amilovy; 4- diethyldithiocarbamate of sodium.

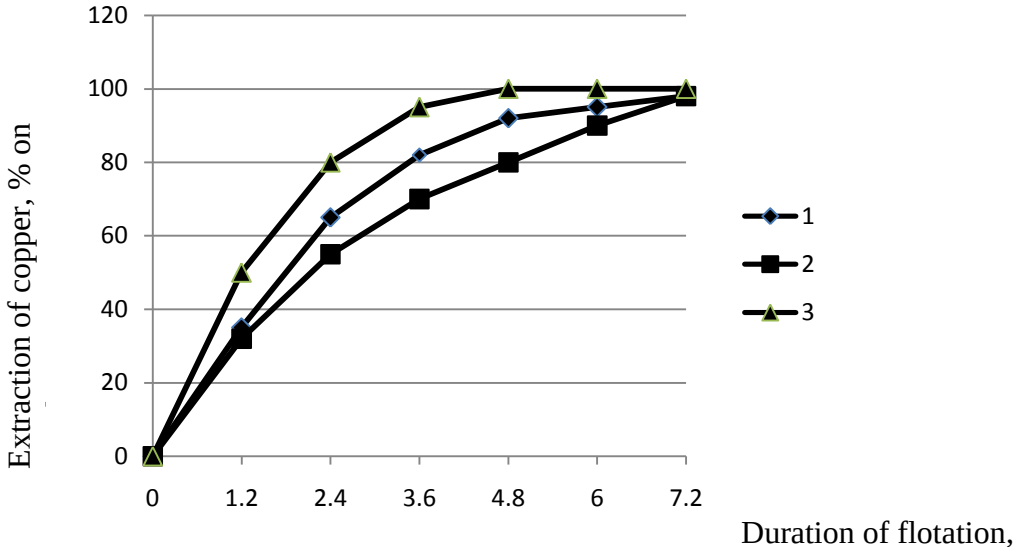

Fig. 4. Dependence of extraction of ions of copper from sulfate solution from flotation duration: 1-ethyl xanthogenate; 2-isopropyl xanthogenate; 3- diethyldithiocarbamate of sodium.

As show results of experiences (tab. 1), from all tested collectors diethyldithiocarbamate of sodium, at his expense of 110% on weight from stoichiometric was the most acceptable, extraction of copper makes 98,6-99,5% on weight.
For further researches we have chosen the collector of diethyldithiocarbamate of sodium since at ionic flotation he has the following advantages:
- forms very strong, steady in acidic environments, insoluble connections with all heavy metals and it is rather steady in solutions with low value pH;
- less toxic.
- reagent, rather low cost.

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Table 1.
The optimum mode of flotation of ions of copper and molybdenum from sulfate solutions various collectors

Collectors	the Expense of the collector, in % from stoichiometric	flotation Duration, in seconds	Extraction, in %	
			Cu	Mo
Amilovy xanthogenate	130	600	94,0-96,0	45,0-49,0
Ethyl xanthogenate	125	600	96,0-97,5	68,0-71,0
Diethyldithiocarbamate of sodium	110	600	98,6-99,5	86,0-88,5
Isopropyl xanthogenate	140	720	96,5-98,2	60,0-65,5

Researches have shown a possibility of use of the collector of diethyldithiocarbamate of sodium at ionic flotation of metals. It is established that extraction of copper, molybdenum, iron and zinc comes from solution in a certain interval of values pH. The first floats copper (at pH = 5-5,5), then iron and molybdenum (at pH = 3-3,5). In a copper product (concentrate) 98,6-99,5% on the mass of copper are taken and content her in a product is 69,8-72% on weight, at the same time extraction of molybdenum and gland makes 1-2% on weight and 4-7, respectively. In a molybdenic product 68-70% on the mass of iron are taken, 85-89% on the mass of molybdenum and 0,5-1,5% on the mass of copper and contents them in a product make 20,0-25,0; 50,5-52,0; 1,0-2,0% on weight, respectively. The received copper product after drying can be overworked in the converter, molybdenic it is possible to use as additive for receiving high-quality steel.

At ionic flotation each taken ion interacts with the collector. As a result the expense of the collector per unit mass is much higher than a kolligend, than at flotation of minerals. At flotation of ions for full extraction of a kolligend it is necessary, on extremely measure, a stoichiometric expense of the collector; minimum possible weight relation of the collector to a kolligend depends on their equivalent scales. At pH =5-5,5 flotation of 1 mol of copper requires only 0,01 mol of the collector. For molybdenum flotation an expense surfactant makes 1 mol on 1 mol of molybdenum. The general consumption of reagent makes 16-17,5 mg on 1 l of sulfate solution. Losses of separate metals in tails lie ranging from 0 up to 0,6% on weight, and the sum of losses of all metals doesn't exceed 1%.
Having passed some time, in solution formation of multinuclear connections which often leads to hydroxide loss begins. Therefore we recommend to float sulfate solution, right after leaching.

IV. CONCLUSION AND FUTURE WORK

1. Application as the collector of diethyldithiocarbamate of sodium change pH allows to take from solutions consistently 98,6-99,5% on the mass of copper, 85-89% on the mass of molybdenum.
2. Copper differs according to the floatation characteristics markedly from other elements because its usual valency 2. Thanks to a double charge of the ion copper is an element which gives easily processed skin.
3. The received copper product (concentrate) containing 69,8-72% on the mass of copper after drying can be overworked in the converter. The molybdenic product containing 20-25% on the mass of iron and 50,5-52% on the mass of molybdenum can be used as additive for receiving high-quality steel.
4. The fulfilled solution containing 0,10-0,15 g/l of Cu of 0,15-0,25 g/l goes to leaching of a candle end.

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