

Investigation of the electrolysis of sulfate acid solutions of copper and zinc in the presence of surfactants

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Abstract

The process of electrolysis of zinc proceeds in sulfate acid solutions, where cathodic precipitation of zinc, as the main substance, and copper, as an impurity ion, is always present in the electrolyte. Organic surface-active substances are of particular interest for hydrometallurgy. They affect the cleaning of solutions from impurities and the electrolysis of zinc. Flocculants, high molecular weight surfactants (molecular mass from 1 to 20 million), are used in large quantities in solutions, which are used to increase the rate of settling the pulp and to separate the solution from the solid insoluble mass. The anionic surfactant-lignosulfonate (LST) is introduced into the electrolysis stage to increase the efficiency of the process (reducing the negative effect of antimony, arsenic and others, reducing acid entry into the atmosphere of the shop, etc.), along with liquorice, bone glue. The aim of the work was to study the regularities of the influence of cationic and anionic surfactants on the electro reduction of copper and zinc in acidic solutions using potentiostatic and potentiodynamic methods.

Electrochemical investigations were carried out on an electrolyte containing solutions: 0.28 M CuSO₄ + 18 g/l H₂SO₄ and 0.25 M ZnSO₄ + 18 g/l H₂SO₄. Flocculants were dosed in the electrochemical cell in the form of an aqueous solution with a concentration of 2.5 g/l in an amount of 25 mg/l. Lignosulfonate was dosed at 80 mg/l. Potentiostatic data and the removal of polarization curves in a dynamic mode were carried out at the potentiostat *Potentiostat P-30J com. firm Elins*, using a three-electrode cell. The working electrode (cathode) is made of U0A grade zinc with an area of 0.35 cm² (for zinc electroconversion studies) and of M2 grade copper with a 0.12 cm² area (for copper electroreduction studies); the auxiliary (anode) is made of platinum plate with an area of 0.20 cm², the reference electrode is silver chloride (AgCl/Ag).

Analysis of the obtained data in potentiostatic conditions and linear scanning showed that the addition of 80 mg/l of LST allows obtaining higher discharge current densities during electrolysis of a solution of 0.28 M CuSO₄ + 18 g/l H₂SO₄ than in electrolysis 0.25 M ZnSO₄ + 18 g/l H₂SO₄. At the same time, under these conditions, the addition of cationic flocculants had a negative effect on the electrolysis of both compositions of the solutions, especially in the region of more positive potentials, in agreement with the theory of electrochemical processes. According to theory, an anionic surfactant should reduce the cathodic polarization, and increase the cationic activity, which, accordingly, will affect the increase and decrease of the cathode current. Higher discharge current densities during the electrolysis of a solution of 0.28 M CuSO₄ + 18 g/l H₂SO₄ with the addition of LST than without an additive may be due to the higher value, calculated by us, of the total differential capacity of 173.5·10⁻³ F/cm² (for solution with the addition of LST), against 120·10⁻³ F/cm² (for a solution without an additive). For the electrolysis of a solution of 0.25 M ZnSO₄ + 18 g/l H₂SO₄, the values of the total differential capacity, in contrast to the copper-containing solution, are practically the same and amount to 12.62·10⁻³ F/cm² for the electrolyte without additives and 13.99·10⁻³ F/cm² with the addition of 80 mg/L LST.

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