

The electroreduction are investigated zinc from the background solution of sodium sulfate in the presence of cationic and anionic flocculants

© Alexander V. Kolesnikov

Chelyabinsk State University. Brothers Kashirinykh St., 129. Chelyabinsk, 454001. Russia.

Phone: +7 (357) 794-25-12. E-mail: avkzinc-gu@yandex.ru

Keywords: electroreduction are investigated, flocculant, cationic, anionic, zinc, the current density, potential, background solution of sodium sulfate, polarization.

Abstract

The purpose of the work was to study the electroreduction of zinc in the presence of cationic and anionic flocculants used for settling and clarification of slurries in the hydrometallurgical production and wastewater treatment. The flocculants are dosed out in the form of an aqueous solution with a concentration of 2.5 g/l of 50 mg/l in an electrochemical cell. Dosage of flocculants are consistent with their consumption in hydrometallurgical cycle. The study were conducted on sulfate electrolyte containing 0.005, 0.0125 and 0.025 mol/l ZnSO₄ background in 0.5 mol/l Na₂SO₄ solution. Potentiostatic, galvanostatic studies and removal of the polarization curves in the dynamic mode were performed on potentiostat "Potentiostat P-30J of Elins firm Electrochemical Instruments" by using a three-electrode cell. The measurements were performed at room temperature. The current density during potentiostatic studies ranged from 0 to -30 mA/cm². The calculations used the following data: average amount of current for the period of withdrawal potentiostatic curve is equal to 60 sec; current in the initial period (1 sec); a linear scan of potential from -1050 to -1250 mV (Ag/AgCl) at a scan of 5 to 100 mV/s. The potential at the electrodes during the measurement in steady state was maintained at minus 1100, 1150, 1200 and 1250 mV (Ag/AgCl) and the current in galvanostatic measurements was maintained in the range from 0 to minus 0.6 mA. Transport number and the current exchange were calculated according to galvanostatic measurements, building semi-logarithmic dependence of Tafel of the polarization changes from the logarithm of the current density. In the calculations was focused on the area of the inclined straight line with a correlation coefficient (R²) more than 0.99.

It has been shown that with increasing concentration of zinc in the electrolyte decreases the potential at zero current, the increased current exchange, transport number and current density. The current value of the exchange consistent with the data of other authors for the cathodic process on zinc. The increase of the transport numbers with the increase concentration of zinc in the background solution indicates a decline in the Gibbs function of a reaction discharge of the zinc, and thus, the cations close to the electrode faster.

When stationary potentiometric studies the current density was decreased significantly with the addition of 50 mg/l of cationic flocculant Б6645 with all the potentials only for the electrolyte containing the highest amount of zinc 0.025 mol/L. The discharge current of the zinc did not increase with the change in potential from -1250 to -1200 mV. It is noted that this behavior is due to the negative impact of sulfates, which help reverse the dissolution of the cathode zinc.

It is shown that the largest polarization of the cathodic process occurs with the addition of the cationic flocculant. The magnitude of the polarization of the initial solution and with the addition of anionic flocculant Б4034 were almost the same for all the studied of the current densities. If you increase the speed of a linear scan increased the current density, which is associated with an increase in the contribution of the kinetic component of the discharge over the zinc diffusion in the electrolyte background solution of sodium sulfate.

According to electrochemical theory, the cationic surface active flocculant bestlock K6645 in the presence of specific adsorption should increase the cathode polarization of high rate discharge of zinc in connection with the increase of the diffusion potential, and active anionic flocculant bestlock K4034 the cathode polarization should reduce in turn, and the cathode current density increase thereby.

Thus, the experimental data obtained cathodic deposition of zinc from the electrolyte background solution of sodium sulfate in the presence of flocculants with a molecular weight of from 1 million to 10 million are consistent with the theoretical considerations of electrochemical processes.

References

- [1] A.V. Kolesnikov. Studies of reasons for the effective use of lignosulfonate in the electrolysis of zinc. *Butlerov Communications*. **2014**. Vol.40. No.12. P.110-116. ROI: jbc-02/14-40-12-110
- [2] A.V. Kolesnikov. Investigation of the effect of surfactants with inversion-voltammetri metod analysis of metals. *Butlerov Communications*. **2016**. Vol.47. No.7. P.93-96. DOI: 10.37952/ROI-jbc-01/16-47-7-93
- [3] A.V. Kolesnikov. Studies of the discharge of zinc from the background solution of sodium sulfate in the presence of lignosulfonate. *Butlerov Communications*. **2017**. Vol.49. No.1. P.128-135. DOI: 10.37952/ROI-jbc-01/17-49-1-128
- [4] A.V. Kolesnikov, and K.V. Semenov. Studies of kinetic parameters of the zinc sulphate solution in the presence of an electrochemical system lignosulfonate. *Butlerov Communications*. **2016**. Vol.47. No.7. P.70-73. DOI: 10.37952/ROI-jbc-01/16-47-7-70
- [5] A.V. Kolesnikov. Influence of flocculants on electroreduction of zinc from sulfate solutions. *Bestn. SGTU. Chemistry and Chemical Technologies*. **2014**. No.3 (76). P.47-52. (russian)
- [6] A.V. Kolesnikov, K.V. Semenov. Change in the parameters of electrochemical processes in the presence of lignosulfonate. *Materials of the 8th International Scientific and Practical Conference "Fundamental and Applied Sciences Today"* May 10-11. **2016**. North Charleston, USA. Vol.1. P.115-118. (russian)
- [7] A.V. Kolesnikov, K.V. Semenov. Electrolysis of zinc from sulphate acidic and neutral solutions in the presence of lignosulfonate. *Actual problems of the humanities and natural sciences*. Part 1. **2016**. No.4 (87). P.57-60. (russian)
- [8] A.V. Kolesnikov. Cathodic and anodic processes in solutions of zinc sulfate in the presence of surface-active substances. *Izv.Vyssh.Uchebn.Zaved.Chemistry and Chemical Technology*. **2016**. Vol.59. No1. P.53-57. (russian)
- [9] A.V. Kolesnikov. Reduction of copper by metallic zinc in aqueous solutions in the presence of high-molecular surfactants. *Kondensirovannye sredy i mezhfaznye granitsy*. **2016**. Vol.18. No.1. P.46-54. (russian)
- [10] I.V. Minin, N.D. Solovyova. Kinetics of electroreduction of zinc from sulfate electrolyte in the presence of surfactant additives. *Bestn. SGTU. Chemistry and Chemical Technology*. **2013**. No.1 (69). P.58-62. (russian)
- [11] A.V. Kolesnikov, L.A. Kazanbaev, P.A. Kozlov. Effect of organic substances on the processes of carburization and electrolysis of zinc. *Non-Ferrous Metals*. **2006**. No.8. P.24-28. (russian)
- [12] A.I. Biryukov, A.P. Thrones, and V.S. Mukhametianov. Features of corrosion-electrochemical behaviour of steels with different chromium content in highly acidic sulfate media. *Butlerov Communications*. **2016**. Vol.46. No.5. P.61-66. DOI: 10.37952/ROI-jbc-01/16-46-5-61
- [13] N.A. Bykovsky, L.N. Puchkova, and N.N. Fanakova. Electrochemical processing of distiller fluid of ammonium-soda manufacture. *Butlerov Communications*. **2015**. Vol.43. No.7. P.122-126. DOI: 10.37952/ROI-jbc-01/15-43-7-122
- [14] A.R. Latypov, E.V. Boev, and D.Ye. Bugay. Reducing the rate of corrosion of oil and gas equipment by polarization surface. *Butlerov Communications*. **2015**. Vol.43. No.7. P.127-134. DOI: 10.37952/ROI-jbc-01/15-43-7-127
- [15] L.A. Kazanbaev, P.A. Kozlov., V.L. Kubasov, A.V. Kolesnikov. *Hydrometallurgy of zinc (cleaning solutions and electrolysis)*. Moscow, Publishing house "Ore and Metals". **2006**. 176p. (russian)
- [16] V.V. Skorchelletti. *Theoretical electrochemistry*. Ed. 4th corr. and add. Leningrad: Chemistry. **1974**. 568p. (russian)