

Studies of the discharge of zinc from the background solution of sodium sulfate in the presence of lignosulfonate

© Alexander V. Kolesnikov

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

Phone: +7 (351) 794-25-12. E-mail: avkzinc-gu@yandex.ru

Keywords: lignosulfonate, zinc, the current density, potential, background solution of sodium sulfate, the order of reaction with respect to the ions of zinc.

The purpose of the work was to study the regularities of lignosulfonates influence on the cathodic deposition of zinc restricted migration component of the current due to background solution of sodium sulfate. Electrochemical studies were conducted on sulphate electrolyte containing 0.005, 0.0125 and 0.025 mol/l ZnSO₄ background in 0.5 mol/l Na₂SO₄ solution.

Potentiostatic studies and detaching polarization curves were performed in dynamic mode potentiostat PS-Pack-2 by using a three-electrode cell. 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: the average amount of current for the period of withdrawal potentiostatic curve equal to 60 sec; current in the initial period (1 sec); a linear scan of potential from -1050 to -1250 mV (for Ag/AgCl) at a scan speed of 5 to 100 mV/c. The potential at the electrodes during the measurement in steady state was maintained at minus 1100, 1150, 1200 and 1250 mV (for Ag/AgCl).

For a second initial stage of electrolysis was fixed maximum current, and in the end (after 60 sec), it was reduced by 2-5 times depending on the concentration of zinc and the stationary potential. Average values of the current density was calculated for the entire period of five replicates. In some cases, the standard error is 37%, as a whole for the entire sample, it was 14.6%.

According to the linear potential sweep in the region from -1050 to -1250 mV solutions for three compositions was showed that the maximum discharge current density increases with increasing scanning rate with 5 to 100 mV/s from 3 to 5 times. Small deviations from the origin passing direct current dependency values of the square root of scan speed was indicated flow on the surface of the working electrode of several processes, one of which occurs in a diffuse, and the other in the kinetic regime.

The order of the reaction process at the electrode zinc ion was calculated for potentials at the four solutions without additives and with the additive of lignosulfonate 80 mg/l. Processing of statistical data potentiometric studies carried out in the first second start of the process. Average reaction order for the initial solution was 1.19, and for the solution of lignosulfonate – 1.49.

It has been shown that increasing the effective surface area of the cathode with increasing concentration of zinc in the electrolyte increases as the reaction order for the zinc ion, and to increase the quantity of electricity in comparison with the stoichiometric discharge reaction of zinc. The presence in the electrolyte of lignosulfonate further increases the effective surface area of the cathode. Practically eliminates the formation of gas bubbles on the surface in studies in a neutral environment with background of the electrolyte of sodium sulfate. The cathode deposits are obtained without dendrites greater whiteness, corrosion, etc., allowing the reagent to successfully put into production of electrolytic zinc.

References

- [1] A.V. Kolesnikov. Research the causes of the effective use of lignosulfonate in the zinc electrolysis. *Butlerov Communications*. **2014**. Vol.40. No.12. P.110-116. ROI: jbc-02/14-40-12-110
- [2] A.V. Kolesnikov. Study the effect of surfactants with inversion-voltamperometric analysis. *Butlerov Communications*. **2016**. Vol.47. No.7. P.93-96. DOI: 10.37952/ROI-jbc-01/16-47-7-93
- [3] A.V. Kolesnikov. Effect of flocculant on electroreduction of zinc from sulfate solutions. *Bestn SGTU "Chemistry and Chemical Technologies"*. **2014**. No.3 (76). P.47-52. (russian)
- [4] O.V. Negvoglod, E.N. Selivanov. Mass transfer in the electrochemical oxidation of the pellets sulphide copper-nickel alloy. *Butlerov Communications*. **2016**. Vol.47. No.8. P.80-86. DOI: 10.37952/ROI-jbc-01/16-47-8-80
- [5] V.V. Pryanichnikova, N. Shulaev, N.A. Bykovsky, R.R. Kadyrov. Electrochemical purification of contaminated soils. *Butlerov Communications*. **2016**. Vol.47. No.8. P.47-51. DOI: 10.37952/ROI-jbc-01/16-47-8-47

- [6] A.I. Biryukov, A.P. Thrones, V.S. Mukhametianov. Features of corrosion-electrochemical behaviour of steels with different content of chromium in highly acidic sulfate environments. *Butlerov Communications*. **2016**. Vol.46. No.5. P.61-66. DOI: 10.37952/ROI-jbc-01/16-46-5-61
- [7] N.A. Bykovsky, L.N. Puchkov, N.N. Fanakova. Electrochemical processing of distilled liquid of ammonium-soda production. *Butlerov Communications*. **2015**. Vol.43. No.7. P.122-126. DOI: 10.37952/ROI-jbc-01/15-43-7-122
- [8] A.R. Latypov, E.V. Boev, D.E. Bugay. Reducing the rate of corrosion of oil and gas equipment using the polarization surface. *Butlerov Communications*. **2015**. Vol.43. No.7. P.127-134. DOI: 10.37952/ROI-jbc-01/15-43-7-127
- [9] A.V. Kolesnikov, K.V. Semenov. Changing the parameters of electrochemical processes in the presence of lignosulfonate. *The proceedings of the 8th international scientific-practical conference "Fundamental and applied Sciences today" on may 10-11, 2016. North Charleston, USA*. Vol.1. P.115-118. (russian)
- [10] A.V. Kolesnikov, K.V. Semenov. Electrolysis of zinc from sulphate acidic and neutral solutions in the presence of lignosulfonate. *Actual Problems of Humanitarian and Natural Sciences*, CH. 1. **2016**. No.4 (87). P.57-60. (russian)
- [11] A.V. Kolesnikov. The Cathodic and anodic processes in solutions of zinc sulfate in the presence of surfactants. *Izv. Vyssh.Uchebn.Zaved "Chemistry and Chemical Technology"*. **2016**. Vol.59. No.1. P.53-57. (russian)
- [12] U. Iin, A. Razanovich, D.B. Goring. Chemistry and biochemistry of lignin, cellulose and hemicellulose. *Moscow: Forest Industry*. **1969**. 158p. (russian)
- [13] A.L. Rotinyan, K.I. Tikhonov, I.A. Shoshina. Theoretical electrochemistry. *Leningrad: Chemistry Publ*. **1981**. 422p. (russian)
- [14] V.V. Scorcelletti. Theoretical electrochemistry. Ed. 4-e, rev. and ext. *Leningrad: Chemistry*. **1974**. 567p. (russian)
- [15] A.V. Kolesnikov, K.V. Semenov. Research of kinetic parameters of the electrochemical system of solutions of zinc sulphate in the presence of lignosulfonate. *Butlerov Communications*. **2016**. Vol.47. No.7. P.70-73. DOI: 10.37952/ROI-jbc-01/16-47-7-70
- [16] I.V. Minin, N.D. Solovyeva The kinetics of electroreduction of zinc from sulfate electrolyte in the presence of surfactant additives. *Bestn SGTU. «Chemistry and Chemical Nechnology»*. **2013**. No.1(69). P.58-62.