Full Paper _____ *Thematic Section:* Research into New Technologies.
Reference Object Identifier – ROI: jbc-02/18-53-3-90 *Subsection:* Electrochemistry.
Publication is available for discussion in the framework of the on-line Internet conference "*Butlerov readings*".
http://butlerov.com/readings/
The article is published based on the materials of the 2nd stage of *the Mini-Symposium "Butlerov's Heritage –17-18"* (Kazan).
Submitted on January 26, 2018.

Investigation of the influence of the addition of lignosulfonate on the determination of cadmium by inversion-voltammetric analysis

© **Alexander V. Kolesnikov**,*+ and **Anastasia A. Dydykina**
Chelyabinsk State University. Brothers Kashirins St., 129. Chelyabinsk, 454001. Russia.
Phone: 794-25-12. E-mail: avkzinc-gu@yandex.ru

*Supervising author; +Corresponding author

Keywords: voltammetry, lignosulfonate, surfactants, cadmium, peak height and area, register histograms.

Abstract

An inversion-voltammetric analysis of cadmium in the presence of additives of lignosulfonate was carried out. The aim of the work is to determine the effectiveness of the addition of lignosulfonates (LST) under various conditions of conducting cadmium analysis by the method of inversion voltammetry.

A voltammetric analyzer *ECOTEST-VA*, compatible with a personal computer with software N_VA2010.exe, was used in the work. The measurements were carried out in a three-electrode cell, which included a working carbon-graphite macroelectrode, an auxiliary platinum electrode *EPV-1*, and a comparative silver chloride electrode *EVL-1MZ.1*. Stirring of the solution was carried out by a controlled magnetic stirrer. To create an amalgam mercury film on the surface of a carbon-graphite macroelectrode, a hydrochloric acid solution of divalent mercury with a concentration of 0.05 mmol/l was used as the background solution. The concentration of cadmium in the solutions being analyzed was 50-200 μg/l. The addition of LST varied from 10 to 200 mg/l. The determination was carried out at sweep speeds from 25 to 200 mV/s, the start of the scan minus 1300 mV, the end of the scan plus 200 mV (Ag/AgCl). The accumulation time is 60-90 sec. Potential of electrode cleaning is 100 mV.

The data of register histograms are obtained in the analysis of cadmium in solutions with the addition of LST from 10 to 200 mg/l. The maximum increase in heights and areas of peaks was limited to additives of LST 25-50 mg/l. A further increase in the amount of the additive somewhat reduced the effectiveness of its effect upon the removal of register histograms at the same content of cadmium in the solution. The given values of the heights and peak areas have been at different rates of potential sweep are given. Unlike the data obtained at a constant sweep speed, the peak-to-area peaks differ markedly. Perhaps this is due to a decrease in the accumulation time by 1.5 times. The greatest increase in peak height with the addition of LST have been at sweep speeds of 25 and 50 mV/s. With an increase in the speed, the sweeps from 25 to 200 mV/s peak height increase 2-3 times, and peak areas increase 3-4 times. According to the data obtained at different scanning rates, logarithmic dependences of the current and velocity were constructed, which allowed estimating the limiting process of the anodic process of dissolution of cadmium from amalgam. It is shown that in the absence of the addition of LST, the rate of dissolution of cadmium is determined by diffusion, and with the addition of LST and low scanning speeds, the process of cadmium ionization from amalgam is related to kinetic limitations.

Calculations of transport coefficients are carried out. It is noted that an increase in the transfer coefficient in the presence of LST suggests that the adsorption of an anionic surfactant lignosulfonate has a lesser effect on the process of dissolution of cadmium from amalgam than on the reverse process of reduction of cadmium ions.

The use of lignosulfonates in the inversion-voltammetric analysis makes it possible to expand the limit of detection of cadmium and, consequently, to improve the accuracy of the analysis.

References

[1] A.V. Kolesnikov. Investigation of the effect of surfactants in inversion-voltammetric analysis. *Butlerov Communications.* **2016**. Vol.47. No.7. P.93-96. ROI: jbc-02/16-47-7-93
[2] A.V. Kolesnikov. Cathodic and anodic processes in solutions of zinc sulfate in the presence of surface-active substances. *News of universities "Chemistry and Chemical Technology".* **2016**. Vol.59. Iss.1. P.53-57. (russian)

[3] M.A. Loshkarev, Yu.M. Loshkarev. The effect of surfactants on electrode processes. *In the collection «Voltamperometriya organic and inorganic compounds»*. Moscow. **1985**. P.35-45. (russian)
[4] E.A. Osipova, N.K. Zaitsev, D.M. Fedulov, A.G. Dedov. Investigation of the processes of discharge and ionization of lead in the presence of surface-active substances using a system with replacement of the solution without opening the circuit. *Herald of Moscow un-ta. Ser.2. Chemistry*. **2004**. Vol.45. No.6. P.405-409. (russian)
[5] T.S. Ivonina, I.E. Stas. Influence of the conditions of electroconcentration on the degree of inhibition of the signal by butyl alcohol in the method of inversion voltammetry. *Proceedings of the Altai State. University*. **2002**. No.3. P.17-21. (russian)
[6] L.A. Khustenko, V.V. Moshkin. Automated determination of copper in production waters of thermal power station by the method of inversion voltammetry. *Factory laboratory. Diagnostics of materials*. **2009**. Vol.75. No.1. P.24-28. (russian)
[7] S.G. Antonova, G.N. Noskova, N.A. Kolpakova. Determination of selenium (IV) using the method of anode inversion voltammetry. *Proceedings of Tomsk Polytechnic University*. **2010**. Vol.317. No.3. P.103-107. (russian)
[8] I.E. Stas, T.S. Ivonina. On the nature of the limiting stage of the electrode process involving lead ions in the presence of surface active tetrabutylammonium ions. Influence of the electromagnetic field on the degree of reversibility of the process. *Proceedings of the Tomsk Polytechnic University*. **2006**. Vol.309. No.5. P.68-72. (russian)
[9] S.A. Stukalova, L.V. Fomina, V.A. Batenkov, T.V. Stukalova. Determination of iridium in aqueous solutions by inversion voltammetry. *Proceedings of the Altai State. University*. **2002.** No.3. P.37-41. (russian)
[10] A.M. Bond. Polarographic methods in analytical chemistry. *Moscow: Chemistry*. **1983**. 136p. (russian)
[11] L.I. Antropov. Theoretical Electrochemistry. *Moscow: High school.***1984**. 519p. (russian)