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DETERMINATION OF MERCURY(II) ION IN WASTEWATER BY INVERSION VOLTAMMETRIC METHOD

Boqiyev Q.S.[1],
Sayfiyev M. N.[1],
Ziyayev D.A.[2]
[1]PhD student of the National University of Uzbekistan.
[2]Associate Professor of the National University of Uzbekistan. 4,
University Street, Tashkent, Uzbekistan, 100174.
E-mail: qudratboqiyev1997@gmail.com Tel: +998912146568

Abstract:
Development of convenient methods for the determination of mercury ions in micro-quantities from the composition of wastewater by inversion-voltammetric method in complex mixtures. Evaluation of metrological characteristics of determination of mercury(II) ion by inversion voltammetric method has been improved.

Keywords: buffer mixture, electrochemical sensor, trace element, wastewater, cadmium, background electrolyte, inversion voltammetry, adjacent cations.

The ever-increasing concern about environmental pollution has prompted intensive research into effective and reliable methods for monitoring heavy metals, particularly mercury contaminants, in water resources. Mercury, a highly toxic element, poses a serious threat to aquatic ecosystems and human health when present in high concentrations [1].

Mercury pollution in wastewater poses a major environmental threat due to its persistent and toxic nature. In solving this important problem, analytical methods play an important role in the detection and quantification of mercury (II) ions in wastewater. Accurate determination of mercury (II) concentrations in wastewater is essential to implement effective anti-pollution measures and ensure environmental and human well-being [2].

In recent years, analytical methods have played an important role in solving environmental problems, and electrochemical methods, in particular, have proven to be versatile and sensitive tools for the analysis of trace metals. Among various analytical methods, inversion voltammetry has emerged as a powerful and sensitive method for the determination of mercury (II) ions. This electrochemical method offers advantages such as high sensitivity, selectivity, and the ability to work in complex matrices, making it particularly suitable for the analysis of environmental samples. Mercury is released into the atmosphere through both natural processes (such as volcanic activity) and human activities (primarily the burning of fossil fuels, industrial processes, and waste incineration). In the atmosphere, mercury can remain for extended periods before depositing onto land or water. Once mercury is deposited onto land or water, it can enter aquatic ecosystems. Microorganisms in sediments can convert mercury into methylmercury, a highly toxic and bioavailable form. Methylmercury then accumulates in fish and shellfish through a process known as biomagnification. High levels of mercury can be toxic to aquatic organisms, including fish, invertebrates, and amphibians. It can disrupt their reproductive and neurological functions, affecting the overall health of the ecosystem.

The results of the analysis were recorded using a graphite-based electrochemical sensor, a standard electrode with saturated potassium chloride and an electrolyzer made of an auxiliary graphite electrode with a large surface area, as well as an ABC-1.1 device equipped with a computer.

In conducting the research, we chose favorable conditions for the determination of copper ion by the inversion voltammetric (IV) method using an electrochemical sensor (ES). First of all, the effect of the background electrolyte was studied in the determination of copper ion in method IV [3].

The control of the electrochemical reaction requires the role of the background electrolyte and buffer mixture in the proton-donating activity of the medium and the control of the ion concentration determined within well-defined limits during electrolysis. During the experiments, the following solutions are used as background electrolytes: 0,1 M HNO_3; 0,2 M H_3PO_4; 0,2 M HCl; 0,2 M H_3PO_4 +0,2 M KNO_3; 0,5 M LiCl; 0,5 M KNO_3; 0,2 M H_2SO_4 and 0,5 M NH_4OH+0,5 M NH_4CI. We used different volumes and concentrations of these background electrolytes and buffer mixtures. The obtained results are shown in the table below.

Effect of background electrolyte in determination of mercury(II) ion by inversion voltammetric method
(amperage= 2,5 mkA; t=120 s; $S_{Hg(II)}$= 5,0 mkg/dm^3)

Background electrolyte nature and concentration	Hg(II)	
	Ye, mV	I, mkA
0,1 M HNO_3	341,0	29
0,2 M H_3PO_4	334,0	33
0,2 M HCl	357,0	26
0,2 M H_3PO_4 +0,2 M KNO_3	312,0	52
0,5 M LiCl	320,0	41
0,5 M KNO_3	361,0	35
0,2 M H_2SO_4	346,0	25
0,5 M NH_4OH+0,5 M NH_4CI	291,0	21

As can be seen from the above results, the best result was observed in 0,2 M H_3PO_4 +0,2 M KNO_3 background electrolyte. We used this background electrolyte in our further research. In our further research work, we tested different concentration solutions of mercury(II) ion under these optimal conditions.

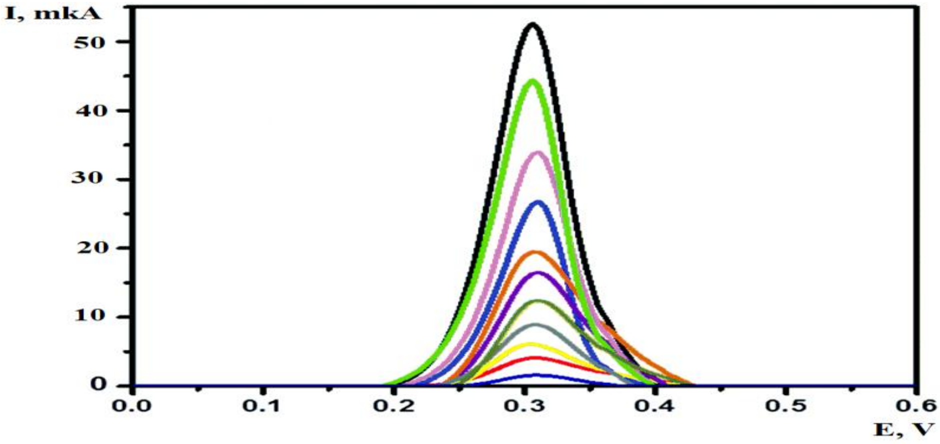

Figure 1. Investigation of mercury(II) ion solutions with different concentrations under selected optimal conditions.

As can be seen from the picture, when we measured solutions of mercury(II) ions with different concentrations, the results were positive. So the method is working correctly. In our further studies, we can apply this method to real objects.

REFERENCES

1. D.A. Ziyayev, M.N. Sayfiyev. Analytical possibilities of the inversion voltamperometry of cadmium determination by carbon-paste electrode modified by EDTA / Modern sturcture and development of science in our life 1 (1), 2019. –P. 98-104.

2. M. Sayfiyev, Q. Boqiyev, U. Axmadjonov, M. Abduqahhorova, D. Ziyayev. Inversion-voltamperometrics in determination of copper ions from soil importance of the method / AIP Conference Proceedings 2432 (1), 2022. –P. 1012-1015.

3. Д.А. Зияев, М.Н. Сайфиев, Н. Атакулова. Инверсионное вольтамперометрическое определение меди (II) и цинка с применением графитсодержащих электродов, модифицированных эдта / Ўзбекистон кимё журнали № 5. 2021. –С. 71-76.