Determination of the concentration of metal cations in tap water using plasma emission spectroscopy

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One of the fields of applications of gas discharges in contact with liquids is the optical emission spectroscopy for the analysis of the content of metal ions in water. The advantages of the method: high sensitivity, low energy costs, simplicity of equipment, - make it promising for the quantitative determination of ions in solutions, including those of biological or industrial origin. In [1, 2], the possibility of determining sodium, potassium, magnesium, calcium ions, as well as ions of a number of heavy metals in tap water was shown. However, the analysis of solutions of unknown composition is complicated by the fact that the presence of additional electrolytes in it can unpredictably affect the line intensities of the metals being analyzed. This is due to a change in the composition of the plasma, its parameters and the efficiency of excitation of the emitting states. One of the possible solutions to the problem is to use the method of emission actinometry of the plasma when a known amount of the component-actinometer is added to the test solution.

The aim of the work is to show the possibility of quantitative analysis of metal ions in a tap water by the method of optical plasma actinometry using an atmospheric pressure discharge with a liquid cathode. The emission spectra of the DC discharge were recorded with an AvaSpec-3648 spectrometer. The details of the experiment are described in [3]. Samples of tap water taken from centralized drinking water supply systems of the Ivanovo city were analyzed. To provide the necessary electrical conductivity, nitric acid was added to the samples to pH 1. The actinometer component was rubidium, which cations were added to the analyzed solution to a concentration of 10–2 g/l., The lines of sodium, potassium, magnesium, calcium and rubidium atoms, as well as the lines of hydrogen and oxygen atoms and the bands of NO, N2 molecules and OH radicals were recorded in the discharge emission spectra. The results of the tap water analysis are presented in the table.

Table. The results of the analysis of tap water by the method of plasma optical emission actinometry

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| --- | --- | --- | --- | --- |
| Ion | Concentration, g/ l | Ion | Concentration, g/ l | Water hardness factor,°GH |
| Na+ | 0.11 ± 0.01 | Mg2+ | 0.09 ± 0.01 | 5.6 ± 0.4 |
| K+ | 0.04 ± 0.01 | Ca2+ | 0.19 ± 0.02 |

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References

1. Jiang X., Xu X., Hou X., Long Z., Tian Y., Jiang X., Zheng C. J. Anal. At. Spectrom. 2016. v. 31. p. 1423–1429.
2. György K., Bencs L., Mezei P., Cserfalvi T. Spectrochim. Acta, Part B. 2012. v. 77. p. 52–57.
3. Sirotkin N.A., Titov V.A. Plasma Chem. Plasma Process. 2017. v. 37. p. 1475–1490.