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PULSE CONDUCTOMETRY OF UKRAINE NATURAL WATERS IN ELECTRIC FIELD OF RISING STRENGTH

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Relevance of research. Among the many physico-chemical methods of analysis, the conductometric method is well-known and widely used. It is based on the measurement of the electrical conductivity of liquid media. The application of conductometry has long become common in various fields of science and production.

Considering the science of hydrochemistry, it can be confidently stated about the significant role that the measurement of electrical conductivity plays in the analysis of the quality of natural water sources [1-3]. In water bodies that mainly contain soluble mineral compounds (most surface and artesian sources), electrical conductivity is an indicator of the total concentration of inorganic electrolytes [1, 2]. Since electrical conductivity is a cumulative indicator of the content of various dissolved substances in the form of ions in water, measuring this parameter for natural waters will allow assessing both their overall mineralization and the overall pollution with dissolved conductive impurities, mostly of anthropogenic origin [1-3]. As natural waters are the main driving force of many global biological, physico-chemical, geochemical, and geophysical processes on the planet, there arises a need to study their physical properties, particularly conductivity, which in this context acquires special significance as a parameter of environmental monitoring.

The purpose of research. Application of the conductometry method and apparatus in a pulsed electric field of rising strength (PEFRS) for measuring the conductivity of natural water from various sources and determining the possibility of their environmental monitoring.

Basic research materials. The practical capabilities of traditional conductometry are limited in some cases because the electric field intensity in this method is insignificant (tens of V/cm) and, most importantly, constant. In contrast, as shown by our recent research, conductometry in the PEFRS offers more possibilities, allowing the use of the dependence of the liquid medium’s conductivity on the field intensity, which accelerates different types of ions differently [4,5]. Based on this fact, further studies of the pollution of natural water sources will be conducted using the modernized method and apparatus of conductometry in the PEFRS. In this case, the measurement error of the conductivity of natural water will not exceed 3.5 %.

The practical part of the work began with taking water samples from a natural source into disposable Eppendorf tubes with a volume of 1-2 ml with a hermetic lid. Immediately after sampling, the tube lid was closed to exclude contact with air and water evaporation. The obtained data on the electrical conductivity of natural water, depending on the intensity of the electric field, were plotted on a general graph for comparison. All calculations, statistical processing, and graph plotting were performed in Microsoft Office Excel. The obtained results of the electrical conductivity measurements in the PEFRS of natural waters are shown in Fig. 1.

In Fig. 1, the electrical conductivity of water from the main rivers in Kharkiv and the region is presented. Water samples from the Kharkiv and Lopan rivers were taken from the shore near the confluence and upstream within the city limits for each river at the same time. Based on the dependence of the water conductivity of these rivers (upstream – lower, downstream – higher), the impact of the city’s environmental conditions can be assessed even over a relatively small section of the flow, considering that several city storm water outlets, enterprises, and residential areas are located here. Moreover, this part is the center of Kharkiv with many city highways with high traffic

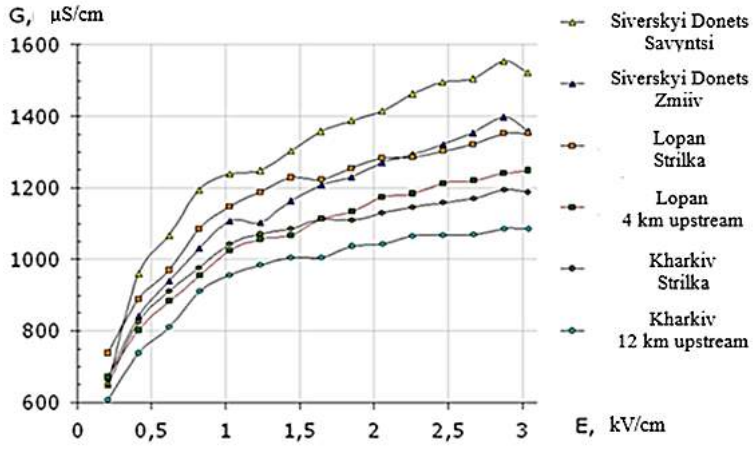

Figure 1 – Conductivity in the PEFII of the water of the Kharkiv and Lopan rivers within the city of Kharkiv and the Siverskyi Donets river 35 and 80 km downstream from Kharkiv

density. Further in Fig. 1, the electrical conductivity of the water of the Siverskyi Donets river, which carries the waters of the Kharkiv and Lopan rivers, is also presented. Water samples from the Siverskyi Donets river were taken in the area of Zmiiv and downstream in the area of Savintsi, 35 and 80 km from Kharkiv. From the obtained dependencies of electrical conductivity, it follows that the river waters manage to undergo some self-purification, and downstream of the Siverskyi Donets, it is significantly increased, as the water has passed areas adjacent to the floodplain with developed agricultural and industrial production.

One of the features of the proposed method is that the results of measuring the electrical conductivity of river water integrally reflect only the fact of the presence of conductive pollutants in addition to natural mineralization. To determine the composition and contribution of each ion, it is necessary to apply a differential approach, the description of which is presented in works [4-6].

Conclusion. Thus, by measuring the electrical conductivity of river water using the conductometry method in the PEFRS, it is possible not only to track the dynamics of seasonal processes, determine the timing of self-purification and stabilization of its parameters, but also to monitor anthropogenic pollution of rivers downstream, obtain additional information about their physical properties, which can be used in human activities and for assessing its impact on the biosphere.

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