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INVESTIGATION OF CHANGES OF PHYSICAL AND CHEMICAL PROPERTIES OF TAP WATER UNDER INFLUENCE OF POWERFUL UNDERWATER SPARK DISCHARGES

Purpose. The purpose of this investigation is to study the changes in the redox potential and pH-value of the tap water as a function of underwater spark discharges, storage device capacitance and the charging voltage. Methodology. To define the electric parameters of discharge circuit we used the Rogowski loop and the compensated capacitance-ohm potential divider. To determine water properties before and after the treatment we used the following devices: the water analyzer Anion -7051 with the limit of absolute error of the EMF measurement ± 2 mV, the BANTE 902 device with the absolute error of ± 0.002 pH. Results. We managed to establish the time of the origination of changes in the properties of treated water. A change in the positive redox potential to a negative one occurred already after the third pulse at a total energy input of ≥ 1 kJ. The pH value increased in the range of 0.2 – 0.45 pH units. We obtained the relationship of a change in the redox potential as a function of total energy of the pulse train that actually exhibits the linear relation to the mass of erosion products. We established that the electrodes made of stainless steel and the electrodes made of graphite provide similar changes in water properties. An increase in pH is indicative of the progress of reactions that result in the formation of OH^- . Originality. The obtained experimental data prove a rapid and reliable change in the redox potential from positive to negative changes in the redox potential exponent can persist during ten days and even longer. The erosion products of electrodes can be removed from the treated water using the method of magnetic separation. Practical value. The «HYDRA» plant can be used as the electrochemical ideal mixing reactor of a discrete action with the removal of erosion products of the electrode using the method of magnetic separation. References 10, tables 5, figures 13.

Key words: underwater spark discharge, electrodes material, water properties, redox potential, pH – value.

Представлены результаты экспериментального исследования изменения физико-химических свойств водопроводной воды под воздействием мощных подводных искровых разрядов атмосферного давления. Выявлена зависимость изменения окислительно-восстановительного потенциала и pH обрабатываемой воды от параметров импульсов, задаваемых параметрами электрической разрядной цепи, и их количеством. Исследования проведены на разрядных электродах, изготовленных из материалов двух типов: нержавеющей сталь и графит. Библ. 10, табл. 5, рис. 13.

Ключевые слова: подводный искровой разряд, материал электродов, свойства воды, окислительно-восстановительный потенциал, водородный показатель pH.

Introduction. Powerful underwater spark discharges (PSD) are widely used for different branches of industry and science, in particular for the material destruction and deformation, the treatment of working holes, and also to change physical and chemical properties of liquid media and/or for the liquid media decontamination [1-3].

The underwater discharge is characterized by many physical factors that affect the medium treated both at the breakdown phase and at other phases of the discharge progress. These factors include the influence of strong electric field on the medium at the pre –breakdown phase of the discharge, the shock compression of environment, intensive pulse radiation of it in a wide wavelength range, thermal effect in the region of current conducting channel, the discharge of high-temperature fine particles of electrode materials into the vapor-&-gas medium due to the electroerosion and cavitation processes. Such multifactor action allows us to change physical and chemical properties of the treated medium and to implement electrochemical ideal-mixing reactors of a discrete action due to the development of intense hydraulic gas dynamic flows in large volumes. Hence, the action discreteness and the ideal mixing are considered to be the main distinctive features of electrochemical PSD-based reactors.

One of the main indicators that characterizes the action of discharge on the chemical composition of water is the pH and the redox potential. A change in these

exponents results in the water activation. It has been established [4] that the normal behavior of biochemical processes in the human body requires the correspondence of the redox potential of drinking water and that of intercellular liquid and it must be in the range of +100 to –200 mV. The redox potential of treated drinking water actually always exceeds 0 and it is in the range of +100 to +400 mV [4]. The water with the redox exponent below – 200 mV exhibits high biological activity and the consumption of it must be limited.

Due to an ample amount of influencing PSD factors it is not easy to determine the individual influence of each factor on a change in the properties of treated liquid. At the same time, in order to control a change in the physical and chemical properties of water it is necessary to get a quantitative estimation of a change in the required properties of liquid in the specified chemical reactor as a function of the parameters of discharge pulses and their number.

The objective of this study was to investigate the relationship of a change in the redox exponent and pH of the water treated by the «HYDRA» plant as a function of pulses and their parameters specified by such parameters of electric discharge circuit as the storage capacitance and the charging voltage.

Experimental procedure. The HYDRA plant system and possible areas of its application are described in the papers [4-6]. A general view of the «HYDRA» plant and electric circuit are given in Fig. 1, 2.

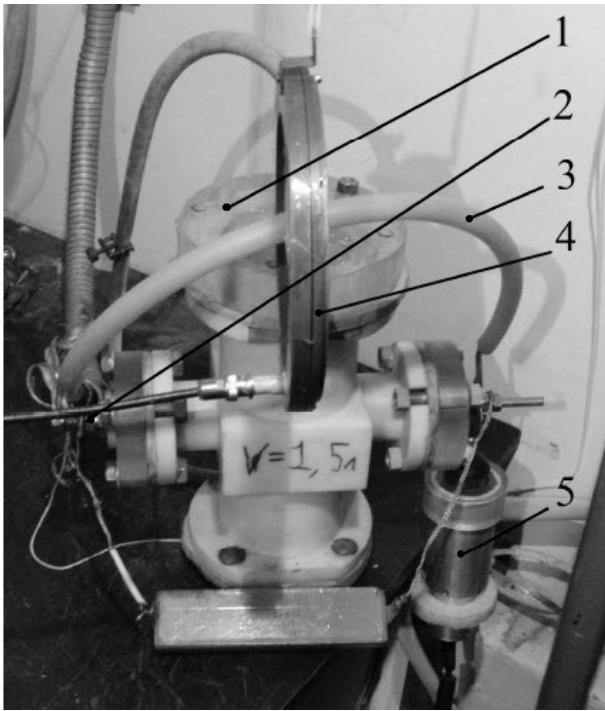


Fig. 1. General view of the electrochemical reactor 1 is the reactor vessel; 2 and 3 are current distributors that supply current to discharge electrodes; 4 is the Rogowski loop; 5 is the potential divider

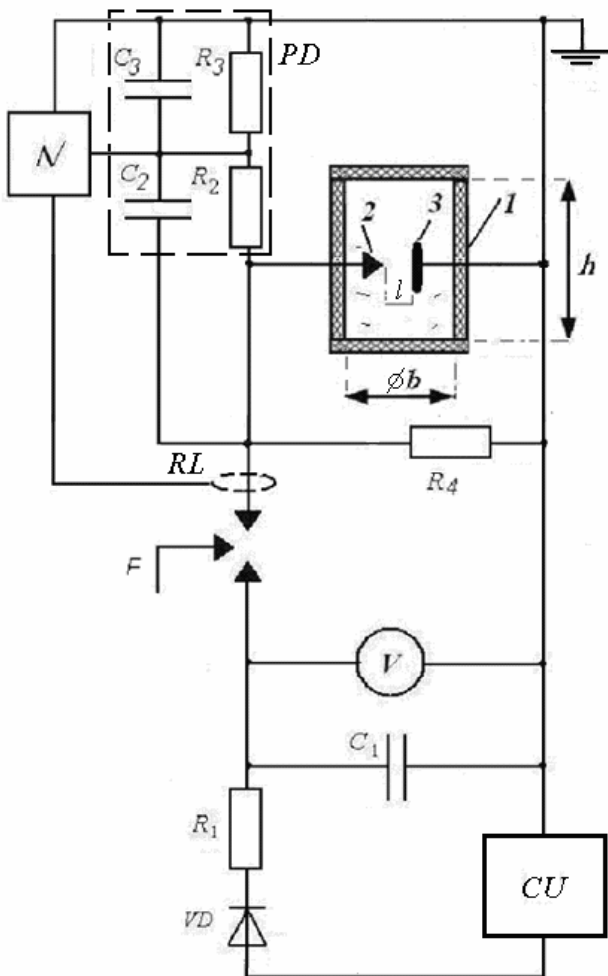


Fig. 2. Electric circuit of the «HYDRA» plant 1 – electric discharge chemical reactor; 2 and 3 are discharge electrodes

The capacitor bank C_1 is discharged via the controlled three-electrode air discharger F onto the chemical reactor 1 whose electrodes 2 and 3 form the discharge gap 1 and the damping resistance R_d connected to it in parallel. The pulse capacitors IK-100/0.4 and IK-100/0.25 were used for the capacitor bank.

The capacitor bank C_1 is charged by the DC voltage source formed by the following elements: charging unit CU in the form of step-up transformer UPC-70 and the autotransformer; the half-wave rectifier VD in the form of tandem diode assemblies of a KC-201E type; the charging resistance R_1 formed using the tandem resistance of TVO-60 type with the equivalent resistance of 270 kOhm.

The air discharger F was operating as a two-electrode discharger or three-electrode discharger. When the discharger F was working using no third electrode the charge voltage of the capacitor bank was controlled by the value of interelectrode gap of the discharger F . When the third control electrode of the discharger was used the charge voltage of the capacitor bank was controlled by the autotransformer. The charging voltage of the capacitor bank was equal to 10 kV, 15 kV and 20 kV.

Charging voltage of the capacitor bank C_1 was measured by the electrostatic kilovoltmeter of a C 196 type. The rated error was equal to $\pm 1\%$ of the maximum value of a measurement range.

The discharge current was measured using the Rogowski loop (RL) with the sensitivity of 3627A/V. The RL sensor sensitivity was measured at a frequency of 2.2 MHz using the categorized noninductive current sensor CSNM 191 of Honeywell company with the current value output that operates using the Hall Effect. The comparison data for the reference signal obtained from CSNM 191 sensor and the signal obtained from fabricated Rogowski loop are given in Fig. 3. A relative error of the reference signal was within $\pm 0.5\%$ of the measured value.

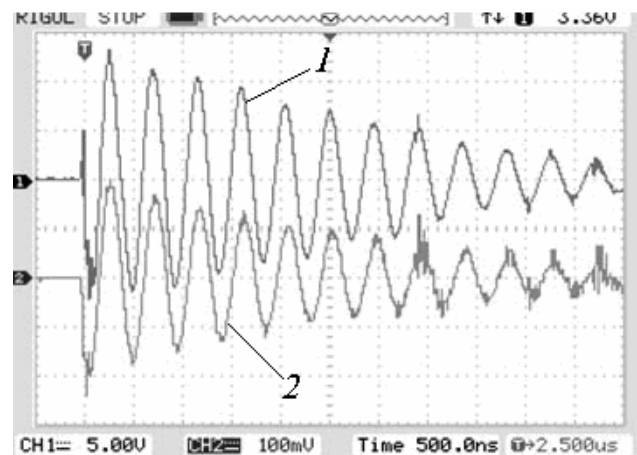


Fig. 3. Discharge Current Oscillographing Data. The current sensor CSNM 191 was used for first channel and the fabricated Rogowski loop was used for second channel

The discharge gap voltage was measured using the North Star High Voltage compensated capacitance-ohm potential divider (PD) of a PVM-12 type with the dividing coefficient of 1:1000, bandwidth of 80 MHz and the maximum pulse voltage of 32 kV.

The damping of high frequency electric oscillations caused by the stray capacitances of the circuit was provided by the resistor R_4 connected in parallel to the discharge gap. The noninductive resistor of a TBO-60 type with the nominal of 47 kOhm was used as the resistance R_4 .

The gap voltage and the discharge current were recorded using the ATTEN two-channel electronic oscillograph of an ADS 1102 CAL⁺ type with the bandwidth of 100MHz and the digitizing rate of 1 GSa/s. The sweeping of signals registered by the potential divider was performed in a sleeping mode along the input signal front.

The electrochemical reactor corresponded to the dielectric chamber and its casing was made of caprolon (Fig. 2). The wall thickness of the casing was equal to 5 mm. The chamber height was $h = 240$ mm and its diameter was $b = 90$ mm. We used for studies the needle – semisphere system of electrodes (Fig. 4). To study the influence of electrode materials we manufactured two pairs of electrodes. One pair was made of stainless steel of a 12X18H10T grade and the other was made of graphite to produce electrocarbon products (GOST 10274-79). The steel grade was determined using the «SPRUT» plant and X-ray fluorescence method. The needle-semisphere electrode was shaped as a cone at an angle of 60°, the height of 25 mm and the base diameter of 30 mm. The semisphere radius of the second electrode was equal to 10 mm. Pin-like current leads to which the electrodes were connected were placed into the dielectric to prevent their oxidation and reduce pre-breakdown losses. The size of interelectrode gap l varied in the range of 1 to 5 mm.

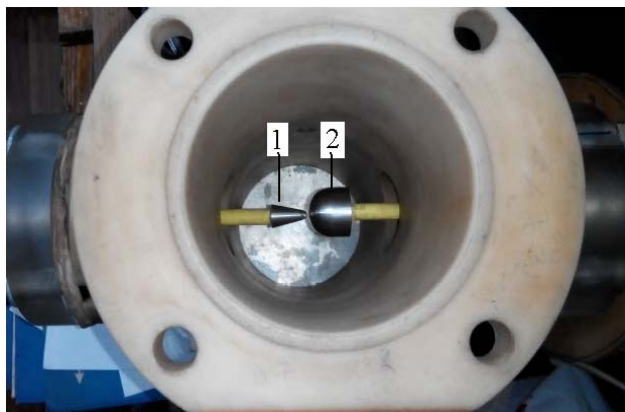


Fig. 4. General view of the discharge electrodes:
1 – needle; 2 – semisphere

Industrial capacitors of IK-100/0.4 and IK-100/0.25 types, have a high spread of nominal values (permissible deviation $\pm 10\%$), which prevents us from calculating the total discharge energy with sufficient accuracy. An absolute error of the capacitance measurement increased when the capacitors were connected to make up the capacitor bank. To obtain the specified values of the total capacitance two methods of its measurement were used, in particular the indirect method using the voltage measurements oscillographing data during the discharge

of the capacitor bank, and the direct measurement method using measuring devices.

As for the indirect method the discharge circuit parameters were selected to meet the following condition:

$$R_c \gg 2\sqrt{\frac{L}{C}}, \quad (1)$$

where R_c is the charging resistance; C is the capacitor bank capacitance; L is the equivalent inductance of charging circuit.

The condition of the relationship of resistances expressed as

$$R_c \gg R_{ir}, \quad (2)$$

where R_{ir} is the internal resistance of DC source.

In this case the capacitor capacitance C was calculated proceeding from the time constant τ that was determined experimentally using the expression:

$$C = \tau/R_c. \quad (3)$$

The capacities were charged by DC voltage source $U_{const} = 4$ V. The charging resistance was equal to $R_c = 1 \pm 0.01$ MOhm. Fig. 5 gives the measured capacitor voltage data. The voltage oscillogram shows that a drop in voltage from -4 V to $U_{const}/e = -1.47$ V occurs after $\tau = 390$ ms. Hence, we have in this case $C = 0.39$ μ F.

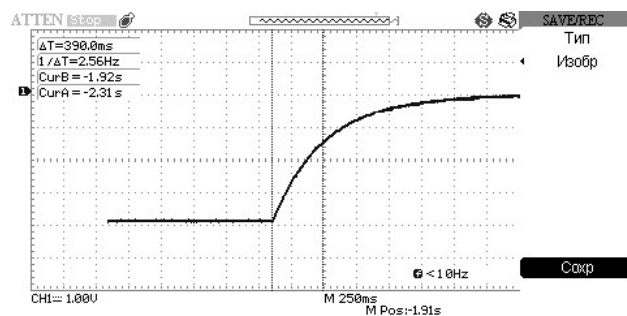


Fig. 5. Defining τ on the voltage curve of the capacitor during its discharge

We also measured the capacitance of capacitor banks using the digital measuring LCR device E 7-8 with the error in the measurement range of up to 10 μ F within ± 1.6 nF, and the measuring device DL-6243. Table 1 gives the measurement data.

Table 1
Measurement data of the capacitances of capacitor banks in μ F

Bank number	Measuring method			
	Indirect	Device E 7-8	Device DL 6243	LSM
No 1	1,05	1,0495 \pm 0,0016	1,013	1,037
No 2	1,92	1,927 \pm 0,0016	1,925	1,924
No 3	2,95	2,947 \pm 0,0016	2,945	2,947

For the computations we took the capacitance value of a capacitor bank that was determined using the least-squares method (LSM) for the given measurement data: for the No 1 $C = 1.037$ μ F, for the No 2 – $C = 1.924$ μ F, and for the No 3 – $C = 2.947$ μ F.

To calculate the discharge energy the bank capacitances were specified according to the data of five measurements that were processed using the least-squares method.

The PSD power was specified to a large degree by the discharge circuit inductance. The equivalent inductance of circuit was defined from the expression [7] using the analysis data of the curve of discharge current in the short-circuit mode:

$$L = \frac{T}{C \left[4 \cdot \pi^2 + \left(\ln \frac{I_1}{I_3} \right)^2 \right]}, \quad (4)$$

where T is the discharge period; I_1 and I_2 is the current amplitude for first and third discharge half-periods.

Due to the strong influence of unwanted high-frequency oscillations onto the discharge current curve during the first discharge half-period the inductance for this paper was calculated using current amplitude values of second and fourth discharge half-periods.

The equivalent circuit resistance that includes the active resistance of connecting wires and the internal resistance of capacitor bank was defined using the enumerative technique selected for the discharge current curve approximation. Fig. 6 gives the discharge current measurement data in the short-circuit mode and the appropriate approximating current curve for the selected resistance. The oscillogram was obtained for the capacitor bank discharge of $C = 1.924 \mu\text{F}$ with the charging voltage of $U_{\text{charge}} = 10 \text{ kV}$.

For the given data the discharge circuit inductance was equal to $2.398 \mu\text{H}$, and the calculated active resistance of the discharge circuit was equal to $R = 200 \text{ mOhm}$. Circuit parameters were measured in the same way, when different banks were used (Table 2).

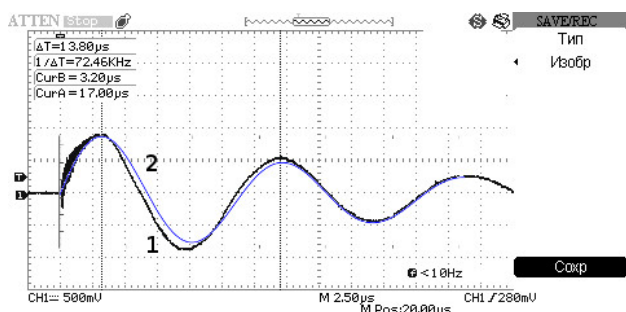


Fig. 6. Discharge current in the short-circuit mode 1 and the approximation curve 2

Table 2

Discharge circuit resistance and inductance measurement data

Bank number	Inductance, μH	Resistance, mOhm
No 1	2.40	200
No 2	2.54	225
No 3	2.62	240

A slight change in the inductance and resistance with a change in the capacitance of capacitor bank gives us all grounds to believe that it is necessary to establish the relationship of a change in the properties of water treated by the «HYDRA» plant as a function of the capacitance and charge voltage of the capacitor bank and the number of pulses.

The water properties were measured using the following devices. The water concentration of nitrates was measured using the nitrate meter IT – 1201 with the indication range of mass concentration of 0,001 to 9999 mg/l and the margin of error $\pm 11 \%$. We also used the conductivity meter BANTE 902 with the range of 0~200 mS/cm, and the error of $\pm 0.5 \%$. The redox potential was measured using the water analyzer Anion-7051 with the margin of absolute error of EMF measurement $\pm 2 \text{ mV}$. The water pH was measured using BANTE 902 device with the measurement range of $-2.000 \sim 20.000 \text{ pH}$ and the absolute error of $\pm 0.002 \text{ pH}$. A change in the ion concentration in the water solution was measured using the photometric method according to [8] that allowed us to measure Fe concentrations of $\sim 10^{-6} \text{ mole/l}$.

The electrodes of diagnostic devices were washed properly in the distilled water before each measurement. The same sample (initial and treated water) was measured three times. The samples were subjected to a diagnosis during the first 15 minutes after the treatment and after 3 and 6 hours following the experiment.

The mass of discharge electrodes was measured using the scales of a VLR-200 type with the balance error of 0.5 mg for the weight up to 50 g and 1 mg for the weight range of 50 g to 200 g. The mass of electrodes made of stainless steel was compared after 280 pulses and that of graphite electrodes was compared after 30 pulses. Powerful underwater spark discharges were applied using the following parameters: $U_{\text{charge}} = 10 \text{ kV}$, $C = 2.947 \mu\text{F}$, the single pulse energy was equal to $W = 152.5 \text{ J/pulse}$.

The tap water with the conductivity of 758-766 $\mu\text{S/cm}$ precipitated during 24 hours was selected as a test subject. To determine a change in the water properties in question the water was exposed to the train of pulses in amount of 1 to 200.

Test data. The water treated by powerful underwater spark discharges in the «HYDRA» plant contained the suspension of particles that precipitated with time. Fig 7 gives the data for the water treatment by steel electrodes at the following electric parameters of the circuit: $U_{\text{charge}} = 20 \text{ kV}$, $C = 2.947 \mu\text{F}$.

The sediment is built up nonuniformly in time, which is indicative of the availability of the suspension of particles of a different size. The most intensive formation of the sediment was observed during first minutes after the treatment. And the sediment volume is increased with an increase in the number of pulses to which the tap water was exposed. The method of visual control showed that the precipitation of particles is stopped after 3 or 4 days upon the treatment completion.

The processed data of the research done using the «Hydra» plant were used for the establishment of the relationships of a change in the redox potential and pH of the treated water as a function of the number N of pulses at different parameters of electric discharge circuit (the capacitor charge voltage and the capacitance) given in Fig. 8-10. In Fig. 8-10 used the following symbols for the charge voltage of the capacitor bank: ■ – 10 kV, ▲ – 15 kV, ● – 20 kV. The data were obtained using steel electrodes.

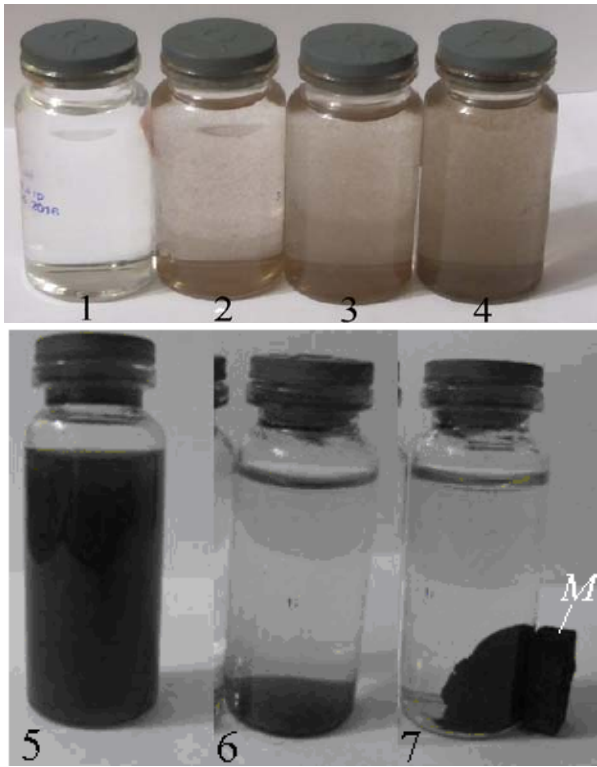


Fig. 7. The samples of tap water treated by underwater spark discharges:

- 1 – the initial sample; 2 – the sample after 5 pulses;
- 3 – the sample after 25 pulses; 4 – the sample after 50 pulses;
- 5 – the sample after 200 pulses; 6 – the sample No 5 precipitated during 4 days; 7 – the sample No 5 separated by the permanent magnet

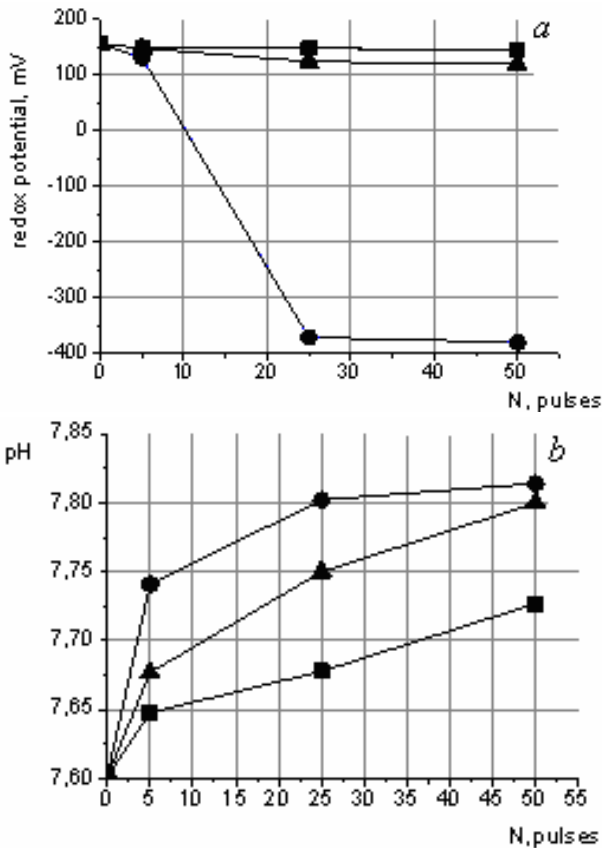


Fig. 8. Dependence of water properties on the number of pulses at $C = 1.037 \mu\text{F}$: *a* – the redox potential, *b* – pH

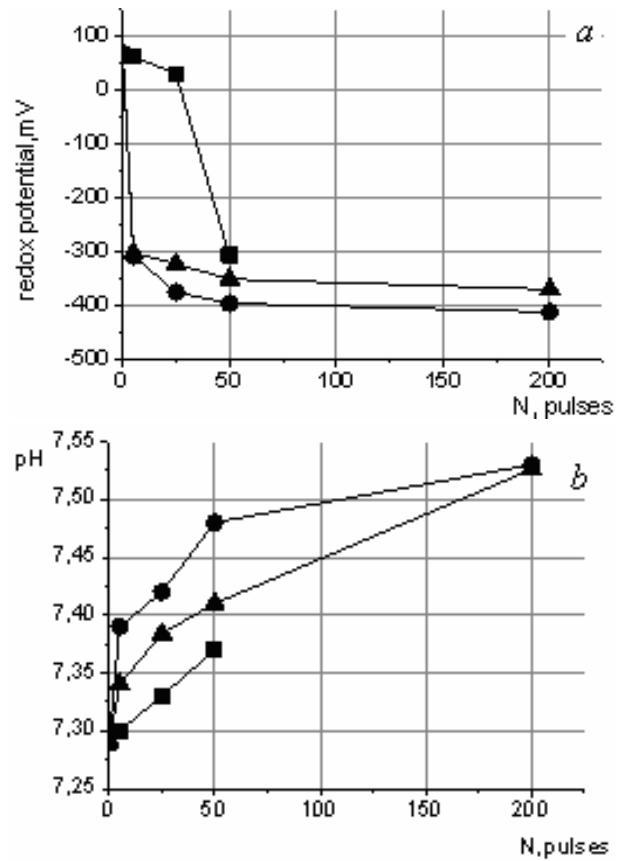


Fig. 9. Dependence of water properties on the number of pulses at $C = 1.924 \mu\text{F}$: *a* – ROP, *b* – pH

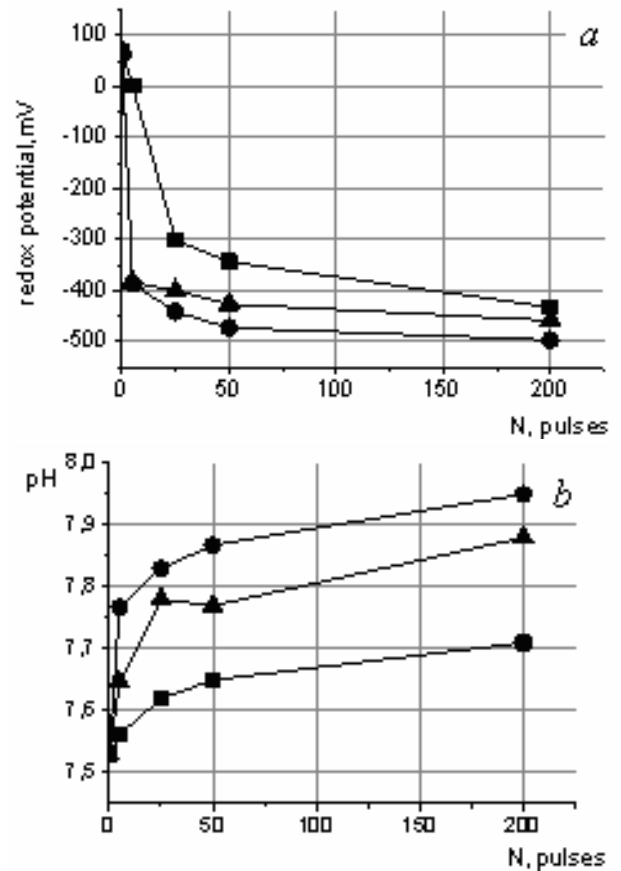


Fig. 10. Dependence of the water properties on the number of pulses at $C = 2.947 \mu\text{F}$: *a* – ROP, *b* – pH

With an increase in the number of pulses a decrease in the redox potential is observed and at a certain threshold of pulses the positive redox potential is changed to negative. The pH of treated water is increased with an increase in the number of pulses N .

To specify the ROP transition point the step discreteness with regard to the number of pulses was decreased. A one-pulse step was selected right up to 6 PPD, and then the additional train of pulses was generated with an increasing step. The data are given in Fig. 11.

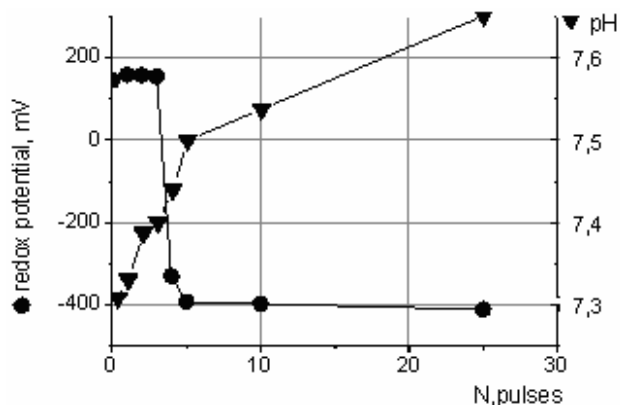


Fig. 11. Dependence of water indices on the number of pulses at $U_{charge} = 20$ kV, $C = 1.924$ μ F

It has been established that the positive-to-negative change in the ROP occurs already after 3 to 5 pulses.

It is assumed that a change in the given water properties occurs due the effect of the erosion products of electrodes. It is known [9] that the mass of erosion products exhibits linear dependence on the discharge energy. Therefore, we had to establish the relationship of a change in the ROP as a function of total energy of the train of discharges (Fig. 12). The total energy is the sum of total energies of single pulses ($\Sigma[C \times U_{charge}^2/2]$).

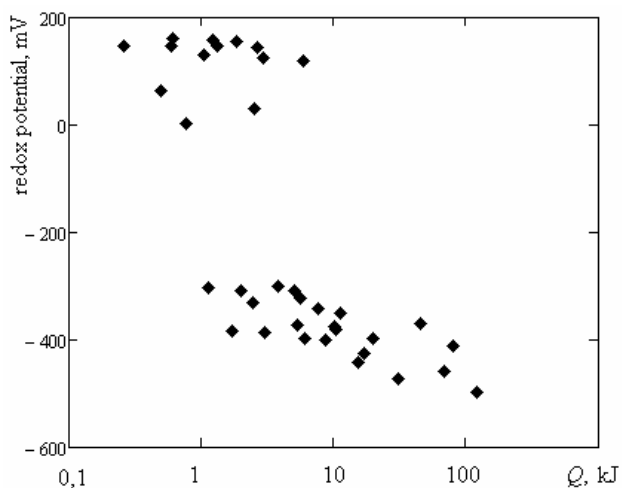


Fig. 12. Dependence of the water ROP on the total energy of the train of discharges

With regard to the «HYDRA» plant the positive-to-negative change in the water redox potential occurs in the range of total energy of 1 to 10 kJ. The availability of such a wide range can be related to a

difference in the particle dispersion through which the surface area of the interaction of material particles with the water is specified. In other words, the difference is observed in the particle surface area at the same mass of erosion products.

A certain increase in the water conductivity is observed and the amount of nitrites is within the maximum permissible concentration it does not exceed 20 mg/l at EU norms of 50 mg/l.

To determine the influence of electrode material on the relationship of a change in the studied water properties we carried out the experiments using graphite electrodes. It should be noted that this material withstands lower shock loads due to its brittleness. Therefore, the number of pulses in the train was reduced 2-2.5 times. Fig. 13 gives the obtained research data.

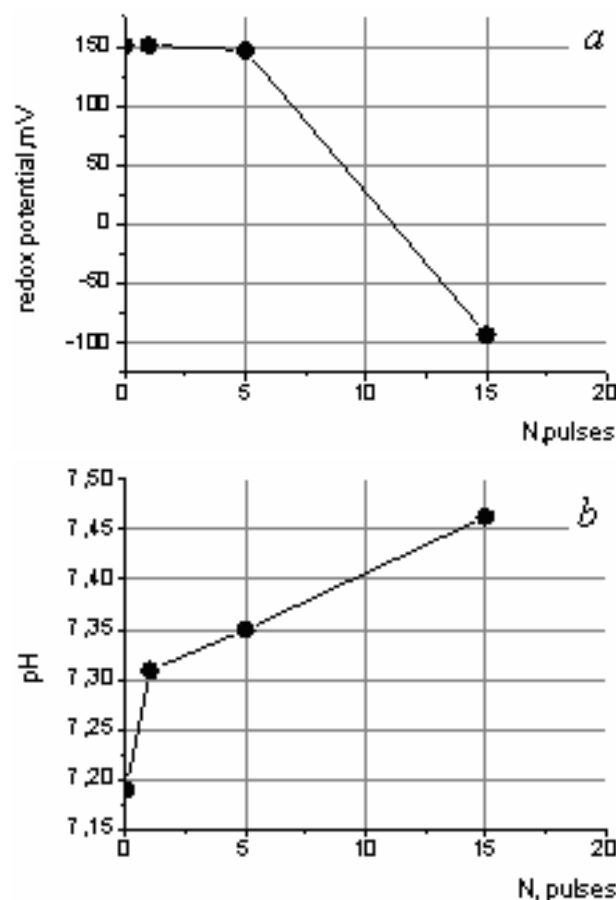


Fig. 13. Dependence of the water indices on the number of pulses at $U_{charge} = 20$ kV, $C = 1.924$ μ F, where a – ROP, b – pH

Graphite electrodes hold the tendency of the positive-to-negative change in the water ROP with an increase in the number of PPD. At the same parameters of discharge circuit the jump in ROP occurred already at third pulse. This can be related to a more intensive decrease in the electrode mass both due to the erosion and the mechanical destruction.

Table 3 shows the data of the change in the electrode mass. We can see that the graphite electrode erodes faster. We failed to measure a change in the mass of graphite cathode due to its mechanical failure. It is assumed

for the Table 3 that m_1 , m_2 is the electrode mass before and after the experimental work, accordingly.

Table 3

A change in the mass of discharge electrodes

	m_1, g	m_2, g	Mass loss $\mu g/J$ pulse
Anode is the stainless needle	3.86520	3.79025	1.76
Cathode is the stainless half-sphere	62.31290	62.24010	1.7
Anode is the graphite needle	5.48075	5.47880	1.96

To determine the stability of changes in water properties the water treated at discharge circuit parameters of $C = 2.947 \mu F$, $U_{charge} = 20 kV$, $N = 200$ was subjected to the analysis after 24 hours.

Here, No 1 is the initial water sample; No 2 is the initial filtered sample; No 3 is the filtered water sample after the train of 200 pulses; No 4 is the water sample after the train of 200 pulses precipitated during 24 hours and then passed through the coal filter (Table 4).

Table 4

Comparison of the properties of water treated by the «HYDRA» plant

	No 1	No 2	No 3	No 4
ROP	+160	+158	-496	-330
pH	7.745	7.745	7.95	7.78

The water was filtered to eliminate the influence of admixtures on water properties, in particular the erosion of electrode material. The Table 4 shows that the samples No 1 and No 2 differ from each other within the device error, i.e. the coal filter introduces no changes into the indications. The sample No 3 has a highly negative ROP and an increased pH value. The properties of the sample No 4 give us all grounds to assume that the changes that occurred in the properties of water treated by the «HYDRA» plant are irreversible.

We also studied the changes in pH of the distilled water (DW) and the tap water (TW) after its exposure to the action of underwater spark discharges at the following electric circuit parameters: $U_{charge} = 20 kV$; $C = 2.947 \mu F$, and the number of pulses $N = 100$. The water pH was measured potentiometrically with the accuracy of up to 0.1 pH units. Table 5 gives the measurement data (lower index «0» corresponds to the measurements of water before the treatment with underwater pulse discharges; the index «1» is for the water after the treatment).

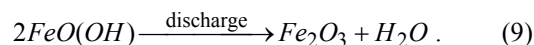
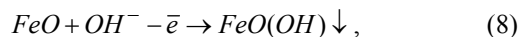
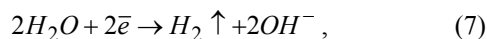
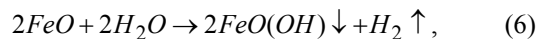
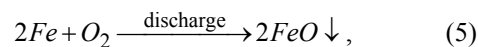
Table 5

Research data of a change in pH of the distilled water (DW) and tap water (TW)

Time	30 minutes after the treatment	24 hours	7 days	14 days
Water type				
DW ₀	6,65	6,66	6,67	6,65
DW ₁	7,12	7,14	7,12	7,12
TW ₀	7,70	7,72	7,71	7,71
TW ₁	8,1	8,34	8,68	8,64

With the elapse of time (6 to 7 days) pH is increased insignificantly. It is assumed that this is the consequence of the removal of gaseous products from the water solution after the electrolysis and chlorination products.

It has been established that the electric discharge generated using steel electrodes may result in such processes:



Hereat, a very small amount of Fe (III) can be formed in the solution. Therefore, we studied the changes in the concentration of Fe in the water treated with underwater pulse discharges. The measurements were taken for the untreated water (TW₀) and four samples treated by the discharges with the same electric circuit parameters $U_{charge} = 20 kV$, $C = 2.947 \mu F$. The number of pulses was equal to 100. We obtained the following iron concentrations: TW₀ = 0.48 mg/l; TW₁₁ = 0.54 mg/l; TW₁₂ = 0.56 mg/l; TW₁₃ = 0.54 mg/l; TW₁₄ = 0.56 mg/l. These data are indicative of a negligibly low change in the concentration of pure iron in the water that was treated with PPD. For the sake of comparison, the average statistic values of iron in the tap water correspond to 0.3 mg/l.

We also found out that it is quite possible to use the magnetic separation for suspended and precipitated water particles. It is known that the iron oxide (II, III) called the magnetic iron FeO·Fe₂O₃ also possesses magnetic properties. The formation of iron oxide (III) in the reaction (9) is possible due to the thermal action of the discharge on iron oxide (II) particles that were formed earlier. Therefore, the «HYDRA» plant with the magnetic separation can be used for the controlled change in the water redox potential and pH values.

The properties of water treated by the «HYDRA» plant also changed when the graphite electrodes were used. We can thus assume that the reaction (7) progresses during the PPD. It should be noted that the paper [10] describes theoretical study of the influence of gas discharge processes on water properties.

Conclusions.

The «HYDRA» plant was used for the investigation of the relationship of a change in the redox potential and pH of the treated water as a function of the number of pulses and pulse parameters specified by the parameters of electric discharge circuit (the capacitance and the charging voltage). A decrease in the redox potential was observed with an increase in the charge voltage of the capacitor bank, the capacitance of it and an exact total energy of the discharges. The water pH is increased. A change in the water redox potential and pH is retained for a long time after the sediment removal. Specified discharge parameters have the pulse threshold and if it is exceeded a positive-to-negative change in the redox potential occurs. The «HYDRA» plant with the magnetic separation can be used as an ideal mixing

electrochemical reactor of a discrete action with the removal of aftereffect products.

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Investigation of changes of physical and chemical properties of tap water under influence of powerful underwater spark discharges.

Purpose. The purpose of this investigation is to study the changes in the redox potential and pH-value of the tap water as a function of underwater spark discharges, storage device capacitance and the charging voltage. **Methodology.** To define the electric parameters of discharge circuit we used the Rogowski loop and the compensated capacitance-ohm potential divider. To determine water properties before and after the treatment we used the following devices: the water analyzer Anion-7051 with the limit of absolute error of the EMF measurement ± 2 mV, the BANTE 902 device with the absolute error of ± 0.002 pH. **Results.** We managed to establish the time of the origination of changes in the properties of treated water. A change in the positive redox potential to a negative one occurred already after the third pulse at a total energy input of ≥ 1 kJ. The pH value increased in the range of 0.2 – 0.45 pH units. We obtained the relationship of a change in the redox potential as a function of total energy of the pulse train that actually exhibits the linear relation to the mass of erosion products. We established that the electrodes made of stainless steel and the electrodes made of graphite provide similar changes in water properties. An increase in pH is indicative of the progress of reactions that result in the formation of OH⁻. **Originality.** The obtained experimental data prove a rapid and reliable change in the redox potential from positive to negative changes in the redox potential exponent can persist during ten days and even longer. The erosion products of electrodes can be removed from the treated water using the method of magnetic separation. **Practical value.** The «HYDRA» plant can be used as the electrochemical ideal mixing reactor of a discrete action with the removal of erosion products of the electrode using the method of magnetic separation. References 10, tables 5, figures 13.

Key words: underwater spark discharge, electrodes material, water properties, redox potential, pH – value.