discharge system for water treatment based on the multielectrode high-voltage ring pulsed discharge

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Electric discharges in gas bubbles inside liquid offers promise as a possibility to solve some technological problems, in particular, sterilization and cleansing of water from microbiological, organic, and chemical contamination[1]. To enhance efficiency of discharge action, we designed a reactor based on the multielectrode ring high-voltage repetitive discharge in liquid (water), in which the discharge action on water is aided by gas bubbles forming in the interelectrode gaps.

The reactor consists of five cylindrical sections joined sequentially to form a single chamber. Each section contains a multielectode discharger as shown in the figure 1:

1 – dielectric chamber wall, 2 – equidistant electrodes
3 – electrical insulation on the inside, 4 – gas inlet,
5 – interelectrode gap (hole diameter d≤1mm), 6 – high-voltage connection.

The equally-spaced location of the discharge gaps in a circle ensures the focusing of both UV radiation and hydrodynamic perturbations in cross-section of the chamber. This is a further factor which aids in achieving enhanced action of the discharge on the liquid.

Power supply is a five-channel high-voltage pulse generator. The performance characteristics of the channel are as follows: voltage U≤20 kV, pulse repetition frequency
 f≤100 Hz, reservoir capacitor energy W≤1.6 J, (С = 8∙10-9 F). The pulse parameters are: current I≤300 A, duration
τ=3–5 µs, mean power N ≤200 W. Hence, the mean power of 5 channels of the generator reached 1 kW in our experiments. The total volume of 5 sections of the reactor was equal to Vr=400 cm3. The reactor has provision for operation with water flow; operation in still water is also possible.

**Figure 1.**

**Experimental conditions and results**:

1. The discharge effect on the surface of the pond water contaminated with mezophobious aerobes with concentration of 3.4·104 bacteria per 1 cm3 was studied, the other water parameters being рН=8.1, specific conductivity σ=360 µS/cm, temperature t=26ºC. It was shown that, in order to 10 times reduce the number of microorganisms the specific energy of γ=0.5 J/cm3 is required.

2. Such type treatment of waste products of galvanic factory results in a several times decrease in concentration of some metals. In the case of chromium, it decreased by a factor of 30 (γ=10-15 J/cm3).

 Note that the device was used to produce a stable colloidal solution with carbon nanostructures. The liquid was 95% ethanol, the injected gas was argon. The does not loses its properties over long period of time (more then one year) [2].

References

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2. A.M. Anpilov, E.M. Barkhudarov, I.A. Kossyi, G.S. Luk’yanchikov, M.A. Misakyan, and I.V. Moryakov. Thin film of nano-dimensional carbon deposition on the metallic samples as a multipactor prevention method. Appl. Phys. N6, 2014.