Wastewater disinfection methods

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Abstract. This article presents the results of experimental studies on wastewater disinfection using various methods. Proven use of ozone as an oxidizing agent is the most “clean” method compared to other methods.

1. Introduction
The methods of wastewater disinfection can be divided into four main groups:
- thermal;
- chemical using strong oxidizing agents;
- oligodynamic (exposure to noble metal ions);
- physical (using ultrasound, radiation, ultraviolet rays);
- gaseous (using various types of gas discharges).

Due to the ease of implementation, it is chemical and physical methods of disinfection that are usually used in practice.

Chemical methods involve the introduction of oxidizing agents into the water, leading to the death of microorganisms. Either halogens or oxygen compounds are used as oxidizing agents. As halogens there iodine, bromine, and chlorine-containing reagents are used. Ozone, hydrogen peroxide and potassium permanganate are oxygen-containing reagents. Of these oxidants, in practice, preference is given to chlorine, ozone, sodium hypochlorite, which cause inactivation of intestinal viruses as a result of denaturing their protein coat.

Physical methods imply the effect of various physical phenomena on the treated water – heating, ultrasonic vibrations, ultraviolet and gamma radiation, electric discharge, magnetic fields, as well as microfiltration.

Oligodynamic effect is implemented with the help of the noble metal ions such as silver, copper, zinc, which can be used as independent agents, or in combination with other reagents, such as H₂O₂ - hydrogen peroxide, NaOCl - sodium hypochlorite, etc. [1].

A large number of studies are devoted to the problem of water purification and disinfection using various types of gas discharges. It is assumed that the disinfecting effect of a pulsed electric discharge in water is associated with several factors affecting microorganisms. Under the action of free atoms and radicals, there occurs the breakdown of amino acids and protein, depolarization of nucleic acids, and the breakdown of other biologically active substances. In addition, the shock wave and ultraviolet radiation of the discharge in the liquid have a direct effect on microorganisms. The decontamination effect continues for a long time after the discharge treatment is stopped (a day, a week or more), which is caused by the action of decomposition products of microorganisms in the active phase of the process. A pronounced bactericidal effect on the microbial cell is observed at a discharge energy (0.6 - 0.8) x 10² J.
Because of its high efficiency, chlorination of water for its disinfection has become widespread all over the world. In practice, chlorine gas Cl₂, chlorine dioxide ClO₂, sodium hypochlorite NaClO and calcium hypochlorite Ca(ClO)₂ are used. Chlorine lime is used only slightly and only for disinfection of small volumes of waste water [1]. However, the use of halogens and ozone for water disinfection can cause the formation of compounds with mutagenic properties (trihalomethanes, aldehydes, etc.). Also, when using chlorine-containing reagents in the sewer, dechlorination should be applied. This is due to the high toxicity of chlorinated water for biocenoses of the reservoir. A significant disadvantage of the method of treating water with chlorine gas is the need to transport and store large volumes of highly toxic liquid chlorine in cylinders, which poses a potential threat of emergency emergencies.

2. Results
The use of the so-called “environmentally friendly” oxidizing agents (ozone - O₃) allows to get rid of these shortcomings, the use of which does not lead to water pollution by the products of the decomposition of the reagent. The comparison of “pure” oxidizing agents shows that ozone has a number of technological advantages.

3. Conclusions
One of the methods for obtaining ozone is to supply voltage between the electrodes. The method is characterized in that technical water — an electrolyte — is used as one of the electrodes — a cathode, and an electric discharge is ignited by applying a voltage between a solid anode and an electrolytic cathode equal to \( U = 28 - 75 \, kV \), with a pulse frequency \( f = 40 - 100 \, MHz \), with an interelectrode distance of \( 2 < l < 10 \, mm \), where \( U \) is the discharge voltage; \( l \) is the distance between the solid anode and the electrolytic cathode; and \( f \) is the pulse frequency.

References
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