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Use of CHLORINE for Purification of Household Waste Water

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ABSTRACT: This article discusses the use of chlorine for domestic wastewater and the resulting appearance of toxic substances in the water and ways to eliminate them. Based on model studies, the effect of chlorine on microorganisms present in wastewater has been analyzed. Also, the decrease in the number of microbes after water chlorination has been studied. On the basis of the study carried out, the article presents proposals for the use of wastewater ozonation instead of chlorination.
In addition, recommendations are given to improve the quality of water supply management.

KEY WORDS: chlorine, waste water, ozone, microorganisms, chloroform, dioxin, flocculants.

I.INTRODUCTION

According to many experts, chlorination of water is the largest invention in medicine, or rather in preventive hygiene of the 20th century, which has brought enormous benefits to humans. Chlorination of water as an effective means of combating infectious diseases has spread rapidly throughout the world and is currently used by many hundreds of millions of people.

It's no secret that chlorine is a poison. The poison is so powerful that it was chlorine that was one of the first gases used as a chemical weapon in World War I. Chlorine toxicity is associated with its high oxidizing ability - it is one of the three most powerful halogens. This, in turn, means that chlorine is capable of destroying any organic matter and creating organochlorine compounds on its basis.

In recent years, the study of chlorination products by modern analytical methods has shown that toxic volatile organohalogen compounds (VOCs), mainly methane derivatives, are formed in the process of wastewater disinfection. They contain trihalomethanes (THM) - chloroform, dichlorobromomethane, dibromochloromethane, bromoform, trichlorethylene. In the mixture of THM, the largest amount is accounted for by chloroform. Among LGS, carbon tetrachloride, ethylene chloride, 1,2 - dichloroethane, tetrachlorethylene were found. These compounds are more toxic than chloroform, but they are found in water in much lower amounts. The concentration of VOCs in water varies widely from traces to hundreds of μg/L.

II. LITERATURE SURVEY

The issues of water disinfection were studied by many scientists who gave practical recommendations on this issue: Goncharuk V.V., Dolina L. F.,Smagin V.N., Draginskiy V.L. [1-4]. Special attention Hazipov V.A. and Petrosyan V.S. was also devoted to the study of dioxins[5-6]. The issues of ozonation were studied separately by LidinR.A..and Alekseev S.E. [7, 9-10].

If we consider the influence of chloroform on the sanitary regime of water bodies, that is, on the organoleptic and sanitary-hygienic, toxicological properties of water, then as follows from the studies of V.V. Goncharuk and N.G. Potapchenko[1], chloroform for aquatic organisms and warm-blooded animals is moderately toxic and highly

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accumulative in organisms. An odor with an intensity of 2 points was detected at a chloroform content of 18 µg/l. Chloroform did not affect the color of water in the indicated amounts.

III. METHODOLOGY

Effective methods of preventing the formation of VOCs are measures aimed at reducing the concentration of organic substances before the introduction of chlorine [4]. To solve these problems, we will consider the methods of wastewater treatment, preventing the formation of VOCs.

Untreated wastewater contains a huge number of pathogenic microorganisms: from 10^3 to $7 \cdot 10^6$ in 1 cm^3 (coli-titer (CT) - 10^{-2} - 10^{-7}, and coli-index (CI) - $2 \cdot 10^8$; enterococcal titer TE = 10^{-1} - 10^{-4} units / cm^3).

Then, after biological treatment in secondary sedimentation tanks, 1 ml of water contains up to $2 \cdot 10^6$ bacteria and the number of bacteriophages reaches 100. The toxicology of water is judged not by the degree of reduction of bacterial contamination, but by the number of pathogenic microorganisms remaining in the water. Filtration through quartz filters reduces the CI of wastewater by 10 times, and treatment on filters loaded with zeolites or ion-exchange resins - by two orders of magnitude, and the CI reaches 10^4.

Reduction of bacterial contamination for various structures is presented in Table 1.

Reducing bacterial contamination in various structures	%
Lattice	to 10
Sand traps	10-25
Primary sedimentation tanks without preaerators	to 25
Primary sedimentation tanks with pre-aerators	to 30
Primary sedimentation tanks with biocoagulation	to 40
Illuminators - decayers with natural aeration	to 40
Filter fields	97-99,99
Irrigation fields	97-99,99
Biological ponds	96-99,99
Biological filters	90-95
Aeration tanks	90-95
Disinfection facilities	99,0-99,99

In primary sedimentation tanks, E.coli bacteria are reduced by 30 - 40%, after secondary - 90-95%.

The reason for the decrease in the concentration of microbes is that in a neutral environment, viruses and bacteria arrive as a carrier of a negative electrical charge. From a physicochemical point of view, these objects are hydrophilic biocolloids, which makes it possible to use coprecipitation with the suspension of the main sedimentation tanks and bioflocculation in aerotanks for their removal [4].

The bactericidal activity of various chlorine reagents is associated with their redox potential and, other things being equal, increases in the following order:
chloramine —► bleach,
hypochlorites —► chlorine —► chlorine dioxide.

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Numerous materials [3-5] provide impressive evidence that chlorination of drinking and waste water causes high levels of mutagenic activity and toxicity, detected by a variety of biological tests. When treating water with chloroactive compounds, products with high genotoxicity were found and isolated:

• trihalomethanes,
• chlorophenols C^6H^5ClO / C^6H^4ClOH,
• n-nitrochlorobenzene ($NO^2C^6H^4Cl$),
• bromoform ($CHBr_3$) and others.

Chloroform of four chloride carbon, belonging to 24 halogenated organic compounds with long-term biological effects, revealed carcinogenic properties and, therefore, they are considered as dangerous compounds for the population. Scientists have identified a new product with a strong mutagenic effect - 3 - chlorine - 4 (dichloromethane) - 5 - hydroxy - 2 (5H) - furanone and its geometric isomer / 6 /. Its concentration in drinking water in some cases can be 30 - 60 mg / cm^3, and in wastewater, depending on the pollution.

IV. EXPERIMENTAL RESULTS

The formation of organohalogen compounds during the chlorination of water is a complex and time-consuming process [6]. It is influenced by certain conditions and, above all, the quality of the source water, that is, the content of organic compounds in it. For the basis of the regularities found in the course of the research, it was found that the greater the value of the chemical oxygen demand (COD) and the color value of the original natural waters, due to the presence of humic substances, the higher the concentration of chloroform in chlorinated water. Even artesian water contains about 175 organic substances. Absolutely all organic substances interact with chlorine. Flocculants, passing through the entire water treatment system, interact with chlorine.

The content of organochlorine compounds for the "fragments" of organic substances increases exclusively. Chloroform is 10-200,000 more than other organic chlorine compounds, and its existence in water is explained with an increase in cancer. The higher the water temperature, the more organochlorine compounds are formed in the water. Containing bromine water will form more organochlorine compounds, since bromine appears to be a catalyst for such processes.
Dioxins are extremely dangerous in waters [7, 8]. It is not some specific substance, but several dozen organic compounds, including tricyclic oxygen-containing xenobiotics, and the family of biphenyls that do not contain oxygen atoms.

Theoretically, the existence of several thousand different dioxins is possible. Dioxin molecules are composed of indispensable biphenyl structural units.

The most dangerous of all toxic substances known in the world is 2, 3, 7, 8 - tetrachlorodibenzo-n-dioxin (2,3,7,8 - TCDD). Tetrachlorodibenzo-n-dioxin is several orders of magnitude more toxic than the currently known strongest poisons of cyanides, strychnine, curare, soman, sarin, herd, XX gases. Dioxin is 67,000 times more toxic than cyanide compounds.

Under normal conditions, these are colorless crystals, odorless, do not decompose at 75 ° C. Its solubility in water is close to 0.001%, in acetone - 0.2%, chemically inert, half-life in soil - 10-15 years, in humans - 6-7 years. Acids and alkalis under normal conditions practically do not act on dioxin.
The toxic effect of dioxin is due to the size of its molecule, which has a rectangular shape of 0.3 x 0.1 nm, which corresponds to the size of the receptors of living organisms. Dioxin molecules destroy the vital functions of the body, forcing it to act differently. It can accumulate in our body for years without showing itself [4].

Already more than 90% of waterworks in the world disinfect and discolor water using chlorine. At the same time, it is used up-to-date and at the same time affordable equipment, known to everyone as a water chlorinator LONII-100KM. Chlorine dosing equipment system capable of purifying wastewater at water treatment and wastewater disposal facilities and similar industrial enterprises, which has a need for mandatory constant water disinfection with chlorine.

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In various literary sources [7-10]ozonization of water is often considered only as one of the methods of disinfection that do not have the disadvantages inherent in other methods of water disinfection. In accordance with this point of view, the purpose of ozonation is limited only by its abiotic effect. Meanwhile, ozone, due to its oxidizing ability, guarantees not only fast and reliable sterilization, but also provides effective oxidation of organic substances, improving the organoleptic properties of water.
As you know, ozone is one of the strongest oxidants / 10 /. By its oxidizing ability ozone is second only to fluorine [9].

From an economic point of view, the introduction of ozone as a reagent for water treatment is also cost-effective /10/. So, at ozone doses of 4-6 mg/l, ozonation is advisable not only from the point of view of obtaining a high effect of water treatment, but also in technical and economic terms.

V. CONCLUSION

Analysis of the available materials shows that at present there are no clearly developed recommendations for the use of ozone in water treatment processes. However, the enormous potential of ozone in water purification processes and its great impact on the aquatic environment are increasingly attracting specialists to conduct new research and searches for reliable methods of natural water treatment.

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