RESULTS OF HARDNESS MITIGATION OF INDUSTRIAL WATER

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Annotation This article deals with modern technologies of wastewater treatment in the chemical industry. Shurtan presents the results of reduction of hardness of water of GCM (water hardness 44 mg-eq/l) using reagent Na_3PO_4 + sulphonol, reagent Na_2HPO_4, reagent Na_2HPO_4 + sulphanol, reagent $Ca(OH)_2$ and Na_3PO_4. The article considers modern technologies. treatment of wastewater from chemical industry. The results of Shortan GCF water hardness reduction (water hardness 44 mg-eq/l) using Na_3PO_4+sulfonol reagent, Na_2HPO_4 reagent, Na_2HPO_4 + sulfanol reagent, $Ca(OH)_2$ and Na_3PO_4 reagent are given.

Keywords: wastewater, water treatment, water supply, industrial enterprises, wastewater treatment plants, physical and chemical treatment, biological treatment.

Annotatsiya Ushbu maqolada kimyo sanoatidagi oqova suvlarni tozalashning zamonaviy texnologiyalari ko‘rib chiqilgan. Shurtan gaz-kimyo majmuasida (suvning qattiqligi 44 mg-ekv/l) suv qattiqligini kamaytirish bo‘yicha o‘tkazilgan tajriba natijalari keltirilgan. Bunda quyidagi reagentlardan foydalanilgan: Na_3PO_4 + sulfonol, Na_2HPO_4, Na_2HPO_4 + sulfanol, $Ca(OH)_2$ va Na_3PO_4. Maqolada kimyo sanoatidagi oqova suvlarni tozalashning hozirgi zamon texnologiyalari yoritilgan. Shurtan gaz-kimyo majmuasi suvi qattiqligini kamaytirish natijalari (qattiqlik darajasi 44 mg-ekv/l) yuqoridagi reagentlar yordamida keltirib o‘tilgan.

Kalit so‘zlar:oqova suv, suvni tozalash, suv ta’minoti, sanoat korxonalari, oqova suvlarni tozalash inshootlari, fizik-kimyoviy tozalash, biologik tozalash

Аннотация В данной статье рассматриваются современные технологии очистки сточных вод в химической промышленности. Приведены результаты снижения жесткости воды Шуртанского газохимического комплекса (жесткость воды 44 мг-экв/л) с использованием следующих реагентов: Na_3PO_4 + сульфонол, Na_2HPO_4, Na_2HPO_4 + сульфанол, $Ca(OH)_2$ и Na_3PO_4. В статье также рассмотрены современные методы очистки сточных вод химической промышленности. Приведены результаты снижения жесткости воды Шуртанского ГХК (жесткость воды 44 мг-экв/л) с использованием указанных реагентов.

Ключевые слова:сточные воды, очистка воды, водоснабжение, промышленные предприятия, очистные сооружения, физико-химическая очистка, биологическая очистка

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Introduction

Water hardness is a property of water that contains calcium $(Ca)^+$ and magnesium $(Mg)^+$ ions. There are two types of water hardness: non-carbonate hardness (permanent hardness) - due to the dissolution of calcium and magnesium sulfates in water; carbonate hardness (temporal hardness) - due to the dissolution of calcium and magnesium bicarbonates in water. The total hardness of water is equal to the sum of these stiffnesses. The total hardness is measured by the sum of the milligrams of calcium and magnesium ion equivalents in 1 liter of water. Water with a hardness of 1-1.5 mgekv/l is very soft, water less than 1.5-3 mgekv/l is soft, water with a hardness of 3-6 mgekv/l is medium, 6-10 mgekv/l is medium hard, and water with a hardness of more than 10 mgekv/l is very hard. The hardness of natural water varies, the hardness of river and lake water is 0.1-0.2 mgekv/l (Tayga and tundra), while the hardness of groundwater, sea and ocean water is 80-100 mgekv/l. Due to the hardness of the water, sediments settle on the walls of the steam boilers. In central water supply, the hardness of mainly consumed water is allowed to be up to 7 meq/l. When the hardness of water is high, water softening methods are used.

Water is used in processes occurring in nature, as well as in industry, in the production of raw materials, as an energy source, in cooling and heating, and in many other industries. Water is also important in human life, not only for living organisms. Water forms in a high-quality and transparent form, formed as a result of natural processes without the influence of the external environment. Currently, the increase in the number of settlements in our country is leading to the rapid development of technology. The opening of large and small industrial enterprises increases their need for water. The discharge of waste by humans into the water, the waste of more water than their own needs, leads to a decrease in water consumption. Factors leading to water waste: human waste disposal in water, harmful substances emitted by manufacturing enterprises affect the environment. Even a tiny bit of oil extracted from the river pollutes the water. Their release of various bacteria leads to the destruction of water bodies. Currently, we are using modern equipment to purify water from pollution. When water is contaminated with various substances, we need to purify it using technological methods.An example of natural purification of water is the presence of underlying green weeds and fungi. To protect water bodies, it is necessary to thoroughly clean them before throwing water into the reservoir. In addition, industrial wastewater from industrial production is highly toxic and rich in chemical reagents. Therefore, when using wastewater in production, it is advisable to use a closed system. Wastewater contains a large number of pollutants. One of them is bacteria. There are many

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ways to purify water. The first is the recovery method, the second is the destructive method. Our recuperative method separates valuable substances from wastewater and sends them for processing. The destructive method decomposes water using oxidation or reduction methods from pollutants.When constructing new structures, it is necessary to properly account for the amount of wastewater in sewerage facilities, first and foremost. At the treatment plant, wastewater is re-purified, neutralized, and the sediments formed from it are recycled.Purified wastewater is discharged into reservoirs and used for irrigation. Large chemical plants use several million cubic meters of clean water per year [1].

In gas production enterprises, wastewater is not suitable for modern treatment methods due to its high salt content, partial formation, natural origin, and diversity of mineral and organic substances. Wastewater from gas fields containing hydrogen sulfide, containing a large amount of dissolved hydrogen sulfide, hydrosulfide, and sulfide ions, is particularly toxic. The disinfection of such waters should be carried out by underground burial. Gas processing enterprises are characterized by a diversity of chemical composition and physical properties of industrial wastewater. Water from plants processing hydrogen sulfide-containing gases is considered the most toxic. Along with gas and hydrocarbon condensate, a certain portion of the mineralized formation water, which is not discharged from products in gas fields, is supplied to plants. As a result, plant water has a high salt content and is additionally contaminated with a wide range of mineral and organic reagents used in gas processing technology. Such waters cannot be effectively purified and must be buried underground [2].

When characterizing wastewater, the following physical parameters are often used: color, smell, nature and quantity of solid particles, cooling rate, temperature, density, flow characteristics, mixing (horizontal and vertical), diffusion rate. Moreover, the concentration of hydrogen ions (PH), salt content, dissolved oxygen content, BPC, HPC, nitrate content, phosphate content, metal content (copper, lead, iron, zinc, nickel, cadmium, mercury), petroleum products, organic compounds (pesticides, fertilizers, detergents) and carbon content are also required [3].

In this regard, the problem of managing industrial wastewater will be of great importance for researchers. Researchers believe that wastewater in the oil and gas industry is a term used to refer to wastewater released as a byproduct as a result of exploration for crude oil and gas. Produced water generated during oil and gas drilling is one of the largest waste streams. This may be saline water accumulated in the underground layers, where wastewater is released during oil and gas production.To comply with utilization standards, wastewater must be treated.

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Wastewater varies depending on the process used and may contain large quantities of hazardous organic and inorganic compounds, dissolved gases, heavy metals, and radioactive materials of natural origin [4].

METHODS AND MATERIALS

Heat treatment - boiling, when water is heated, microorganisms die from high temperatures. Activated clay is rich in nitrogen, phosphorus, and trace elements (copper, molybdenum, zinc). After heat treatment, it can be used as a fertilizer. However, due to the presence of heavy metal salts, it is necessary to consider the possible negative consequences of its use. Obtaining heavy metal ions and other harmful substances from wastewater guarantees the production of harmless biomass that can be used. As a feed additive or fertilizer. When a large amount of sewage sludge is formed, containing salts of heavy metals, it is recommended to burn the sludge. A method for producing oil and coal substitutes based on activated clay has been proposed in Germany. According to calculations, the amount of heat obtained by burning 350,000 tons of active clay is equal to the amount obtained by burning 350,000 barrels of oil and 175,000 tons of coal. The search for other ways to use sedimentary and active clay formed during wastewater treatment continues [5].

Membrane purification - water is fed into a special sieve that allows only water molecules to pass under pressure. In terms of environmental safety, membrane technologies for wastewater treatment are preferable to classical methods. Refined water reserves can be returned to rivers and water bodies and used for artificial fish farming, while purified "grey" water can be used to meet the city's infrastructure needs (irrigation of grass, cleaning of roads, extinguishing fires, etc.). The membrane module separates the clay mixture and is an alternative to the active clay deposition method widely used in secondary deposition tanks used in traditional biological cleaning systems. The discharge solution contains acceptable COD (chemical oxygen requirement) and BOD (biochemical oxygen requirement), and bacteria and viruses are eliminated up to a maximum of 99.9%. Membrane methods of wastewater treatment solve a number of problems related to water purification, including: desalination of mining waters; cleaning of galvanic drains from heavy metals; cleaning of hydrometallurgical wastewater; cleaning of washing wastewater; cleaning of wastewater; cleaning of liquid radioactive waste [6].

Flotation is the process of separating suspended and emulsified pollutants from water into a foam layer as a result of adherence to gas bubbles fed from below in the purified liquid. The process of purifying industrial wastewater, including surfactants, oil, petroleum products, oils, fibrous materials, using the flotation

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method, involves the formation of "particle-bubble" complexes. This is a processed liquid that involves floating complexes and removing the resulting foam layer from the surface. The particle located in it can be pressed to the surface of the gas bubble only when the particle is not moistened with liquid or poorly moistened [7].

Ion exchange is the process of a solution interacting with a solid phase, which has the ability to replace its own ions with other ions in the solution. The substances that make up this solid phase are called ion exchangers, those that are able to absorb positive ions from electrolyte solutions are called cation exchangers, and negative ions are called anion exchangers [8].

Mechanical water purification methods are widely used in industrial ecology at the initial stage of purifying contaminated wastewater from suspended particles and mechanical impurities. The various structures of gravitational, inertial, and centrifugal devices allow for their selection based on the volume of particles being purified, productivity, and wastewater the development and selection of effective methods and technical means is one of the main tasks of environmental engineers. Proper justification of the desired type of device increases the efficiency of water treatment, which reduces the number of devices in the multi-stage water treatment system to standard values. These instructions indicate that the water was stopped in the hydrocyclone provides a methodology for experimental study of the particle cleaning process, the processing of the results of which allows for the evaluation of the efficiency of water purification in a hydrocyclone, as well as the determination of its technological level [9].

Sunking. It is based on the differences in the density and volume of pollutant particles and their separation in the volume of water under the action of gravity. Sedimentation is the process of physical water purification by removing suspended solids from the water. During the sedimentation process, the impurities in the wastewater precipitate and are separated [10].

Centrifugation and hydrocycloning. It is based on the use of centrifugal forces to separate pollutants and water. The method of wastewater treatment in a centrifuge field has significant advantages over sedimentation, which include high permeability of hydrocyclones and centrifuges. Centrifuges and hydrocyclones are used to separate mineral and organic and mechanical impurities from wastewater [11].

To physicochemical purification methods: Coagulation is the process of enlarging colloidal particles in a liquid due to electrostatic forces of intermolecular interaction. As a result of coagulation, aggregates are formed - larger (secondary) particles consisting of a small (primary) cluster. Primary particles in such

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aggregates are directly connected to the intermolecular interaction forces or through a layer of the surrounding (dispersion) medium. Coagulation is accompanied by a progressive increase in particle size and a decrease in their total number in the volume of the dispersion medium (in our case, liquid). One type of coagulation is flocculation, in which small suspended particles under the influence of substances with special additions (flocculants) form floculant clusters with a loose intense sediment. Various mineral coagulants are used for the treatment of industrial wastewater.

RESULT

A series of experiments were conducted to determine the average concentration of fine and large solid particles of mechanical impurities in the technical circulating waters of the oil and gas processing plant. All experiments were conducted at room temperature.

During the experiments, we filtered 100 ml of sample water (Shurtan water sample) for purification, after which the paper filter was dried in a SNOL 1.6.2.5.1/11-I2 furnace at 110°C for one hour, the paper filter was cooled in a dryer for 30 minutes, and then weighed with an accuracy of 0.0001 g using the FA1004G electronic scale. Calculations for the determination of solid particles in mechanical impurities were performed using the arithmetic mean of the results of five parallel experiments. Experiments have shown that the total concentration of mechanical impurities in the composition of Shurtan waters averaged 7.07%.

The following reagents and their combinations were used to reduce the hardness of circulating water: Na3PO4 + sulfonol; Na2HPO4; Na2HPO4 + sulfonol; Ca(OH)2; Na3PO4 mixtures were used.

Shurtan waters were used to purify and soften circulating water from mechanical impurities. The initial hardness of each experimental test water was 44 mg-eq/l. The results of the research on softening experimental water are presented in Figure 1

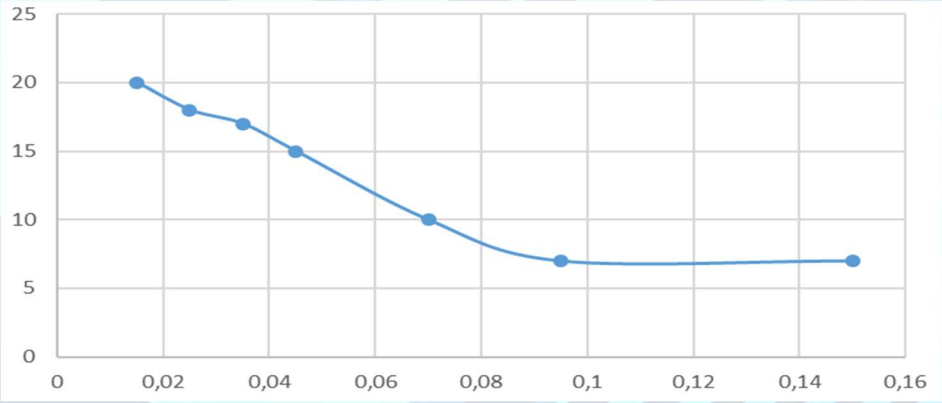


Figure 1. Results of reducing the hardness of Shurtan waters using Na_3PO_4+sulfonal reagent (water hardness 44 mg-eq/l)

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Figure 1 shows that with the addition of 0.015 mg of Na_3PO_4+ sulfonal reagents to 10 ml of water, its hardness was 20 mg-eq/l, while with the addition of 0.025 mg, the water hardness decreased to 18 mg-eq/l. With the subsequent addition of 0.035 ÷ 0.07 mg of the reagent, the hardness of the experimental water gradually decreases to 17 ÷ 10 mg-eq/l, and with the addition of 0.095 mg to 0.15 mg of the reagent, this indicator does not change, i.e., it is 7 mg-eq/l.

To reduce the hardness of this water, experiments were also conducted using the reagent Na_2HPO_4 during the experiments, and the results are presented in Figure 2.

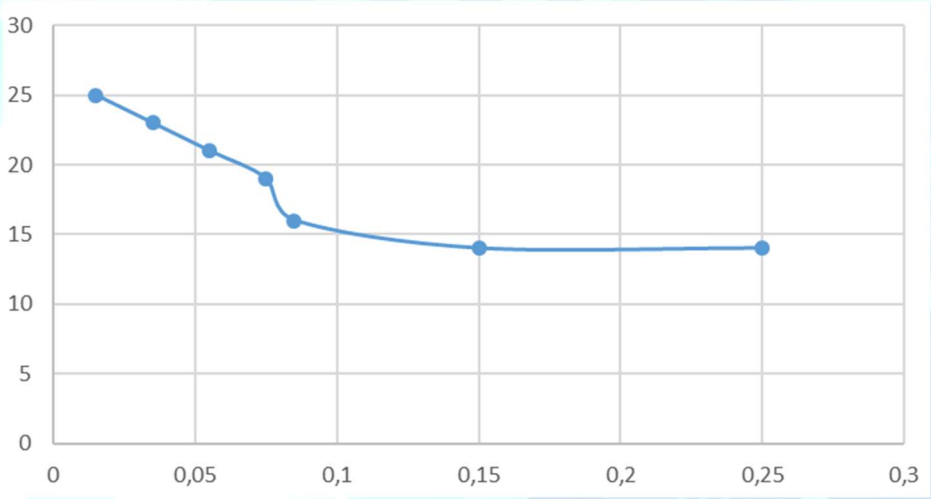


Figure 2. Results of reducing the hardness of Shurtan waters using the reagent Na_2HPO_4 (water hardness 44 mg-eq/L)

To reduce the hardness of the water, Na_2HPO_4 reagent was added to 10 ml of the tested water in the range of 0.015 to 0.35 mg during the experiment. The results show that the water hardness decreased from 25 mg-eq/l to 15 mg-eq/l. Further experiments were also conducted with Na_2HPO_4 sulfonal reagents, which are shown in Figure 3.

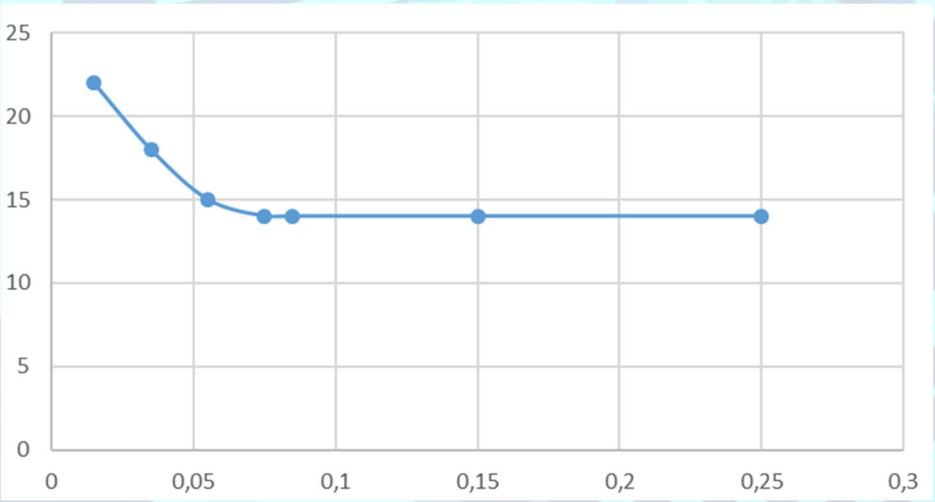


Figure 3. Results of reducing the hardness of Shurtan waters using Na_2HPO_4 + sulfanol reagent (water hardness 44 mg-eq/l)

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To reduce the hardness of Shurtan waters, 10 ml of sample water was added with Na2HPO4+sulfonal reagent in the range of 0.015÷0.25 mg, resulting in a decrease in water hardness from 22 mg-eq/l to 14 mg-eq/l, while with the addition of 0.075 mg to 0.25 mg of the reagent, the water hardness remained unchanged and amounted to 14 mg-eq/l.

A series of experiments were also conducted to reduce water hardness using the reagent $Ca(OH)_2$, the results of which are presented in Figure 4.

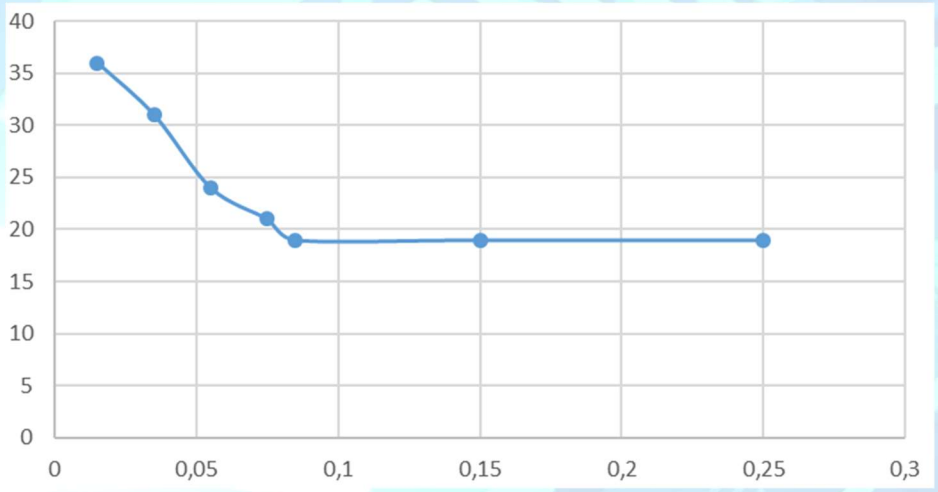


Figure 4. The results of reducing the hardness of Shurtan waters using the reagent $Ca(OH)_2$ (water hardness 44 mg-eq/l)

The application of the relatively inexpensive reagent $Ca(OH)_2$ shows that with the addition of 0.015 mg of $Ca(OH)_2$ to 10 ml of sample water, the hardness decreased from 47 mg-eq/l to 36 mg-eq/l, with the addition of 0.035 mg, the hardness of the water was 31 mg-eq/l, and with the addition of 0.055 mg, the hardness of the water was 24 mg-eq/l, with the addition of the reagent in the range of 0.085÷0.25 mg, the hard. When adding $Ca(OH)_2$ to the sample water, the hardness decreased from 47 mg-eq/l to 19 mg-eq/l, but continuing the experiment, increasing the reagent content did not yield results, which can be explained by the fact that $Ca(OH)_2$ precipitates only hydrocarbonates, it is advisable to use other compounds for the precipitation of sulfates.

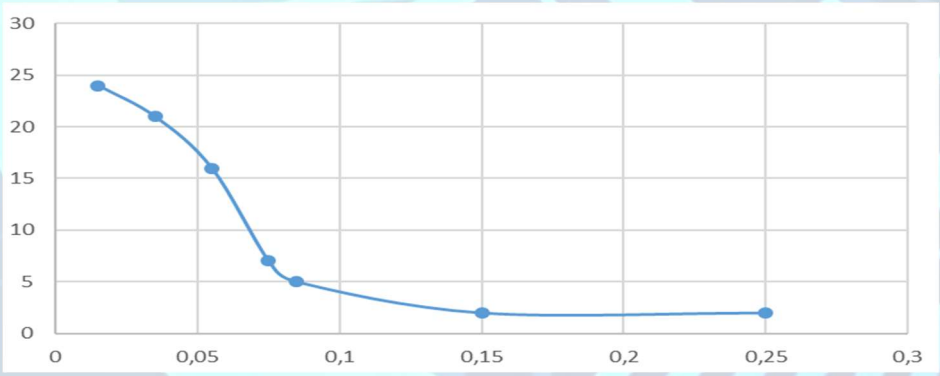


Figure 5. Results of reducing the hardness of Shurtan waters using the reagent Na_3PO_4 (water hardness 44 mg-eq/l)

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Figure 5 shows that with the addition of 0.015 mg of Na_3PO_4 reagent, the water hardness decreased to 24 mg-eq/l, while with the addition of 0.035 mg of reagent, its hardness decreased to 21 mg-eq/l. With the subsequent addition of the reagent from 0.055 to 0.085 mg, the water hardness decreased from 16 mg-eq/l to 5 mg-eq/l. The hardness of water with 0.15 and 0.25 mg of reagents decreased to 2 mg-eq/l, and this indicator remained unchanged.

CONCLUSION

Therefore, research conducted on reducing the hardness of circulating water from an oil refinery shows that, Na3PO4 + sulfonal mixture; Na2HPO4; Na2HPO4+sulfonal; Ca(OH)2 reagents are considered unsuitable for reducing the hardness of circulating water (Fig. 4), as these reagents did not reduce the hardness values of the water to the norm. To reduce the hardness of industrial circulating water, it is recommended to use a 0.15% Na3PO4 reagent.

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