Study on wastewater treatment based on local minerals

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Abstract. In this article, the HMP-3 wastewater treatment process with natural minerals (vermiculite, zeolite, dolomite, saponite, shungite, bentonite, basalt minerals), rice husk, 1% NaClO (sodium hypochlorite) and 3% H_2O_2 (hydrogen peroxide) solutions will be discussed. According to the research results, the activation of samples used for wastewater treatment in the form of 1% sodium hypochlorite solution and 3% hydrogen peroxide solution shows high efficiency.

1. Introduction

The high development of technology in the world is turning into a period of technological crises of the 21st century, as a result of which it has a negative impact on the environment, leading to pollution of the atmosphere, underground water and a shortage of clean drinking water. For this purpose, achieving scientific and practical results in the development of rational technologies for cleaning the environment with the use of various sorption-ion exchange materials, and using local resources wisely, is one of the urgent issues of today[1-3].

In order to find a solution to these problems in our republic, the strategy of action is "to carry out a policy aimed at improving production, to increase its technological diversification by moving the industry to a qualitatively new level." In this, it was shown that the most important thing is to prevent groundwater pollution, to clean enterprise effluents, to achieve their reuse, and to use clean drinking water wisely. For this, it is very important to study the sorbent properties of natural minerals and to conduct scientific research on the treatment of wastewater of enterprises by modifying them[4-6].

A large amount of water is used for various technological processes in metallurgical enterprises. A large amount of wastewater is generated as a result of the transfer of metals to the water used for metal washing in technological processes. Treatment methods using coagulants, flocculants, sorbents, ion exchange and electrochemical methods are widely used in the treatment of generated wastewater. Wastewater treatment methods based on adsorbents are proven to be effective and advanced technologies. Installation devices for implementing these methods are more compact, have high performance, and it is relatively easy to automate the management and operation processes. A number of studies are being conducted aimed at developing new technologies for removing heavy metal ions from wastewater, including new technologies based on the activation of existing natural minerals in thermo-chemical processes [6-9].

Industrial enterprises usually contain pollutants in the form of ion-dispersed compounds, including toxic anions in the form of heavy metal cations, chromate, dichromate and others. The risks of these harmful substances are different, and the use of these wastewaters is highly effective, especially the use of adsorbents [10].

Ways of cleaning underground and industrial wastewaters and bringing these waters to the level of technical water are being studied with the help of natural minerals (vermiculite, zeolite, dolomite, saponite, shungite, bentonite, basalt minerals), rice husk, sodium hypochlorite. For this, it is of great scientific and practical importance to create effective sorbents using local minerals and to create multi-component ion exchange sorbents based on their use in water purification.

Based on the above, studies were conducted to obtain highly effective import-substituting sorbents based on local mineral raw materials and to study ways to treat underground and industrial wastewater with the obtained sorbents.

2. Materials and Methods

Local minerals (vermiculite, zeolite, dolomite, saponite, shungite, bentonite, and basalt minerals), samples obtained by treating rice husk with sodium hypochlorite and hydrogen peroxide were used in laboratory research for the

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purpose of wastewater treatment. 2% of the total weight of water was added to local raw materials and their activated samples used in wastewater treatment. During the research, the total amount of calcium, magnesium and heavy metal chromium and manganese cations in the initial and purified water samples were studied. At the next stage, in order to improve the level of purity of wastewater, the purification process was studied by activating rice husks and natural minerals in a 1% NaClO (sodium hypochlorite) and 3% H_2O_2 (hydrogen peroxide) solution. The obtained results are presented in Tables 1-3 and Figures 1-2.

3. Results and Discussion

The results of the study showed that initially, the total hardness of the wastewater of the HMP-3 enterprise was 50 mg/l, while the total hardness of water samples purified on the basis of zeolite, vermiculite, rice husk, saponite, dolomite, bentonite minerals was respectively It showed a reduction to 12, 26, 32 and 38 mg/l.

The results of the study showed that activated samples are more effective than non-activated samples in wastewater treatment. In this case, the results of the use of samples obtained with the help of chemical treatment revealed that the amount of calcium, magnesium and heavy metals in the complex multi-component composition of waste water, the amount of chromium and manganese cations and the total hardness of water are relatively greater. For example, when zeolite mineral was used, calcium and magnesium cations in water were 415.68 mg/eq.l, 184.36 mg/eq.l, and when soaked in NaClO and hydrogen peroxide, they were 156.86 mg/eq, respectively. 1, 96.02 mg/eq.l and 156.86 mg/eq.l were found to be 96.02 mg/eq.l.

Table 1. Analysis results obtained after treatment of HMP-3 household wastewater with sorbents

№	Sample type (Cleaning raw materials are mixed)	Amount of Ca^+ in water	Amount of Mg^+ in water	The total hardness of the water	The pH of the water
1	HMP-3 household wastewater (untreated)	687.35	364.25	64.72	7.5
2	Zeolite	415.68	184.36	36.15	7.2
3	Vermiculite	601.2	243.2	50.33	7.5
4	Rice husk	500.34	234.25	44.54	7.4
5	Saponite	438.67	207.36	39.21	7.4
6	Dolomite	452.38	223.12	41.21	7.5
7	Bentonite	435.47	204.35	38.80	7.3

Table 2. Analysis results obtained after cleaning HMP-3 household wastewater by soaking sorbents in NaClO

№	Sample	Amount of Ca^+ in water	Amount of Mg^+ in water	The total hardness of the water	The pH of the water
1	Zeolite	156.86	96.02	15.84	7.2
2	Vermiculite	255.83	100.50	21.17	8.6
3	Rice husk	181.94	86.12	16.27	7.4
4	Saponite	153.92	76.24	14.05	7.4
5	Dolomite	192.50	92.20	17.31	7.5
6	Bentonite	196.16	87.83	17.13	7.4

Table 3. Analysis results obtained after cleaning HMP-3 household wastewater by soaking sorbents in H_2O_2 hydrogen peroxide

№	Sample	Amount of Ca^+ in water	Amount of Mg^+ in water	The total hardness of the water	The pH of the water
1	Zeolite	193.79	97.03	17.78	7.2
2	Vermiculite	342.56	137.01	28.55	8.6
3	Rice husk	219.93	108.95	20.08	7.4
4	Saponite	182.40	96.45	17.16	7.4
5	Dolomite	257.77	125.70	23.36	7.5
6	Bentonite	251.49	119.74	22.55	7.4

When purified with saponite mineral, calcium and magnesium cations were 438.67 mg/eq.l and 207.36 mg/eq.l, and the total hardness of water was equal to 39.21. When saponite mineral is used in NaClO soaked state, it was found that the Ca2+ content of wastewater decreased by 153.92 mg/eq.l, Mg+ content decreased by 76.24 mg/eq.l, and the total hardness of water decreased to 14.05. When using a sample treated with a 3% solution of hydrogen peroxide, the amount of Ca2+ decreased to 182.40 mg/eq.l, the amount of Mg+ to 96.45 mg/eq.l, and the total hardness of water was equal to 17.16. found the opposite.

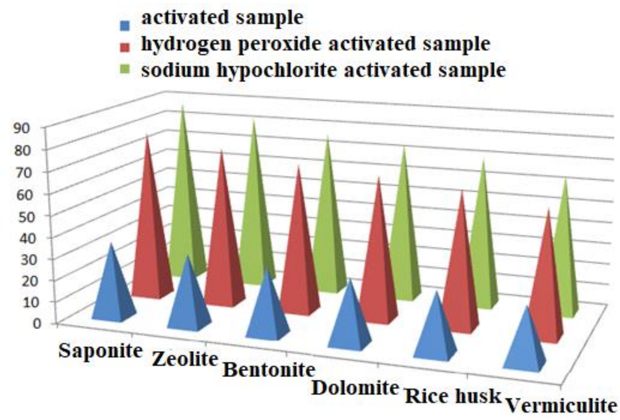

Fig. 1. Changes in the total amount of chromium cations in water samples taken after treatment of HMP-3 household wastewater with sorbents

Changes in the total amount of chromium and manganese cations from heavy metals in water samples taken after treatment of HMP-3 household wastewater with sorbents were studied. The results of the study showed that it is possible to obtain positive results by activating the samples used for wastewater treatment in a 1% NaClO (sodium hypochlorite) and 3% H_2O_2 (hydrogen peroxide) solution. For example, when bentonite mineral is used, the total amount of chromium and manganese cations in water is reduced by 31.25 and 35.63%, and when it is soaked in NaClO and hydrogen peroxide, it is reduced by 76.95 and 80.63% and 69.63 and 75, respectively. It was found that it decreased by 17%. It was found that the total amount of chromium and manganese cations decreased by 30.15 and 34.37% when treated with dolomite mineral. The total amounts of chromium and manganese cations in waste water were reduced by 74.24 and 77.78% when dolomite mineral was used in a NaClO soaked state, and by 67.17 and 72.52%, respectively, as a result of its activation in a 3% H_2O_2 (hydrogen peroxide) solution. was found to be decreased.

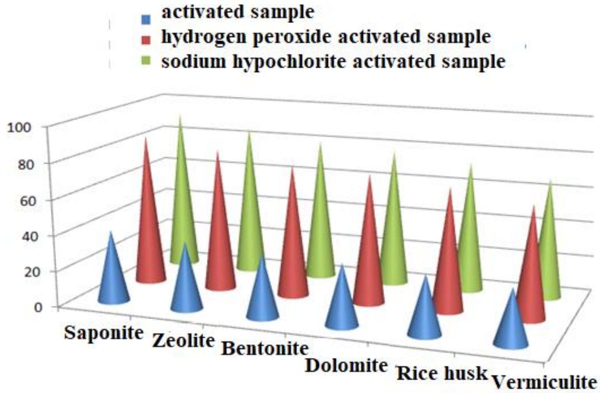

Figure 2. Changes in the total amount of manganese cations in water samples taken after treatment of HMP-3 household wastewater with sorbents

4. Conclusions

Based on these obtained results, it was analyzed that the possibility of obtaining economically effective and ecologically clean local natural sorbents for enterprise wastewater by the method of activation of natural minerals with the help of sodium hypochlorite and hydrogen peroxide, and positive results can be achieved from them. This makes it possible to reuse GMZ-3 household wastewater and prevent environmental pollution.

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