

THE ROLE OF NATURAL SORBENTS FOR WASTEWATER TREATMENT OF CHEMICAL ENTERPRISES

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The usage of natural minerals for wastewater treatment is acceptable from an environmental and economic point of view, but often such materials do not have the required sorption properties. Therefore, there is a need to modify them physically or chemically. As a result of such modification, it is possible to obtain sorbents with a different surface nature and specified characteristics [1]. It is known that a variety of natural and artificial materials are used for wastewater treatment, but activated carbon is most often used. The feasibility of using various materials for wastewater treatment of industrial enterprises is determined primarily by their cost-effectiveness.

Therefore, the aim of this work was to study the ability of some natural and modified materials to filter water, reducing its hardness, as well as their sorption properties. The objectives of the research were to determine the composition of the circulating water from a chemical enterprise producing mineral fertilizers and cyanides, which were planned to be purified using these materials for the subsequent creation of multilayer composite systems.

The ways for treating industrial wastewater from chemical enterprises are very diverse. However, the use of any one treatment method, due to the complex multicomponent composition of wastewater, is not enough. Therefore, it is advisable to carry out multi-stage wastewater treatment, where the final stage is adsorption treatment, that is characterized by high efficiency, simple technological realization with application of available and cheap reagents.

Wastewater pollution is determined by 25 parameters, that include the present of alkali and alkaline earth metal salts, heavy metal salts, total hardness, dry residue, the presence of nitrates, nitrites, thiocyanates and cyanides, etc. Basalt fiber, natural minerals dolomite, saponite, limestone and bentonite, burnt brick, brown coal, sheep wool felt, etc. served as natural materials for the sorption of these salts. A thermally activated bentonite-coal sorbent was also used.

Basalt fiber exhibits sorption activity in 7 parameters – nitrates and nitrites, aluminum, nickel, zinc, iron and copper. Bentonite is a natural filtering and sorbing mineral widely used in the food industry for clarification of fruit juices, in construction as a binder, in drilling wells, and in other sectors of the economy [4]. The application of bentonite leads to a decrease in the pH of the circulating water medium from 7.2 to 6.0, as well as a sharp decrease in the turbidity of the water from 11 to 1 mg/l, with a parallel decrease in the water density from 1.08 to 1.04 g/l. However, there is no diminution in overall hardness, which is due to the presence of calcium and magnesium salts. According to quantitative indicators in relation to salts of heavy and non-ferrous metals, for example, chromium, a decrease in its amount by 10 times, from 0.2 to 0.02 mg/l, was noted. There is also a reduction in the amount of aluminum salts, nitrates and nitrites, chlorine, molybdenum, nickel, zinc, manganese, iron, copper, cyan ions, silicon oxide and bromine. Thus, the use of bentonite in the treatment of recycled water is effective in 17 parameters.

Angren brown coal without activation was used to study its initial sorption properties. As a result, its effectiveness was revealed in 12 parameters. The burnt brick showed a result of 10:12 during the filtration of technical and recycled water, i.e. 10 parameters for technical water and 12 parameters for recycled water.

Thus, the total results of the effectiveness of the usage of minerals and burnt bricks for industrial water filtration are as follows: dolomite – 7; saponite– 0; basalt fiber – 7; bentonite – 17; Angren brown coal – 12; burnt brick – 10.

Studies of the sorption efficiency of modified bentonite-coal sorbents (BC), felt from sheep wool and glass wool in the purification of industrial water gave the following results: BC – 17 parameters; sheep wool felt – 9; glass wool – 6 (Table).

Table

Indicators of sorption properties of natural minerals and modified materials in relation to technical (TW) and recycled water (RW)

Water of chem. enterprises	Dolomite	Saponite	Basalt fiber	Bentonite	Brown coal	Burnt brick	BC sorbent	Sheepwool felt
TW	7	0	7	17	12	10	17	9
RW	21	13	20	22	20	12	20	16
The total hardness for industrial water is 21 mg/eq., for recycled water – 59 mg/eq								
Total hardness according to samples, mg/eq.	42	53	38	24	19	23	16	25

As can be seen from the table, basalt fiber, bentonite, brown coal, burnt brick and bentonite-coal sorbent have the best indicators. These samples effectively adsorb mainly compounds of alkaline and alkaline earth elements, salts of heavy metals, nitrites and nitrates.

Important advantages of natural minerals are their availability and relatively low cost [2–4]. For example, bentonite clays have a high sorption capacity for metal cations and can be used to treat drinking and waste water. The only negative feature of this material is clay content, which complicates water seepage.

Thus, we were able to determine the sorption properties of some natural and artificial materials that can be used for wastewater treatment. In subsequent studies, it is planned to create multilayer compositions from these sorbents for the treatment of wastewater from chemical enterprises.

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